Strategic Regional Pre-Construction Marine Mammal Monitoring Programme Annual Report 2015

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Executive Summary

In May 2014, a Marine Mammal Monitoring Programme (MMMP) was developed for the Moray Firth. The programme aims to address both project-specific and strategic research and monitoring questions relating to the potential impacts of offshore wind farm construction and operation upon key protected marine mammal populations. The two year pre-construction phase of the programme is being funded through a consortium that includes developers (BOWL and MORL), Marine Scotland, The Crown Estate, and Highlands and Islands Enterprise.

Following extensive consultation with key stakeholders the programme is focussing upon two key species, harbour seals and bottlenose dolphins, and key questions that address uncertainties identified during the consenting process. Specifically, the pre-construction MMMP aims to collect additional data on the distribution, abundance and vital rates of both priority species, thereby providing a baseline against which the population consequences of disturbance during construction can be quantified.

The MMMP consists of work packages for each priority species, each including individual based studies of reproduction and survival rates, assessments of trends in abundance, and the collection of data on distribution patterns. This first annual report provides background on the programme aims and the methodologies being used within each of these work packages, and provides key results from studies undertaken in 2014.

Harbour seal work has focused upon the breeding population in Loch Fleet NNR. 54 females were seen with a pup at Loch Fleet in 2014 and the fecundity rate was estimated to be 0.83. The median pupping date was the 19th June, later than for the preceding seven years from 2007 to 2013. In 2014, a total of 183 individuals were identified at Loch Fleet: 92 females, 76 males and 15 individuals of unknown sex. The mean count of adult harbour seals at Loch Fleet was 93 (± 4) during pupping and 123 (± 8) during the moult. Counts at Loch Fleet have been increasing since the mid-1990s. In September 2014 and February 2015, 25 harbour seals were captured at Loch Fleet and fitted with GPS/GSM tags, which are providing information on foraging distribution and diving behaviour.

Bottlenose dolphin photo-identification surveys were focused in the Moray Firth SAC. Seven calves were seen with known females in the SAC in 2014 and the fecundity rate was estimated to be 0.26. In 2014, a total of 41 well-marked individuals were seen in the SAC: 20 females, 14 males and 7 individuals of unknown sex. The estimated number of dolphins using the SAC in the summer of 2014 was 78 (95% CI: 65-94). There was no trend in the estimated abundance of dolphins using the SAC from 1990 to 2014. Passive acoustic monitoring with CPODs was used to determine baseline levels of occurrence in

favoured areas. Dolphin occurrence was highest at the Sutors and Chanonry and lower at sites along the south coast. Dolphin detections varied seasonally but were generally highest from May to August.

In summary, all proposed fieldwork in 2014 was successfully completed, the data have been archived and some initial analyses carried out. Further analyses of these data will be used to address all key project objectives for the annual report in April 2016.

Background

The Moray Firth contains internationally important populations of marine mammals. European Union (EU) Special Areas of Conservation (SAC) have been designated for both harbour seals and bottlenose dolphins, and the area is frequented by other protected species such as grey seal, harbour porpoise and minke whale. There has also been a long history of research in the area, and Moray Firth harbour seals and bottlenose dolphins are now two of the most intensively studied marine mammal populations in the world.

The presence of these well studied protected populations provides a unique mix of challenges and opportunities for regulators and industries wishing to undertake new developments in the Moray Firth. The region has long supported a broad range economic activity, including fisheries, oil and gas developments, and tourism. For emerging industries such as offshore renewables recent EU legislation has led to a challenging step change in assessment and monitoring requirements. Previous research has provided important baseline data, for both site-specific assessments and more general development of methods to meet new legislative requirements. Unique opportunities now exist for conducting research and monitoring alongside regional developments.

A key driver for this Marine Mammal Monitoring Programme (MMMP) has been the requirement for monitoring due to the proposed offshore wind farm developments in the Moray Firth namely, BOWL (Beatrice Offshore Windfarm Ltd.) and MORL (Moray Offshore Renewables Ltd.). However, this MMMP has wider relevance for two reasons. First, other stakeholders require the same monitoring data on trends in these protected populations, particularly for the bottlenose dolphins that range widely along the east coast of Scotland. For example, the UK government must provide regular status updates to the EU; and other developers both within (e.g. ports and harbours, oil and gas) and outside (e.g. other east coast wind farms) the region must consider cumulative impacts on the dolphin population that uses the Moray Firth SAC. Secondly, research around these regional developments can be used to test and develop assessment frameworks that are now being used in other areas, particularly those assessing the population consequences of disturbance.

Given the broader significance of this programme, a two-year pre-construction phase of work has been funded through a consortium that includes BOWL, MORL, Marine Scotland, The Crown Estate, and Highlands and Island Enterprise. This document presents background on the programme aims and the methodologies being used for the study, and provides key results from studies undertaken in 2014.

Aims

The pre-construction MMMP aims to provide baseline data on two priority species (harbour seals and bottlenose dolphins) during the two years prior to construction (2014 and 2015). This pre-construction monitoring period is now anticipated to extend into 2016.

Following extensive consultation with a range of stakeholders, the selection of these priority species was based upon the proximity of EU protected sites (SACs) to the BOWL and MORL sites (see Annex 1), and the opportunities to address key questions that can reduce uncertainty in future assessments (see Annex 2). Specifically, the pre-construction MMMP aims to collect additional data on the distribution, abundance and vital rates of both priority species, thereby providing a baseline against which the population consequences of disturbance during construction can be quantified.

Programme structure

The MMMP consists of two sets of work packages, the first covering the requirements for harbour seal monitoring, and the second for bottlenose dolphin monitoring.

Harbour Seal Monitoring

1) Individual based studies of reproduction and survival;
2) Trends in abundance; and
3) Characterisation of foraging areas.

Bottlenose Dolphin Monitoring

1) Individual based studies of reproduction and survival;
2) Trends in abundance; and
3) Baseline occurrence of dolphins in favoured areas.

Harbour Seal Monitoring Work Packages

WP 1.1: Individual based studies of reproduction and survival

Introduction and Objectives

This work package is being used to assess baseline variability in harbour seal vital rates and condition. This will permit future comparison with data collected during the construction period. These data will then be used to test and refine assumptions in the Moray Firth harbour seal assessment framework (Thompson *et al.* 2013b) that link noise exposure to changes in vital rates.

Parameters to be measured

- Female fecundity (i.e. birth rates);
- Female pupping dates;
- Sex specific survival rates.

Survey Design

Land-based photo-identification is being used to recognise individual harbour seals from their distinct facial pelage markings (Thompson & Wheeler 2008). Repeated observations of known females can then be used to determine whether or not different females in the population give birth each year, and data on the timing of births provides an index of over-winter body condition (see Cordes & Thompson 2013). Repeated sightings of males and females can be used to estimate sex-specific survival rates (Cordes & Thompson 2014).

Figure 1. Examples of suitable photographs for individual photo-identification, showing the distinct facial patterns on the left and right side of four individuals that regularly use the Loch Fleet haul-out site.

Methodology

Regular photo-identification surveys of harbour seals were carried out from late May until late July at Loch Fleet National Nature Reserve (NNR), which is the nearest major harbour seal breeding site to the BOWL and MORL developments (Figure 2). Over the last two decades, Loch Fleet has become an increasingly important breeding site for the Moray Firth harbour seal population (Cordes *et al.* 2011), and the proximity of the haul-out to a public road makes it particularly suitable for photo-identification studies.

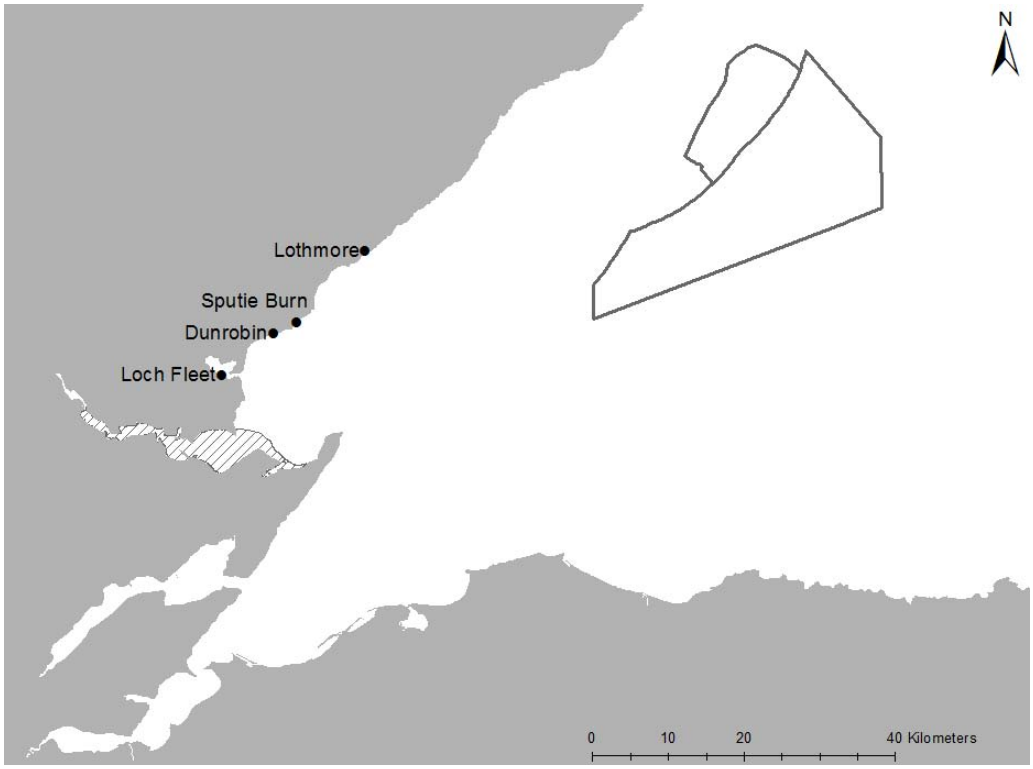


Figure 2. Map of the Moray Firth showing the position of the BOWL and MORL development areas and the four closest harbour seal haul-out sites. The Dornoch Firth and Morrich More SAC is hatched.

Surveys were started around low tide, with observations made from a vehicle parked at a standard vantage point (Grid Ref: NH 791 956). High quality photographic images were taken of all individuals using the main sandbank by trained observers using a digital SLR camera (Canon 60D) attached to a telescope (20–60 x 80 mm Swarovski HD-ATS 80). For adult females, data were also recorded, ideally by photograph, on whether or not a pup was present on each encounter.

Data Analysis

All images were graded for photographic quality and the best quality pictures for each seal, each day, were matched to the existing photo-identification catalogue by an experienced analyst. These initial matches were confirmed by a second experienced analyst and archived with associated field data. Daily sightings of individual seals were used to create a capture

history matrix, which included information on whether or not individual females were seen with a pup.

The annual fecundity rate was estimated by dividing the number of females seen with a pup each year by the total number of reproductive females seen that year. Females that had never been seen with a pup up to and including the year of analysis were defined as non-reproductive and excluded from the analysis, as juvenile females (< 3 years old) are unable to breed. Unless the birth was observed (n = 5 in 2014), pupping date was calculated as the mid-point between the day that the female was last seen alone and the day that she was first seen with a pup (Thompson & Wheeler 2008). If this period was longer than 3 days, the pupping date was excluded from analyses of timing of pupping (see Cordes & Thompson 2013).

Results

In 2014, a total of 39 photo-identification trips (including two non-MMMP trips) were conducted during the pupping period at Loch Fleet from the 27th May to the 30th July. The first pup was seen on the 12th June and the maximum pup count was 51 on the 1st July (Figure 3). The majority of seals present were successfully photographed on all trips, and particular effort was made to ensure that all attending mothers were photographed to allow analysis of pupping dates and individual reproductive success. In total, 7,714 images of harbour seals were taken at Loch Fleet during the pupping period.

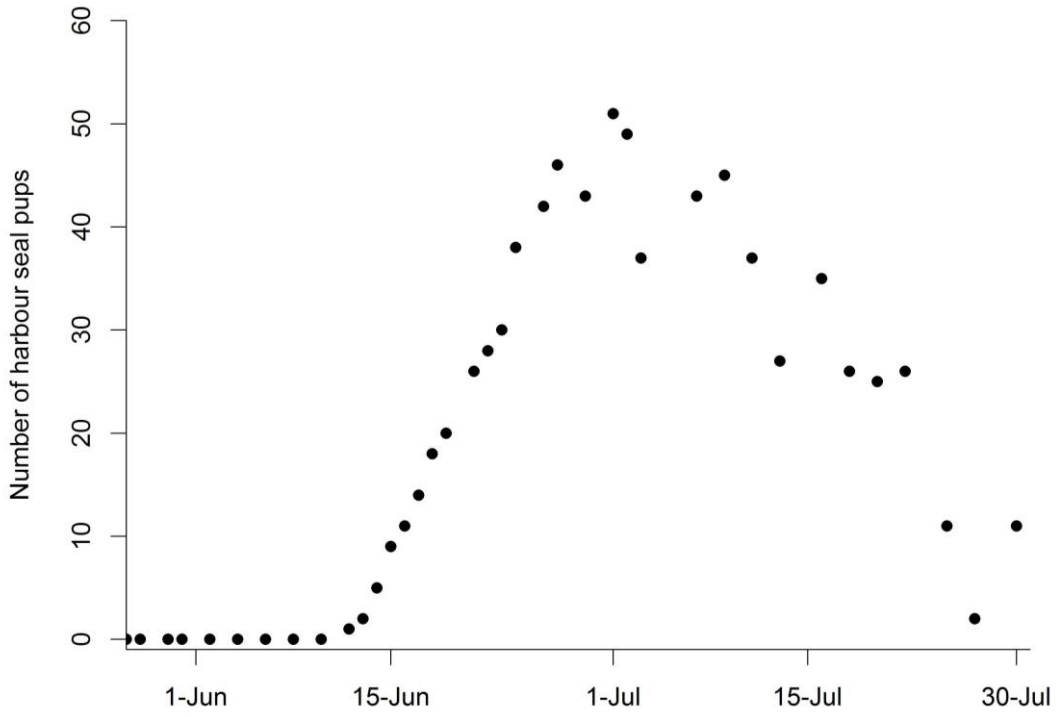


Figure 3. The number of harbour seal pups counted at Loch Fleet during the pupping period from the 27th May to the 30th July 2014.

Female Fecundity

Of 65 reproductive females seen at Loch Fleet in 2014, 54 females were seen with a pup (Table 1, Annex 3). The mean fecundity rate from 2007 to 2014 was 0.83 (SE = 0.02), ranging from 0.77 to 0.96 (Table 1). The reproductive histories of the females that were seen with a pup at Loch Fleet in 2014 are provided in Annex 3. Data on the reproductive histories of females seen at Loch Fleet from 2006 to 2014 will be used to provide unbiased estimates of reproductive rates using a mark-recapture model accounting for uncertainty in breeding status, similar to the model used in Cordes & Thompson (2013). Uncertainty in breeding status arises from the fact that females that are seen but not observed with a pup in a given year cannot be assigned as non-breeding females with certainty using data from photo-identification methods, because for example a pup might die before being seen with its mother.

Table 1. Annual summary data on the number of pups born, the number of known reproductive females seen and the fecundity rate for harbour seals at Loch Fleet.

Year	Number of pups	Number of Reproductive Females	Fecundity Rate
2007	32	37	0.86
2008	49	51	0.96
2009	47	59	0.80
2010	50	60	0.83
2011	44	57	0.77
2012	48	59	0.81
2013	44	57	0.77
2014	54	65	0.83

Timing of Pupping

40 accurate pupping dates were obtained from the 54 females seen with a pup at Loch Fleet in 2014. The median pupping date in 2014, the 19th June, was later than the preceding seven years from 2007 to 2013 (Figure 4).

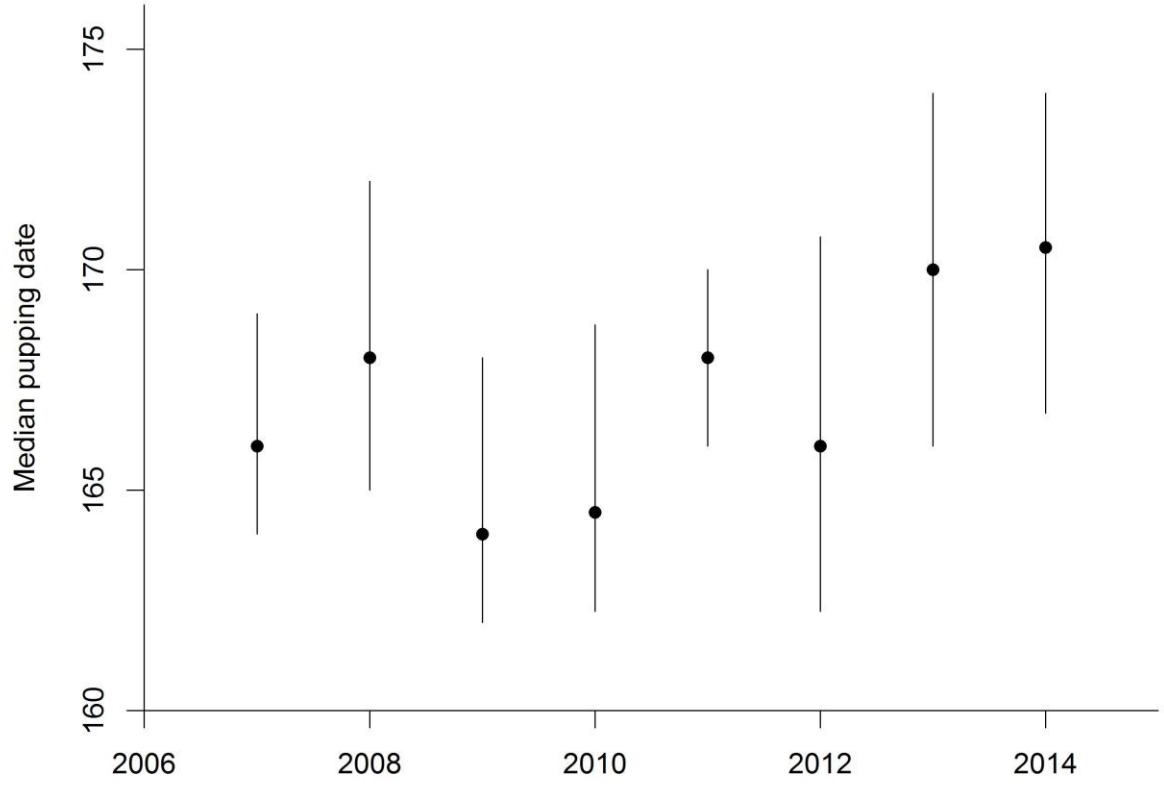


Figure 4. Annual variation in the timing of pupping at Loch Fleet. Points represent the median pupping date with interquartile ranges.

Sex Specific Survival

In 2014, a total of 183 individuals were identified at Loch Fleet: 92 females, 76 males and 15 individuals of unknown sex. The sighting histories of individual harbour seals seen in Loch Fleet in 2014 are provided in Annex 4. Repeated sightings of males and females will be used to estimate sex-specific survival rates using the mark-recapture model described in Cordes and Thompson (2014).

WP 1.2: Trends in abundance

Introduction and Objectives

This work package is being used to assess baseline variability in summer and winter abundance at harbour seal haul-out sites along the northern Moray Firth coast (Figure 2: Loch Fleet and smaller sites near Brora and Helmsdale). These finer–scale summer abundance data from sites that are closest to the BOWL and MORL developments can then be related to broad-scale survey data that are routinely collected by the University of St Andrews Sea Mammal Research Unit (SMRU); i.e. Regional Site Condition Monitoring data from the Dornoch Firth and Morrich More SAC and national harbour seal survey data. This will permit future comparison with data collected during the construction and post-construction period, allowing a test of the short term decline and subsequent recovery predicted under the Moray Firth seal assessment framework.

Parameters to be measured

- Summer abundance of harbour seals during the pupping season and moult;
- Winter abundance of harbour seals.

Survey Design

Throughout their global range, trends in harbour seal abundance are based upon low-tide counts made during either the pupping season (Thompson *et al.* 1997; Huber *et al.* 2001) or moult (Thompson & Harwood 1990; Lonergan *et al.* 2007), when a higher and more consistent proportion of seals are ashore. A range of counting methods has been used in other studies, including land-based counts (Thompson *et al.* 1997), aerial photographic survey (Thompson & Harwood 1990) and thermal imagery (Lonergan *et al.* 2007). In future it is likely that UAVs (unmanned aerial vehicles) may also become a viable survey platform.

Methodology

Land-based counts were made at Loch Fleet, Dunrobin, Sputie Burn and Lothmore (Figure 2) during the pupping season (15th June – 15th July) and moult (1st – 31st August) following the protocols used by the University of Aberdeen during previous studies of trends in harbour seal abundance (Thompson *et al.* 1996; Thompson *et al.* 1997; Thompson *et al.* 2007; Cordes *et al.* 2011). Monthly counts were made at each of these four sites throughout the winter months (from September 2014 to April 2015) and one more monthly count will be made at each of these four sites in May 2015.

Counts were made around low tide and, when possible, in the absence of rain and on days with good visibility. Counts were made from suitable vantage points by a trained observer, using a Swarovski HD-ATS 80 telescope. In Loch Fleet, counts were made as part of the on-going photo-identification studies. Where conditions allowed at other sites, opportunistic

photographs were also taken and will be processed using the same approaches outlined in WP 1.1.

Data Analysis

The mean annual pupping season and moult counts will be related to broader scale harbour seal survey data from the east coast of Scotland that are made available through the Natural Environment Research Council Special Committee on Seals (e.g. SCOS 2012).

Estimates of total abundance will be made using two different approaches. First, counts made during the pupping season can be adjusted using available telemetry data following the approach described in Thompson *et al.* (1997). Second, the matrix of photographic recaptures used to estimate survival (WP 1.1) can also be used to provide mark-recapture estimates of absolute abundance in Loch Fleet (Cordes 2011) and, potentially, at all three sites.

Results

In 2014, a minimum of four counts were made at Loch Fleet, Dunrobin, Sputie Burn and Lothmore during the pupping season and moult. In addition, throughout the winter (September 2014 to April 2015) monthly counts were made at each of these four sites (Table 2). Harbour seal counts at Loch Fleet during the pupping season and moult have been increasing since the mid-1990s (Figure 5).

Table 2. Mean count (± 1 SE) of adult harbour seals at Lothmore, Sputie Burn, Dunrobin and Loch Fleet during the 2014 pupping season and moult and over-winter 2014-2015.

	Lothmore	Sputie Burn	Dunrobin	Loch Fleet
15th June to 15th July (Pupping)	0.2 (0.2)	22.4 (1.33)	0 (0)	92.84 (4.21)
August (Moult)	6.25 (1.89)	38.75 (4.96)	0.25 (0.25)	123.2 (8.25)
1st Sept to 30th April (Winter)	1.88 (1.14)	22.63 (4.21)	0 (0)	58.92 (7.14)

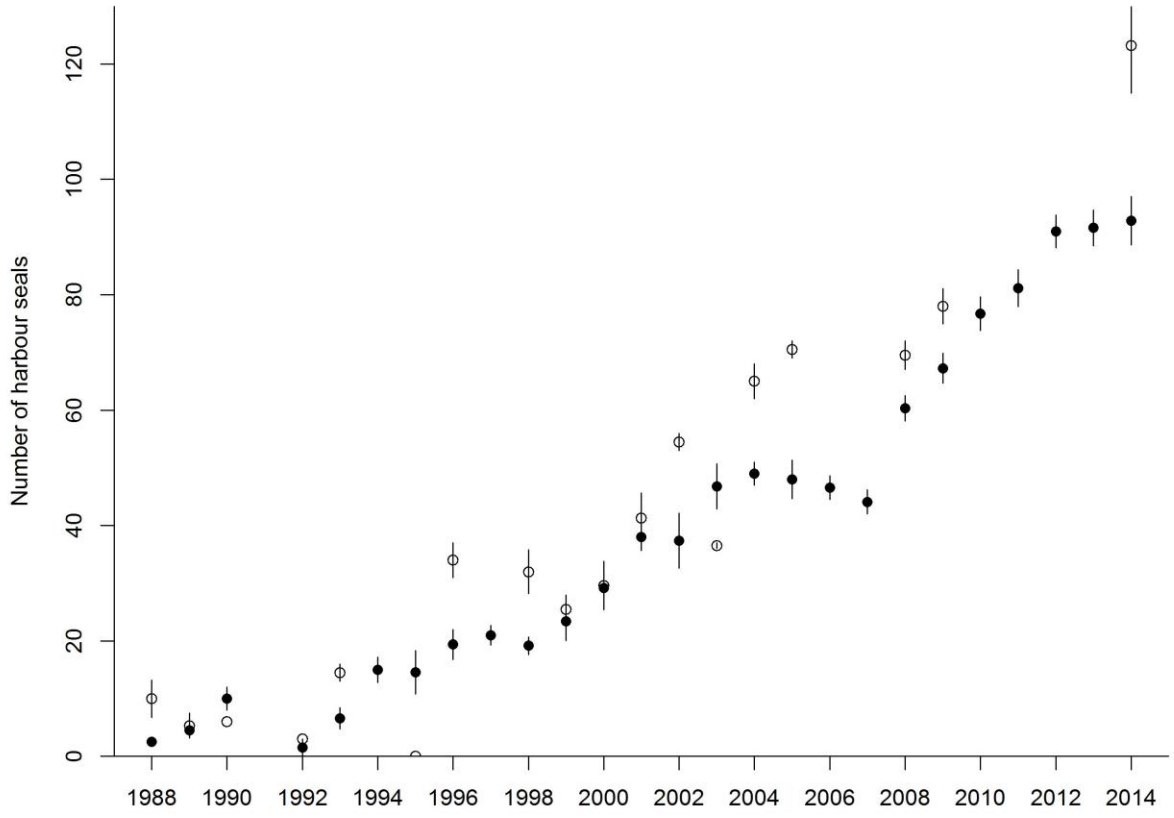


Figure 5. Counts of harbour seals at Loch Fleet, 1988-2014: filled circles are counts during the pupping season; open circles are counts during the moult. Plotted values are the means ± SE.

WP 1.3: Characterisation of foraging areas

Introduction and Objectives

This work package will be used to obtain up to date information on baseline variability in the at-sea distribution and foraging patterns of harbour seals breeding at haul-out sites in the northern part of the Moray Firth. This will permit future comparison with data collected from animals that are exposed to piling noise. These data will also be used to characterise the foraging areas used by different identifiable individuals (see WP 1.1). This will, in turn, allow us to evaluate whether individual variation in vital rates is related to the extent of overlap between individual foraging ranges and areas impacted by construction noise.

Parameters to be measured

- Population distribution at sea during summer and winter;
- Individual home ranges and foraging areas;
- Dive patterns.

Survey Design

A wide range of telemetry devices have previously been used to track harbour seals. This study is using GPS/GSM tags produced by SMRU Instrumentation, that have been widely used to obtain fine-scale data on distribution and activity of harbour seals in UK waters (Cordes *et al.* 2011; Sharples *et al.* 2012).

Tags were expected to last 3-9 months, and the survey was been designed to include two capture periods to maximise the chance of obtaining a balanced dataset across both winter and summer seasons.

Methodology

To collect pre-construction data during the winter of 2014/15 and spring/summer of 2015, harbour seals were captured in Loch Fleet (Figure 2) in September 2014 and February 2015. Study individuals were captured using barrier nets as they flushed from their haul-out sites, before being weighed and anaesthetized. Handling and anaesthesia was conducted by suitably trained and licensed personnel, using specialist boats and equipment (see Sharples *et al.* 2012 for full details).

GPS/GSM tags were attached to the hair at the back of the neck using Loctite® 422 Instant Adhesive and the seals released following collection of standard samples and measurements. Seal capture and handling was conducted under the terms of licences issued by the UK Home Office under the Animals (Scientific Procedures) Act 1986 (# 70/7806) and Marine Scotland under the Marine (Scotland) Act 2010.

Data Analysis

Data on the locations and activity patterns of individual tagged seals are transmitted via GSM to the University of St Andrews when seals move within range of mobile phone masts. The data are then subject to routine error checking and estimation of summary statistics, and archived on a server from which data can regularly be extracted via a secure web portal.

For the baseline characterization, location data will be used to update the habitat association analyses presented in Bailey, Hammond and Thompson (2014), as used to provide the underlying at-sea distribution for the Moray Firth Seal Assessment Framework. Individual home ranges will be characterised using kernel analysis (see Cordes *et al.* 2011). These data will be used to derive estimates of individual and sex-differences in the duration and range of foraging trips, and the extent to which different individuals use the wind farm development areas.

These data will also be used to support the design of additional tracking studies during construction, which are required to validate the dose response curves used in the Moray Firth Seal Assessment Framework and identify how long it takes individuals to return to disturbed sites. All location and activity data will be archived as a baseline for more detailed comparison with subsequent data collected during construction.

Results

A total of 25 harbour seals were captured at Loch Fleet and tagged with GPS/GSM tags (Table 3): twelve harbour seals, six female and six male, in September 2014; and thirteen harbour seals, seven female and six male, in February 2015. 1 adult female that had been captured and tagged in September (Seal ID # 013) was re-captured in February but she was not re-tagged, although her GPS/GSM tag had fallen off. In addition, eight juvenile harbour seals were captured and released without GPS/GSM tags: one male in September 2014; and six females and one male in February 2015.

The capture histories and latest GPS tracks for the seals captured at Loch Fleet are summarised in Annex 5. Figure 6 shows the tracks from 28th September 2014 to 30th April 2015 for all 25 harbour seals captured in September and February. Two individuals have used the wind farm sites.

Table 3. Harbour seals captured and tagged at Loch Fleet, September 2014 and February 2015.

Seal ID	Date caught	Sex	Flipper tag #	GPS/GSM tag #	Weight (kg)	Length (cm)	Girth (cm)
013	28-Sep	female	00518	12915	85.9	148.5	97.0
042	27-Feb	female	00558	13120	83.2	144.0	107.0
076	25-Feb	female	00554	13314	71.7	135.0	100.0
105	25-Feb	female	00545	13203	86.3	139.0	111.0
127	29-Sep	female	00527	13212	72.7	143.0	96.0
158	25-Feb	female	00548	13286	94.5	145.0	106.0
242	29-Sep	female	00528	12922	65.7	130.0	97.5
253	28-Sep	female	00522	13207	64.7	135.0	100.0
294	28-Sep	female	00523	12921	60.5	130.0	98.0
317	28-Sep	female	00520	13210	55.5	132.6	90.0
341	27-Feb	female	00550	13318	73.1	141.0	108.0
383	25-Feb	female	00531	13322	89.7	144.0	103.0
384	26-Feb	female	00555	13320	94.0	143.0	112.0
072	23-Feb	male	00544	13282	83.4	142.0	111.0
090	29-Sep	male	00503	13115	72.3	142.0	102.0
099	25-Feb	male	00543	13313	94.9	154.0	115.0
230	26-Feb	male	00553	13284	90.6	149.0	115.0
260	28-Sep	male	00519	13214	63.5	133.4	100.0
264	23-Feb	male	00541	13255	64.2	140.0	99.0
267	29-Sep	male	00529	12919	93.1	137.0	95.5
270	26-Feb	male	00556	13316	76.3	142.0	105.0
274	28-Sep	male	00521	13208	49.5	129.0	91.0
307	29-Sep	male	00526	13209	72.5	147.0	99.0
322	29-Sep	male	00525	13213	54.7	120.0	96.0
338	27-Feb	male	00551	13204	100.6	157.0	118.0

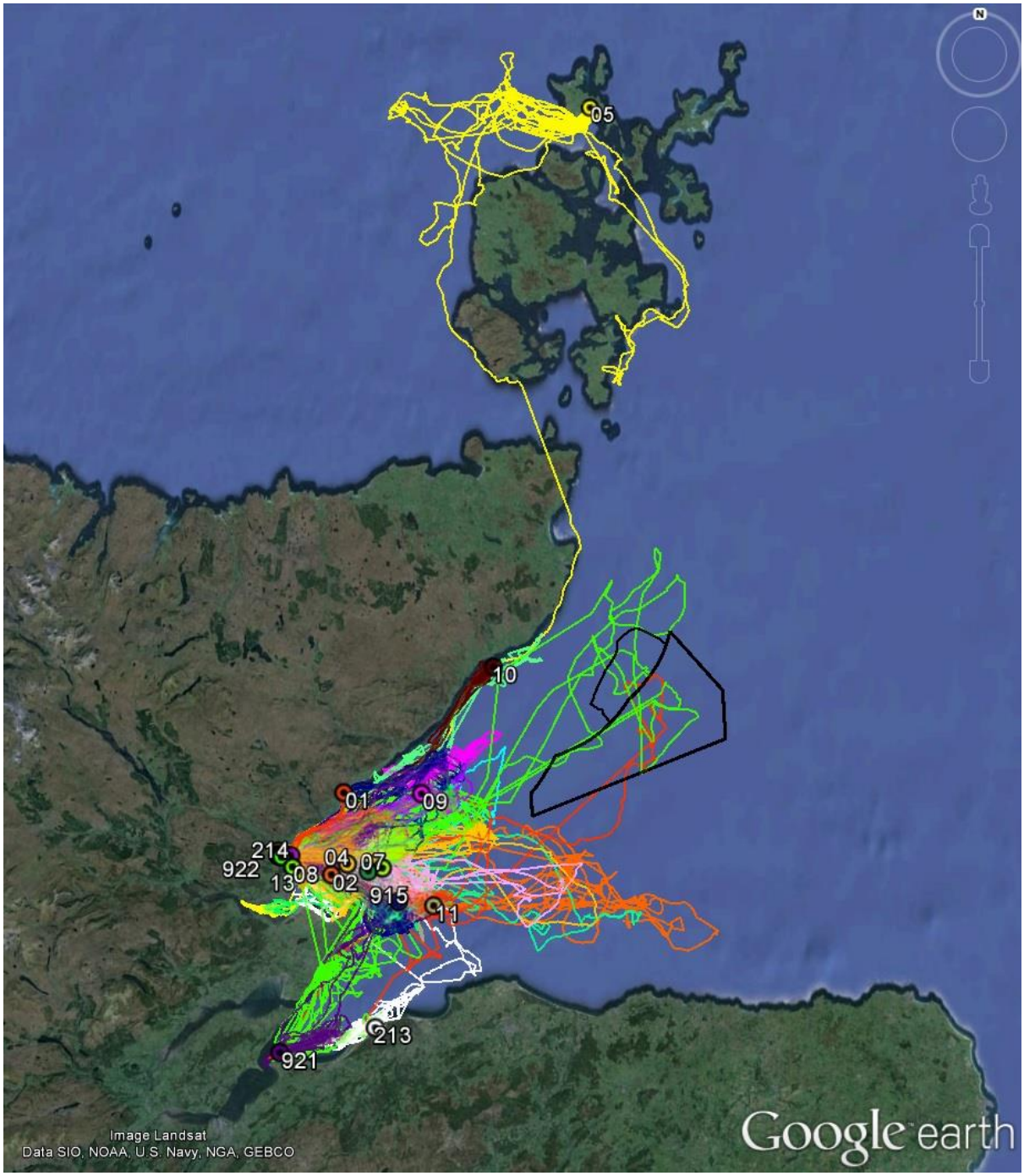


Figure 6. GPS tracks from 28th September 2014 to 30th April 2015 of 25 harbour seals captured at Loch Fleet: each colour represents a different individual.

Bottlenose Dolphin Monitoring Work Packages

WP 2.1: Individual based studies of reproduction and survival

Introduction and Objectives

This work package is being used to assess baseline variability in bottlenose dolphin vital rates. This will permit future comparison with data collected during the construction period.

Parameters to be measured

- Female fecundity;
- Sex specific survival rates.

Survey Design

Established boat-based photo-identification techniques are used to recognise individual bottlenose dolphins from their distinct dorsal fin markings (Figure 7) (Wilson, Hammond & Thompson 1999; Wilson *et al.* 2004; Cheney *et al.* 2013). Following agreed methods for monitoring the population that uses the Moray Firth SAC (Thompson *et al.* 2004; Cheney *et al.* 2014b), repeated observations can then be used to determine whether or not different females in the population give birth each year. Repeated sightings of known males and females can be used to estimate sex-specific survival rates.

Figure 7. Examples of suitable photographs for individual photo-identification, showing the distinct nicks and tooth rake marks on the left and right side of four individuals that regularly use the Moray Firth SAC.

Methodology

Sampling Techniques

Photo-identification surveys within the Moray Firth SAC were conducted between May and September. Surveys were conducted from the Lighthouse Field Station in Cromarty using a specialist MCA coded workboat. Standard and established protocols for monitoring the Moray Firth SAC have been agreed with SNH (Thompson *et al.* 2004; Cheney *et al.* 2014b). Surveys aimed to target areas that maximise the probability of encountering bottlenose dolphins. Whenever groups were encountered, the boat was manoeuvred at slow speed around the dolphins to allow dorsal fin photographs to be taken with an SLR camera. Surveys aimed to obtain high quality pictures of the left and right sides of the dorsal fins of as many individuals as possible, whilst minimising disturbance and ensuring that as many different members of the group were photographed as possible. All survey work was conducted under SNH licence that permits disturbance to dolphins for scientific research. Surveys were carried out by at least three personnel, including an experienced photographer and a suitably certified boat skipper.

Data Analysis

Field data from each survey were archived in an access database. All images were graded for photographic quality (Wilson, Hammond & Thompson 1999; Cheney *et al.* 2014b). All high quality pictures were matched to our existing photo-identification catalogue by an experienced analyst. At the end of this process, all the initial matches were confirmed by a second experienced analyst and the data and photographs were archived.

Fecundity rates within the SAC were approximated by estimating the year of birth of new calves. Bottlenose dolphin calves can be identified in their first, second or third year of life. Calves are aged using foetal folds (vertical creases down their sides from their position in the womb, which fade over time), their paler colour and relative size. However, only calves seen in echelon position (the calf is seen consistently surfacing alongside the mother's dorsal fin) with females were included to avoid possible duplication. We used data from 2003 onward when all new calves photographed were associated with a female. An annual fecundity (birth) rate was calculated by dividing the number calves born each year by the total number of reproductive females seen that year.

Although this provides an estimate of fecundity it does not take uncertainty and misclassification bias into account. For example, reproductive females or new-born calves may have been missed or not photographed. Future analysis aims to estimate breeding probability taking account of this bias. The intention is to develop a multi-state capture recapture model which takes account of females that may be misclassified as non-breeders as the calf was not seen (similar to Kendall, Hines & Nichols 2003). However, for our data a model is required to allow the birth of a calf during the primary sampling period.

Results

2014 Photo-Identification Surveys

In 2014, a total of 21 photo-identification surveys were conducted in the Moray Firth, from the 2nd May to the 22nd September (Table 4 and Figure 8). Of these, 3 surveys went outside the SAC along the south coast of the Moray Firth (Table 4b and Figure 8).

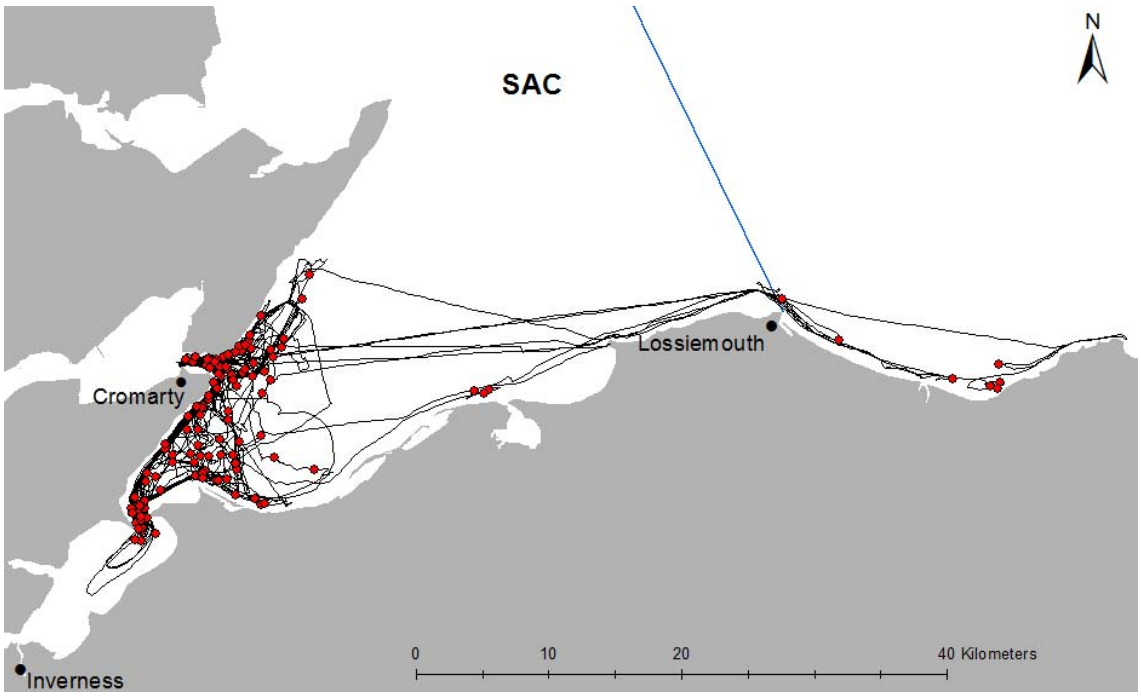


Figure 8. A map showing all the areas covered by photo-identification surveys (black lines) in 2014 and the location of all encounters with groups of bottlenose dolphins (red dots).

Over 136 hours were spent on photo-identification trips within the Moray Firth, with bottlenose dolphins seen on every trip. In total there were 135 encounters with bottlenose dolphins lasting on average 23 minutes each. This makes a total of 53 hours spent with dolphins in the Moray Firth, approximately 39% of our survey time (Table 4a). Seven of these encounters were on the south coast, outside the Moray Firth SAC, lasting on average 49 minutes each (Table 4b and Figure 8).

Boat based estimates of group sizes ranged from 1 to 30 dolphins, with a median of 5 (interquartile range = 2 to 12) (Figure 9).

A total of 12,516 photographs were taken during bottlenose dolphin photo-identification surveys in 2014.

Table 4. 2014 photo-identification survey details, by month, for the Moray Firth (a. all surveys, b. south side Moray Firth).

a.

	Number of Surveys	Survey Duration (hours)	Number of Encounters	Time on Encounters (hours)	% of survey time with dolphins
May	4	23.03	26	9.50	41%
June	4	23.03	29	7.73	34%
July	5	38.37	30	17.43	45%
August	3	20.85	22	8.00	38%
September	5	30.90	28	10.10	32%
Total	**21**	**136.18**	**135**	**52.77**	**39%**

b.

	Number of Surveys	Survey Duration (hours)	Number of Encounters	Time on Encounter (hours)
May	0	0	0	0
June	0	0	0	0
July	2	17.25	3	3.85
August	0	0	0	0
September	1	2.28	4	1.82
Total	**3**	**26.53**	**7**	**5.67**

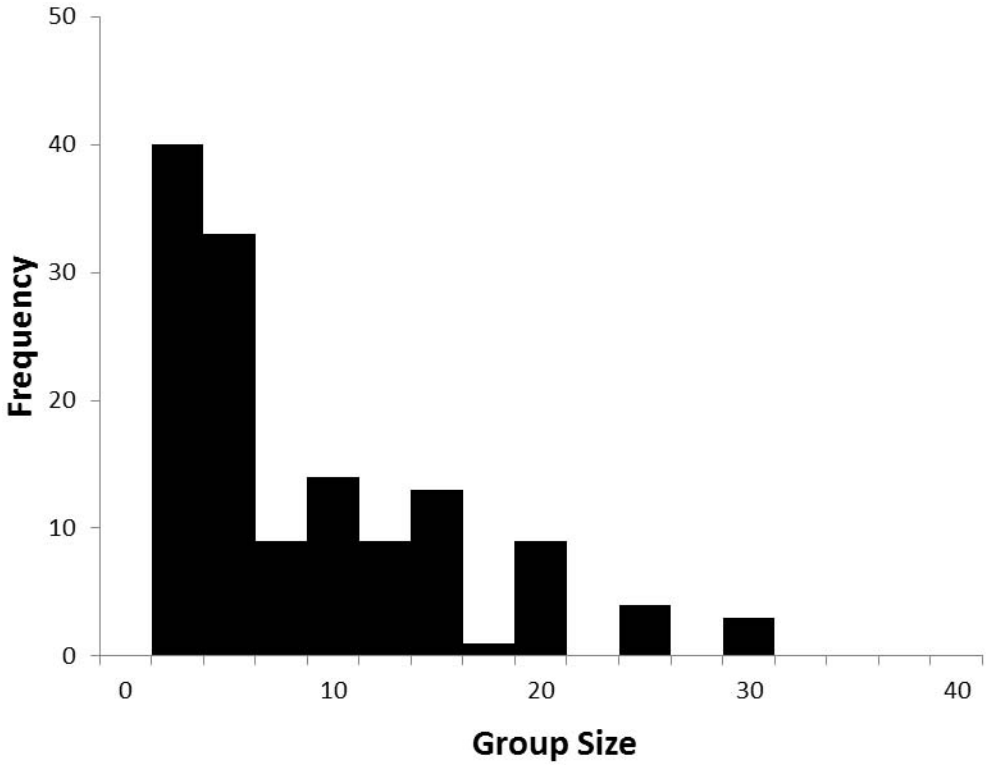


Figure 9. Frequency distribution of different dolphin group sizes during photo-identification surveys in 2014.

Female Fecundity

Between 1989 and 2014 a total of 165 calves were photographed in the SAC in the year they were first identified. Of these 131 (79%) were associated with known females. The number of newborn calves ranged from zero to 11, with an average of five calves born each year (se = 0.58) (Figure 10). The possible increase in the number of calves is likely due in part to our change to digital photography where more photos are taken making it easier to link new calves to known females.

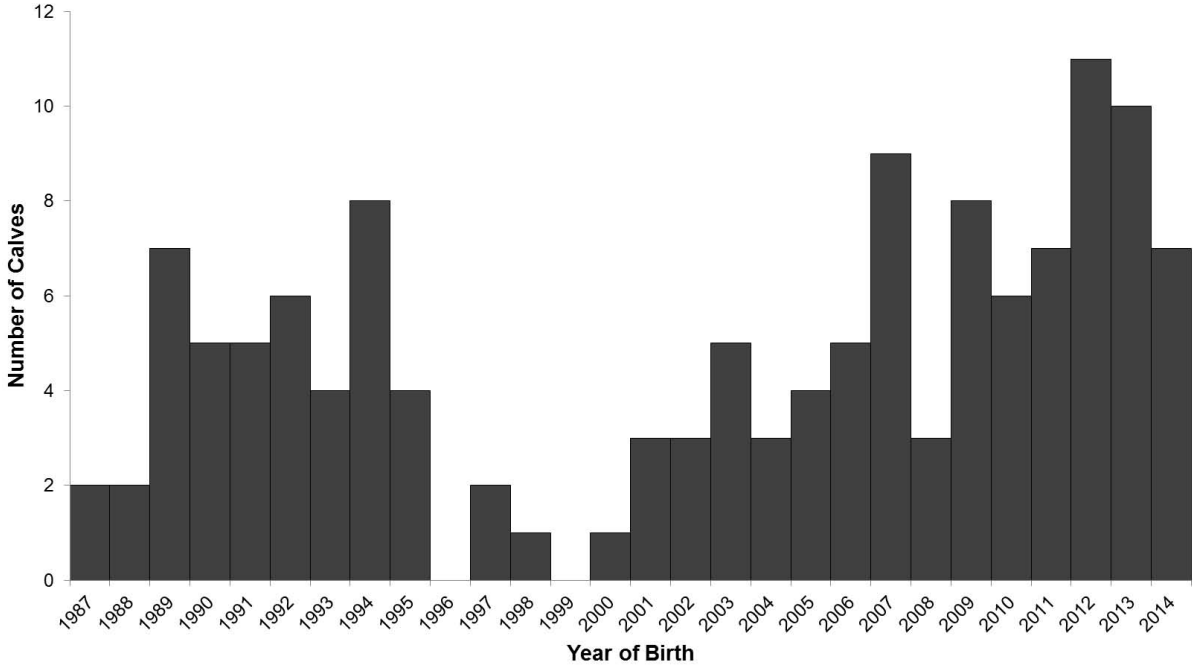


Figure 10. The number and estimated year of birth of calves observed in the SAC with known females.

From 2003 all newborn calves seen were associated with known reproductive females, and this data was used to estimate an annual fecundity rate for animals using the SAC. A total of 78 calves were identified over this time period. The annual fecundity rate varied between 0.13 to 0.39, with an average of 0.26 (SE=0.02) (Table 5). This means that on average, 26% of the reproductive females seen alive in the SAC in any year gave birth to a calf. However, this could be overestimated if any reproductive females that hadn't given birth were not photographed or underestimated if a calf died before they were photographed.

Reproductive histories are available for 51 females with 92 calves seen in the SAC from 2001 to 2014. These years were chosen to provide a time period where the majority of calves can be associated with known females. The aim is to use this data in a new multistate seasonal capture recapture misclassification model to accurately estimate fecundity for dolphins using the SAC. Annex 6 has an example of this data and shows the reproductive history of females with calves born in 2014 and seen in the SAC.

Table 5. Data on the number of calves seen with known females in the SAC from 2003 to 2014.

Year	Number of calves	Number of Reproductive Females	Fecundity Rate
2003	5	13	0.38
2004	3	15	0.20
2005	4	16	0.25
2006	5	21	0.24
2007	9	23	0.39
2008	3	23	0.13
2009	8	30	0.27
2010	6	34	0.18
2011	7	30	0.23
2012	11	40	0.28
2013	10	34	0.29
2014	7	27	0.26

Sex Specific Survival Rates

A capture recapture matrix of well-marked individuals (with dorsal fin nicks) will be created using data from 1990 to 2014 with the aim of estimating survival for dolphins using the SAC. Annex 7 is an example of the data available and shows the sighting history and sex (if known) of well-marked dolphins seen in the SAC between 1990 and 2014.

WP 2.2: Trends in abundance

Introduction and Objectives

This work package is being used to assess baseline variability in the abundance of bottlenose within the Moray Firth SAC and relate these numbers to the overall size of the east coast bottlenose population. This will permit future comparison with data collected during the construction period, allowing an assessment of whether far-field disturbance has led to change in the number of dolphins using the SAC.

Parameters to be measured

- Abundance of dolphins using the Moray Firth SAC in each summer;
- Trends in overall population size.

Survey Design

Regular photo-identification surveys have been carried out from May to September (summer) in the Moray Firth SAC from 1990 to 2014. As per WP 2.1 surveys use established boat-based photo-identification techniques to recognise individual bottlenose dolphins using their distinct dorsal fin markings (Wilson, Hammond & Thompson 1999; Wilson *et al.* 2004; Cheney *et al.* 2013). Following agreed methods for monitoring the population that uses the Moray Firth SAC (Thompson *et al.* 2004; Cheney *et al.* 2014b), repeated observations will be used to provide annual estimates of the abundance of bottlenose dolphins within the SAC.

In most years, some data has also been collected during less regular summer surveys in other parts of the population's range (Cheney *et al.* 2013). These data have also been collected using standardised photo-identification procedures (Wilson *et al.* 2004; Quick & Janik 2008; Quick, Rendell & Janik 2008; Islas-Villanueva 2010; Cheney *et al.* 2013). However, the design and number of surveys has varied among survey areas and years.

Methodology

Sampling Techniques

Abundance estimates are based upon the individual based data collected to estimate vital rates outlined in WP 2.1.

To estimate the abundance of dolphins using the Moray Firth SAC each year, sampling was based upon the University of Aberdeen summer boat based photo-identification surveys from 1990 to 2014.

Our own sampling effort is focussed within the Moray Firth SAC, but analyses of population trends will integrate any additional data available from other parts of the population's range through continued collaboration with other research groups (see Cheney *et al.* 2013).

Data Analysis

Data from our photo-identification surveys in the Moray Firth SAC from 1990 to 2014 were used to create a capture matrix of well-marked individual seen each year. PROGRAM CAPTURE provided annual estimates of the abundance of dolphins within the SAC. This technique is based on the approach described by Wilson, Hammond and Thompson (1999), with modifications described in Cheney *et al.* (2014a).

Results

2014 Photo-Identification Surveys

The results from our 2014 photo-identification surveys are outlined in WP 2.1.

Abundance of dolphins using the Moray Firth SAC in each summer

High quality pictures were obtained from at least 41 well-marked individuals during the 2014 surveys. The mark-recapture estimate of the total number of well-marked individuals was 44 (95% confidence interval (CI): 42-53). This estimated was inflated with the modelled proportion of well-marked individuals (0.5609, see Cheney *et al.* 2014a for full details). The resulting estimate of the number of dolphins using the SAC in the summer of 2014 was 78 (95% CI: 65-94).

Annual estimates of the number of dolphins using the SAC in summer show considerable variability from year to year (Figure 11). However, there is no significant linear trend in these annual estimates ($F_{1,23} = 0.2254$, $p = 0.6394$).

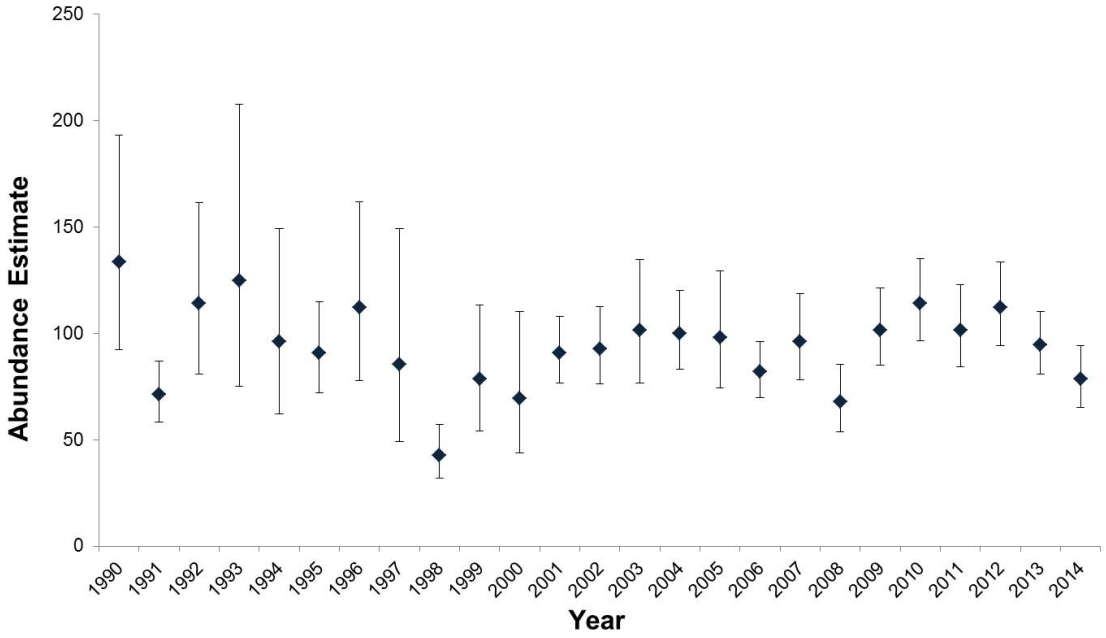


Figure 11. Annual estimates of the number of dolphins using the Moray Firth Special Area of Conservation from 1990 to 2014 with 95% confidence intervals.

Trends in overall population size.

A capture matrix incorporating annual sightings from all available areas will be updated (Annex 7 has an example of this data and shows the SAC sightings history of all well-marked dolphins seen in the SAC in 2014). The state-space model described in Corkrey *et al.* (2008) will be used to provide an updated estimate of trends in the total size of the east coast bottlenose dolphin population (see Cheney *et al.* 2014a for details).

Trends in the proportion of the total population using the SAC will also be investigated (see Cheney *et al.* 2014a for an example).

WP 2.3: Baseline occurrence of dolphins in favoured areas

Introduction and Objectives

This work package is being used to assess baseline variability in the occurrence of bottlenose dolphins at key sites within the Moray Firth SAC and along the southern Moray Firth coast. This will permit future comparison with data collected during the construction period, allowing an assessment of whether far-field disturbance has led to a change in the occurrence of dolphins within these areas.

Parameters to be measured

- Presence of dolphin echolocation clicks in given time periods (minutes, hours and days).

Survey Design

Passive acoustic studies using CPODs use established techniques for monitoring changes in the occurrence of dolphins in different parts of the SAC. This study design is based on previous studies that have demonstrated that echolocation detections can be used to provide a robust index of occurrence for bottlenose dolphins when compared to visual observations (Philpott *et al.* 2007; Bailey *et al.* 2010). These techniques have subsequently been used to compare broad scale spatial variation in the occurrence of bottlenose dolphins around the east coast of Scotland (Thompson *et al.* 2011) and year to year variation in the occurrence of dolphins at key sites within the Moray Firth SAC (Cheney *et al.* 2012; Cheney *et al.* 2014b). These techniques have the advantage that dolphin occurrence at sampling sites can be remotely monitored for 24 hr/day over periods of several months.

Methodology

Year-round samples are being collected at four long-term monitoring sites (Figure 12). Between May and September of each year, deployments are also being made at four additional sites on the south coast of the Moray Firth (Figure 12). Data are collected using V0 and V1 CPODs using seabed moorings that have been optimised for deployments at these sites, and licensed for scientific use by Marine Scotland (# 04860/14/0) and consented by the Crown Estate.

Deployments and recoveries have been made using specialist workboats operated by Moray First Marine, who have extensive experience of these activities through previous work for the University of Aberdeen on Department of Energy and Climate Change funded studies (Thompson *et al.* 2013a) and during baseline data collection for MORL and BOWL.

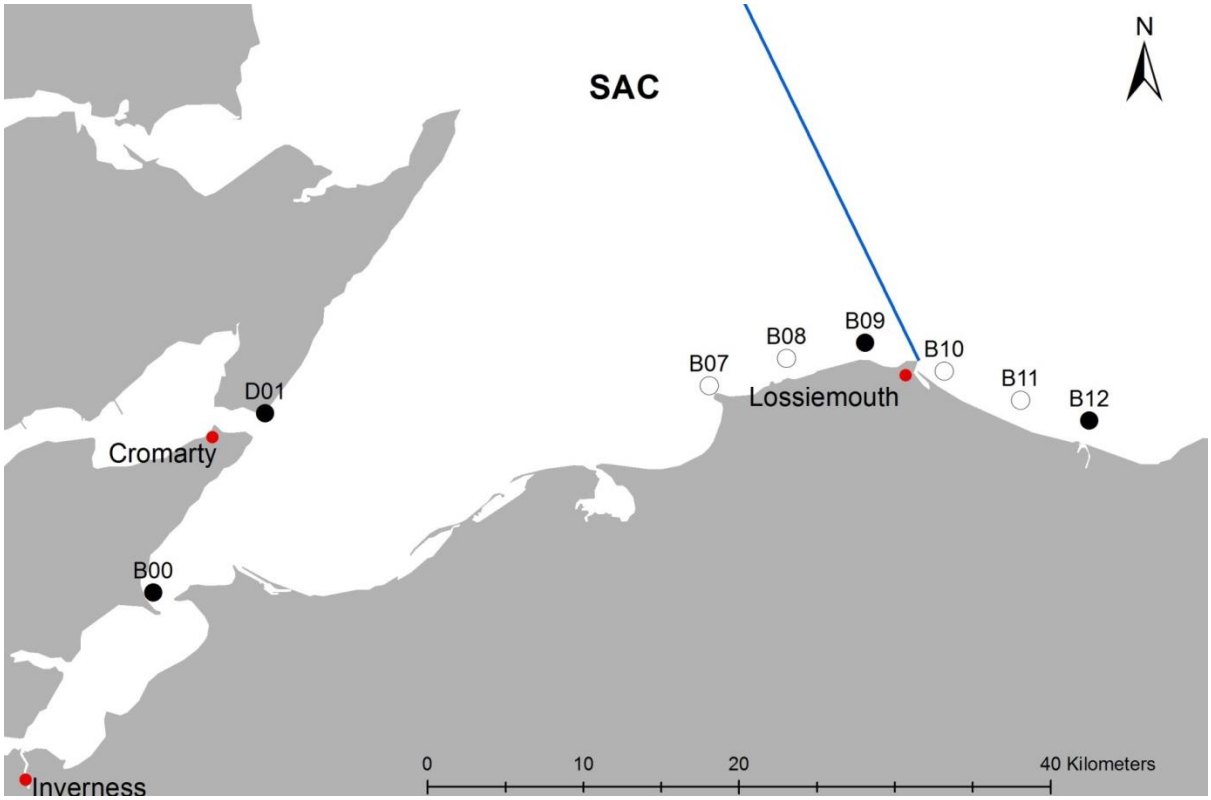


Figure 12. A map showing the CPOD locations (long-term sites = black circles; summer only sites = clear circles). The location of the Moray Firth SAC is shown.

Data Analysis

Data were downloaded using the manufacturer's software, which is also used to identify click trains and categorise these as either porpoise or dolphin clicks with high medium or low levels of confidence. Only click trains categorized with high or medium confidence were used in subsequent analyses (Brookes, Bailey & Thompson 2013). Data were processed using established routines and summarised to provide an indication of whether click trains were detected in each minute or hour of the day. Spatial and temporal variation in occurrence is expressed in terms of detection positive hours per day, or distributions of waiting times. Further details of the analysis approaches are provided in Bailey *et al.* (2010); Thompson *et al.* (2010); Brookes, Bailey and Thompson (2013); Thompson *et al.* (2013a).

Results

Details of the CPOD deployments and recoveries are shown in Table 6. Dolphin occurrence during summer, June to September, 2014 varied between sites (Table 7 and Figure 13): no data were available for B08 as the CPOD was accidently trawled. Dolphins were detected more often and spent more time at the Sutors and Chanonry than at the other five sites on the south coast (Figure 13).

Data on the seasonal variation in dolphin detections by the CPODs at the four long-term sites from 2011 to 2014 are presented in Table 8 and Figure 14. At all four sites dolphin occurrence tended to be highest from May to August, although at the Sutors dolphin occurrence was also relatively high from October to December (Figure 14).

Table 6. Deployment and recovery details for the CPODs at the four long-term and four additional sites on the south coast.

Location	Deployment Date	Recovery Date	Data
Long-term sites:			
Sutors (D01)	04/04/14	03/07/14	✓
	03/07/14	08/08/14	✓
	08/08/14	Not found	×
	04/12/14	09/04/15	✓
	09/04/15		
Chanonry (B00)	18/03/14	05/07/14	✓
	05/07/14	08/11/14	✓
	08/11/14	19/03/15	×
	19/03/15		
Lossiemouth (B09)	27/05/14	15/12/14	✓
	15/12/14	19/03/15	✓
	19/03/15		
Spey Bay (B12)	27/05/14	22/10/14	✓
	22/10/14	24/03/15	✓
	24/03/15		
Additional south coast sites:			
B07	27/05/14	27/11/14	✓
B08	27/05/14	08/09/14	×
B10	27/05/14	22/10/14	✓
B11	27/05/14	22/10/14	✓

Table 7. Summary data on dolphin detections for the CPODs at all sites from June to September 2014.

Site	No. days sampled	% days dolphins detected	Median detection positive hrs/day	Interquartile range
D01	67	98.5	10	7-12.5
B00	121	98.3	7	5-9
B07	122	87.7	2	1-3.75
B09	122	86.9	2	1-3.75
B10	122	90.2	3	2-5
B11	122	91.8	4	2-6
B12	122	91.8	4.5	2-6

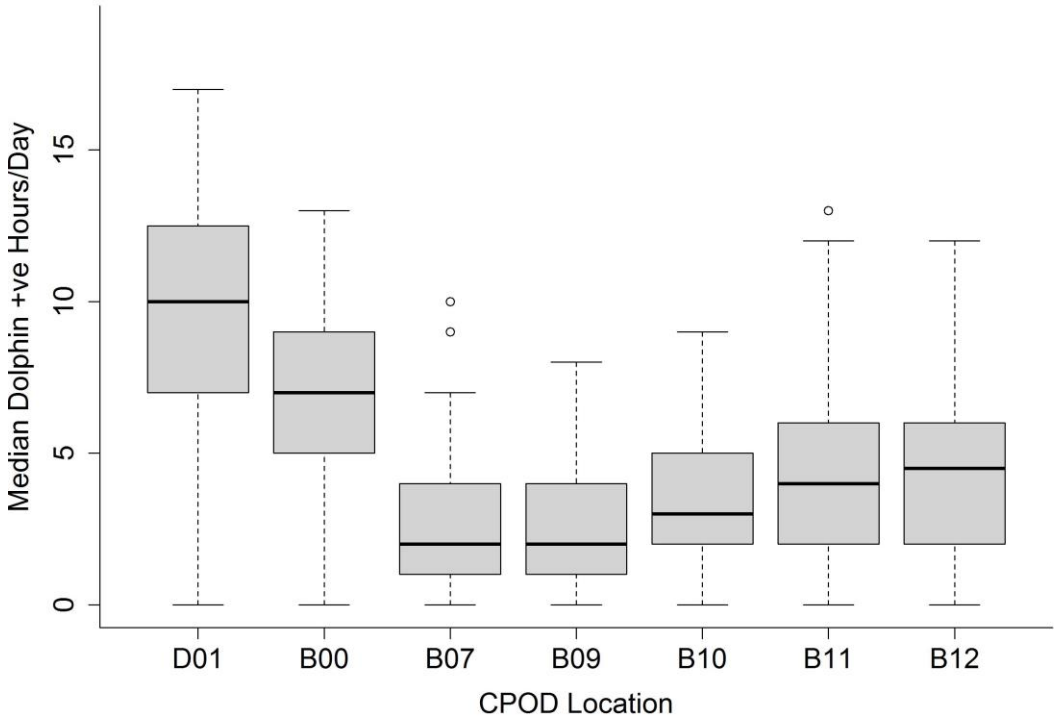


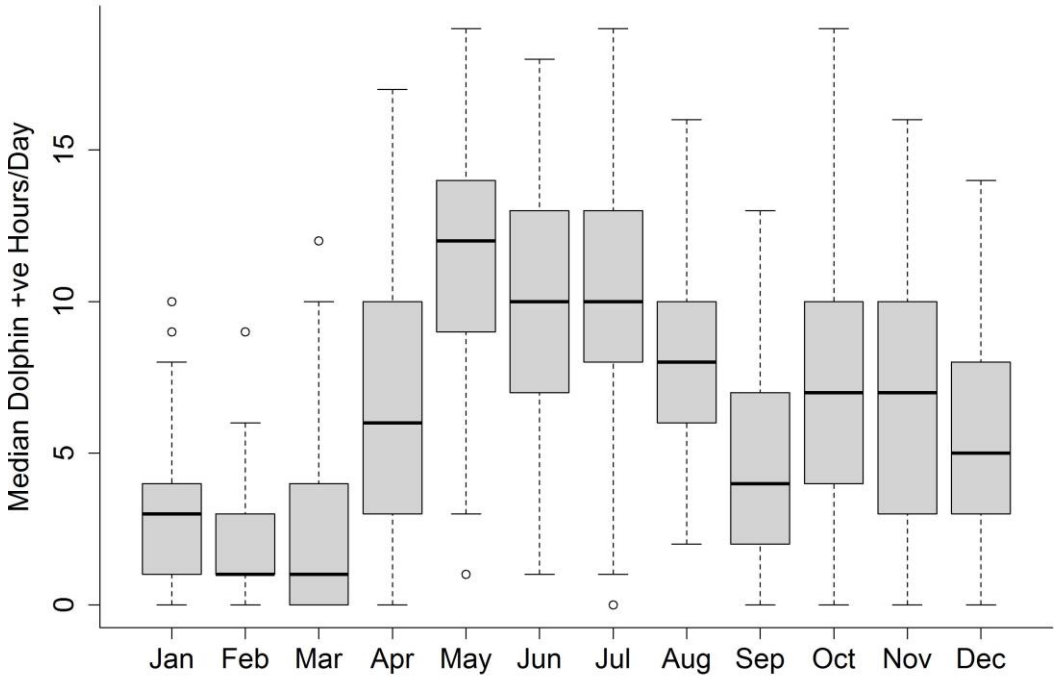
Figure 13. Site variation in the median number of hours/day (± interquartile ranges) that dolphins were detected on CPODs at all sites from June to September 2014.

Table 8. Monthly variation in dolphin detections for the CPODs at the four long-term sites from 2011 to 2014. Months in which the number of days sampled was less than 10 were excluded.

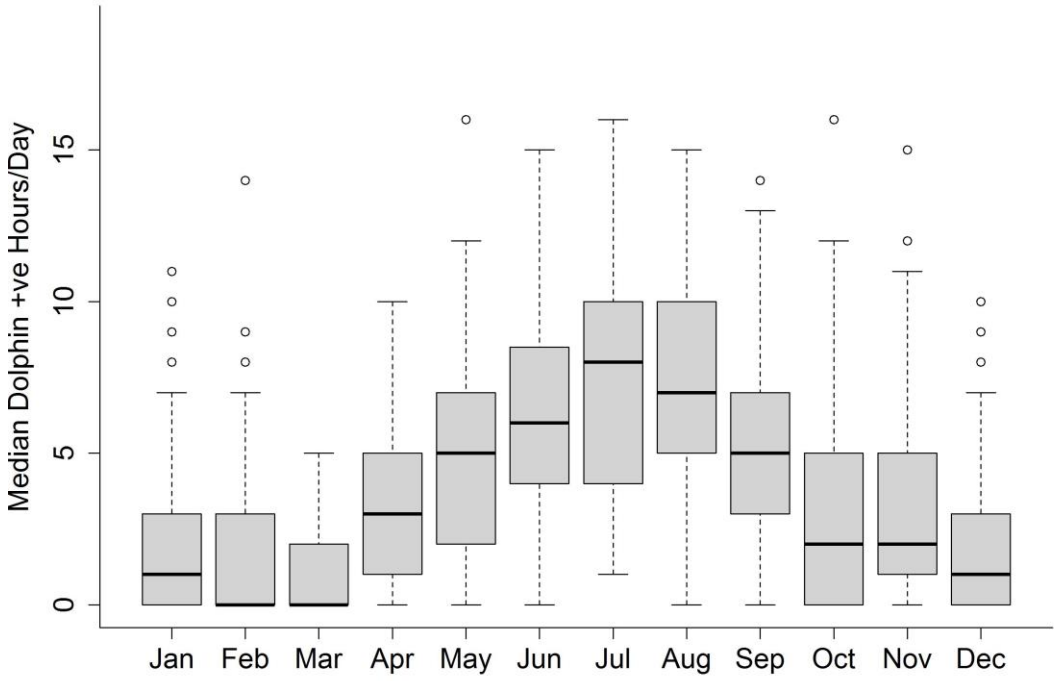
	No. years with data	No. days sampled	% days dolphins detected	Median detection positive hrs/day	Interquartile range
Sutors:					
Jan	2	62	85.5	3	1-4
Feb	2	42	78.6	1	1-3
Mar	1	31	61.3	1	0-4
Apr	4	97	92.8	6	3-10
May	4	124	100	12	9-14
Jun	4	120	100	10	7-13
Jul	4	120	99.2	10	8-13
Aug	3	92	100	8	6-10
Sep	3	90	91.1	4	2-6.75
Oct	3	92	94.6	7	4-10
Nov	3	77	98.7	7	3-10
Dec	3	89	93.3	5	3-8

	No. years with data	No. days sampled	% days dolphins detected	Median detection positive hrs/day	Interquartile range
Chanonry:					
Jan	3	93	53.8	1	0-3
Feb	3	85	47.1	0	0-3
Mar	3	78	46.2	0	0-2
Apr	3	89	89.9	3	1-5
May	4	121	94.2	5	2-7
Jun	4	120	98.3	6	4-8.25
Jul	4	122	100	8	4-10
Aug	4	112	99.1	7	5-10
Sep	3	90	94.4	5	3-7
Oct	3	93	74.2	2	0-5
Nov	3	81	77.8	2	1-5
Dec	3	90	61.1	1	0-3
Lossiemouth:					
Jan	3	93	44.1	0	0-1
Feb	3	85	58.8	1	0-1
Mar	4	81	71.6	1	0-2
Apr	4	120	75.0	1	0.75-3
May	4	123	79.7	2	1-3
Jun	4	120	83.3	2	1-3
Jul	4	122	71.3	1	0-3
Aug	4	123	78.9	1	1-3
Sep	4	120	70.0	1	0-2
Oct	4	124	41.9	0	0-1
Nov	4	106	59.4	1	0-2
Dec	4	101	59.4	1	0-2
Spey Bay:					
Jan	3	93	18.3	0	0-0
Feb	3	83	33.7	0	0-1
Mar	3	63	44.4	0	0-1
Apr	4	120	72.5	1	0-3
May	4	123	90.2	4	2-6
Jun	4	120	93.3	4	2-7
Jul	4	117	90.6	4	2-6
Aug	3	93	89.2	4	2-5
Sep	3	90	81.1	3	1-4.75
Oct	3	92	62.0	1	0-3
Nov	3	88	56.8	1	0-2
Dec	3	93	43.0	0	0-1

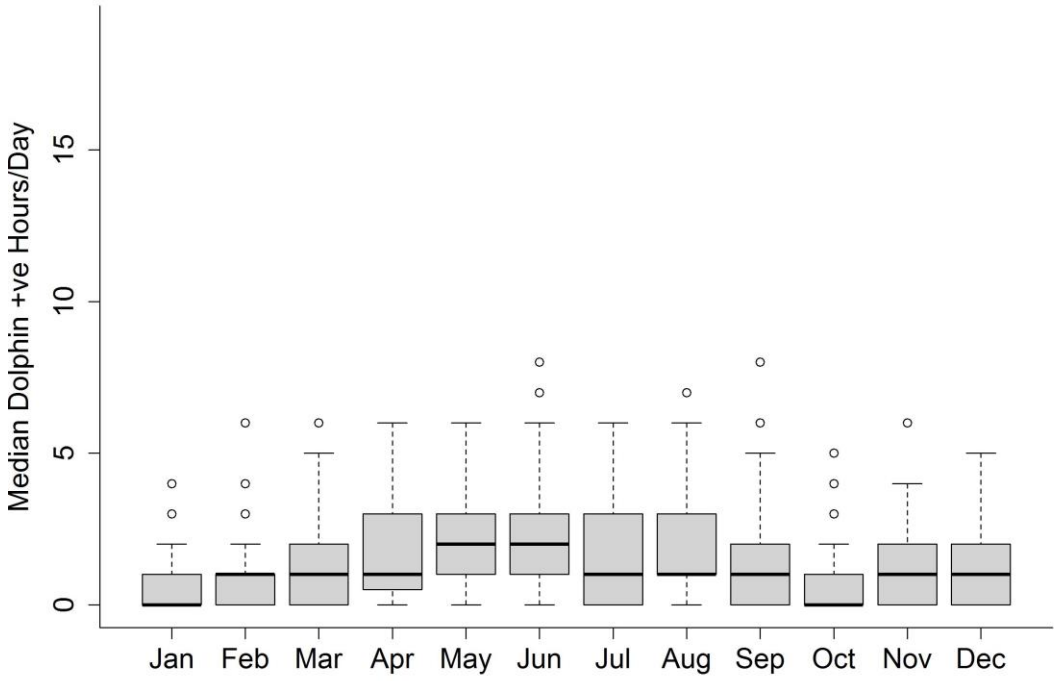
a) Sutors



b) Chanonry



c) Lossiemouth



d) Spey Bay

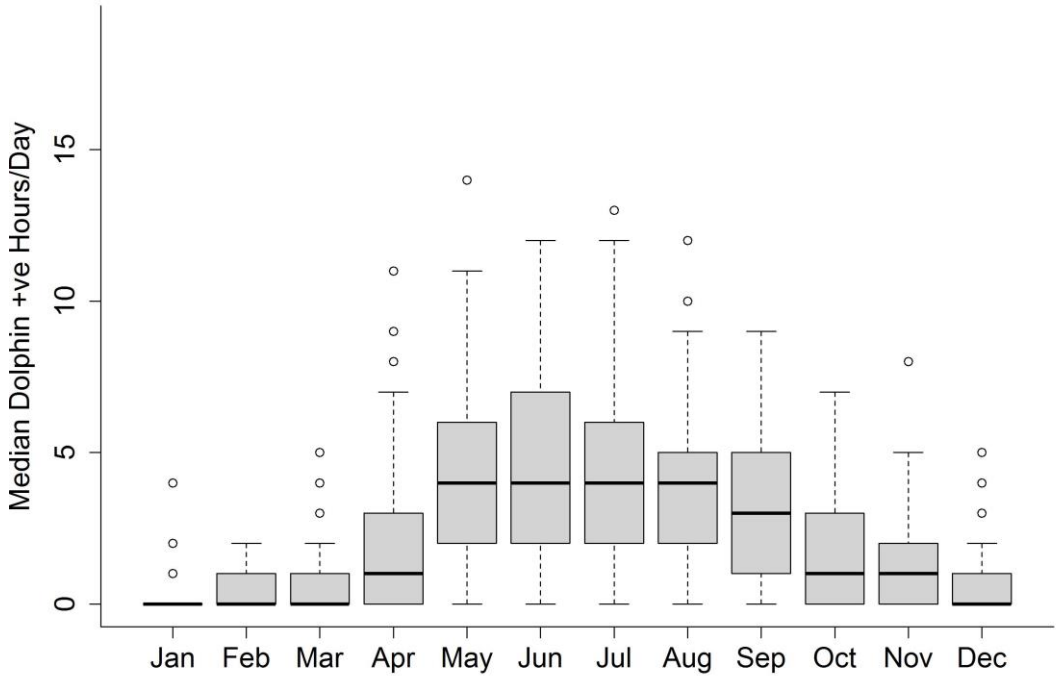


Figure 14. Seasonal variation in the median number of hours/day (± interquartile ranges) that dolphins were detected on CPODs at the Sutors, Chanonry, Lossiemouth and Spey Bay from 2011 to 2014.

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ANNEX 1. *Rationale for prioritization of monitoring for different marine mammal species as presented in earlier consultation documents.*

Harbour seal	**High priority** species for monitoring at Moray Firth sites • Due to proximity to the Dornoch Firth and Morrich More SAC • Because of predictions of significant short-term impacts on this SAC population in the ES under conservative worst case scenarios • To reduce uncertainties and improve predictions of most likely impacts using the Moray Firth Seal Assessment Framework.
Bottlenose dolphin	**High priority** species for monitoring at Moray Firth sites • Due to proximity of Moray Firth SAC • Monitoring is required in the SAC and along southern Moray Firth coast to test worst case predictions of partial displacement and assess whether this influences movements between the SAC and other parts of their East coast range.
Harbour porpoise	**Medium priority** species for monitoring at Moray Firth sites • No local SAC population • Predictions of significant short-term impacts through displacement are likely to be common at other sites • Excellent baseline from previous studies in the area provides opportunities to reduce uncertainty over spatial and temporal scale of displacement and potential for habituation.
Grey seal	**Low priority** species for monitoring at Moray Firth sites • No local SAC population • Although some displacement from foraging areas is predicted, local breeding sites are small • It is anticipated that monitoring of impacts on grey seals will be focused around Firth of Forth developments due to the existence of larger population sizes, local SACs and existing research infrastructure.
Minke whale	**Low priority** species for monitoring at Moray Firth sites • Some displacement predicted, but low and variable numbers of animals mean that there is low power to detect impacts • These animals are part of a large mobile population, meaning that any monitoring should be conducted at a broader scale or at other sites (e.g. Dogger Bank) which hold larger numbers of animals.

ANNEX 2. *Key questions that could be addressed through wind farm monitoring programme as presented in earlier consultation documents.*

Harbour seal	*Short-term* 1) To what extent are foraging harbour seals displaced by piling activity compared to worst-case scenarios in the Moray Firth Seal Assessment Framework that used proxy data from harbour porpoises? 2) If displaced during piling, do seals return to foraging areas between piling events; how does this reduce worst-case assumptions that seals are excluded from foraging areas year-round throughout construction? *Medium-term* 3) Does individual condition or reproduction at local sites decline during construction years as predicted under worst case scenarios? *Long-term* 4) Does construction noise cause PTS? 5) Do long-term survival or reproduction rates vary in relation either to variation in noise exposure or variation in hearing thresholds? 6) What are the long-term trends in abundance within the Moray Firth seal management unit in relation to other UK and European populations? 7) Do increases in vessel activity pose any additional threats to harbour seals?
Bottlenose dolphin	*Short-term* 8) Does the occurrence of bottlenose dolphins along the southern Moray Firth coast vary in relation to levels of offshore piling activity? *Medium- and long-term* 9) Are there changes in the vital rates of bottlenose dolphins using the SAC? 10) Are there changes in the numbers of bottlenose dolphins using the SAC, or the use of different parts of their overall range, in response to different wind farm construction programmes along the East coast of Scotland?
Harbour porpoise	*Short-term* 11) Can data from Horns Rev II be used as a proxy for the levels of displacement from piling at other sites? 12) How soon do porpoises return to affected areas once piling ends? *Medium-term* 13) Do porpoises become habituated or learn to tolerate piling noise during a prolonged construction period? *Long-term* 14) Are there long-term increases or decreases in porpoise density within the operational wind farm sites?

ANNEX 3. *Reproductive histories of female harbour seals seen with pups in Loch Fleet in 2014 (ticks = pup born).*

IDNO	2006	2007	2008	2009	2010	2011	2012	2013	2014
1	✓	✓	✓	✓	✓	✓		✓	✓
2	✓	✓		✓	✓		✓	✓	✓
4	✓	✓	✓	✓	✓	✓		✓	✓
5	✓	✓	✓	✓	✓	✓	✓	✓	✓
7	✓	✓	✓	✓	✓		✓	✓	✓
8	✓	✓	✓	✓	✓	✓	✓	✓	✓
10	✓	✓	✓	✓	✓	✓	✓	✓	✓
14	✓	✓	✓	✓	✓	✓	✓	✓	✓
16	✓	✓	✓	✓	✓	✓	✓	✓	✓
17	✓	✓	✓	✓	✓	✓	✓		✓
20	✓	✓	✓	✓	✓	✓	✓	✓	✓
23	✓		✓	✓	✓	✓	✓	✓	✓
27		✓	✓	✓	✓	✓	✓		✓
33	✓	✓	✓	✓	✓	✓	✓		✓
42	✓	✓	✓	✓	✓	✓	✓	✓	✓
46	✓	✓	✓		✓			✓	✓
59		✓	✓	✓		✓	✓	✓	✓
61		✓	✓	✓	✓	✓	✓	✓	✓
62		✓	✓		✓	✓	✓		✓
63		✓	✓	✓	✓	✓	✓	✓	✓
70			✓						✓
75				✓	✓		✓	✓	✓
77				✓	✓	✓	✓	✓	✓
78				✓	✓		✓	✓	✓
81			✓	✓	✓		✓	✓	✓
84						✓	✓	✓	✓
93								✓	✓
101			✓	✓	✓	✓	✓	✓	✓
103			✓	✓	✓	✓	✓	✓	✓
105			✓	✓	✓	✓	✓	✓	✓
127	✓		✓		✓	✓	✓	✓	✓
149			✓	✓	✓	✓	✓	✓	✓
158			✓	✓	✓		✓		✓
164			✓	✓	✓	✓		✓	✓
167				✓	✓	✓	✓	✓	✓
172				✓	✓		✓	✓	✓
174						✓	✓	✓	✓
180			✓		✓		✓		✓
181			✓		✓	✓	✓	✓	✓
184						✓	✓		✓
223					✓	✓	✓	✓	✓

IDNO	2006	2007	2008	2009	2010	2011	2012	2013	2014
224				✓	✓	✓	✓	✓	✓
242							✓	✓	✓
243								✓	✓
244									✓
246									✓
247									✓
250									✓
252									✓
254									✓
268									✓
273									✓
278									✓
285									✓

ANNEX 4. *Sighting histories of all well-marked harbour seal individuals seen in Loch Fleet in 2014 (male = 1, female = 2, unknown sex = 3).*

IDNO	SEX	2006	2007	2008	2009	2010	2011	2012	2013	2014
1	2									
2	2									
4	2									
5	2									
7	2									
8	2									
10	2									
12	2									
13	2									
14	2									
16	2									
17	2									
20	2									
23	2									
27	2									
28	2									
30	2									
33	2									
35	2									
42	2									
46	2									
52	2									
53	2									
56	2									
59	2									
61	2									
62	2									
63	2									
67	2									
70	2									
72	1									
73	1									
75	2									
76	2									
77	2									
78	2									
80	2									
81	2									
82	1									
83	2									
84	2									

IDNO	SEX	2006	2007	2008	2009	2010	2011	2012	2013	2014
86	1									
90	1									
92	1									
93	2									
95	1									
99	1									
100	2									
101	2									
103	2									
104	1									
105	2									
109	1									
118	2									
120	1									
122	1									
127	2									
128	1									
129	2									
132	1									
149	2									
158	2									
161	1									
164	2									
165	1									
167	2									
169	1									
172	2									
174	2									
176	1									
178	1									
180	2									
181	2									
184	2									
187	1									
189	1									
190	1									
191	1									
202	1									
207	1									
219	3									
222	2									
223	2									
224	2									
229	1									

IDNO	SEX	2006	2007	2008	2009	2010	2011	2012	2013	2014
230	1									
234	1									
242	2									
243	2									
244	2									
246	2									
247	2									
249	1									
250	2									
251	3									
252	2									
253	2									
254	2									
256	1									
257	1									
258	1									
259	2									
260	1									
262	2									
263	1									
264	1									
265	1									
267	1									
268	2									
269	2									
270	1									
271	1									
272	1									
273	2									
274	1									
275	1									
276	2									
277	1									
278	2									
279	1									
280	1									
283	2									
284	1									
285	2									
286	1									
287	2									
288	2									
289	3									
290	2									

IDNO	SEX	2006	2007	2008	2009	2010	2011	2012	2013	2014
291	1									
293	1									
294	2									
295	2									
296	1									
297	1									
298	1									
299	1									
300	2									
301	1									
302	1									
303	1									
304	1									
305	2									
306	2									
307	1									
308	1									
309	1									
310	3									
311	2									
312	1									
313	3									
314	3									
315	1									
316	3									
317	2									
318	1									
319	1									
321	1									
322	1									
323	1									
325	1									
326	3									
327	3									
328	3									
329	1									
330	2									
331	1									
332	3									
333	1									
334	1									
335	1									
336	1									
337	2									

IDNO	SEX	2006	2007	2008	2009	2010	2011	2012	2013	2014
338	1									
339	2									
340	3									
341	2									
342	1									
381	3									
382	2									
396	3									
397	2									
425	3									

ANNEX 5. *Summary information, sightings histories and recent movements of the 25 harbour seals captured and tagged in Loch Fleet during September 2014 and February 2015.*

Seal ID # 013

Vital Stats

- Adult
- Female
- First seen 2006
- Breeding female
- 8 pups
- Not captured before

Sightings and Pupping History

	2006	2007	2008	2009	2010	2011	2012	2013	2014
Seen	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pup	✓	✓	✓	✓	✓	✓	✓	✓	✗

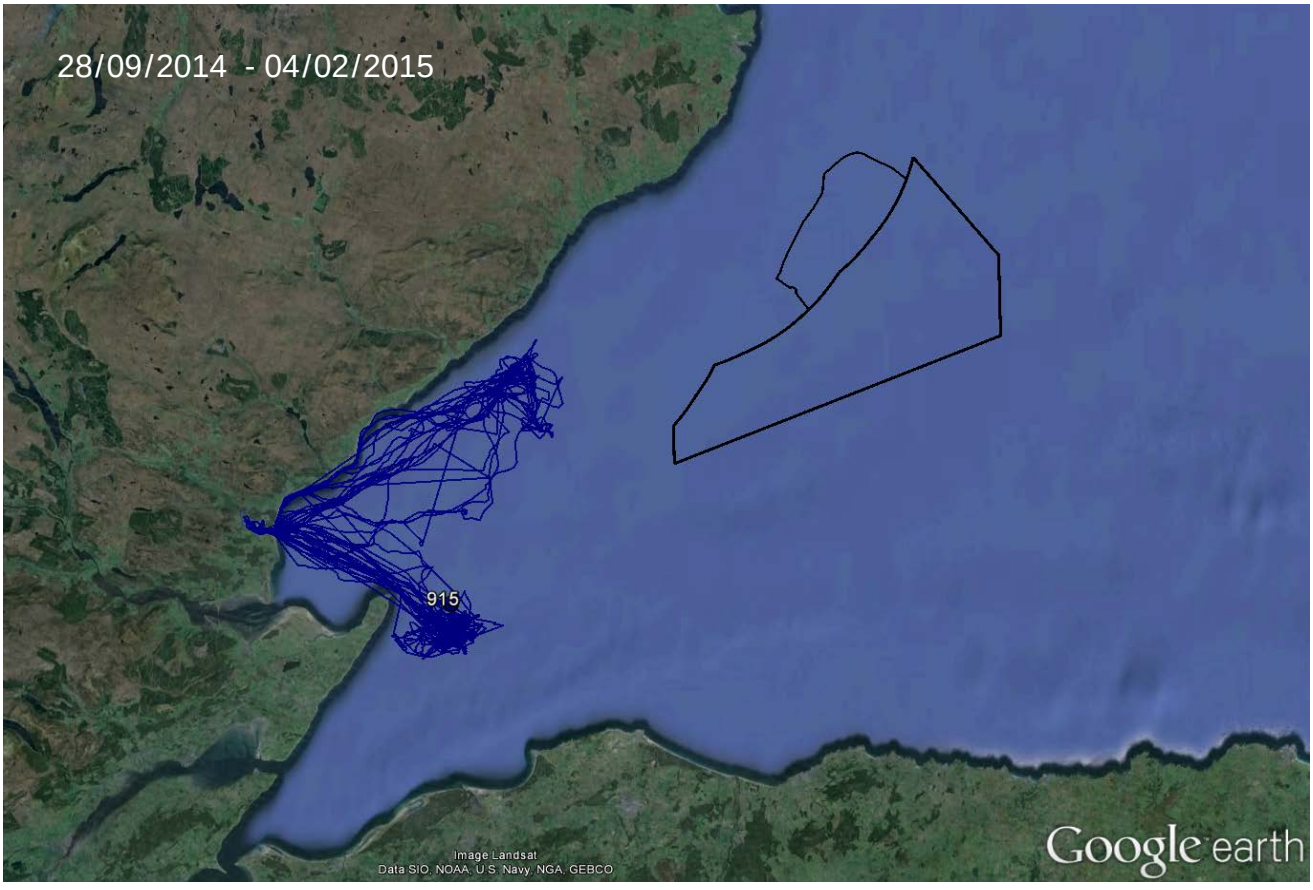
Best Right (2013)

Best Left (2013)

Capture Information

Date captured	28/09/2014
Location	Loch Fleet - SB2
Weight	85.9 kg
Length	148.5 cm
Girth	97.0 cm
Sex	Female
Flipper tag #	00518
GPS/GSM tag attached	Yes
GPS/GSM tag #	12915

Latest GPS Tracks



Seal ID # 042

Vital Stats

- Adult
- Female
- First seen 2006
- Breeding female
- 9 pups
- 14/04/2009 - captured at Loch Fleet and fitted with GPS tag


2014

Sightings and Pupping History

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Seen	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pup	✓	✓	✓	✓	✓	✓	✓	✓	✓	-

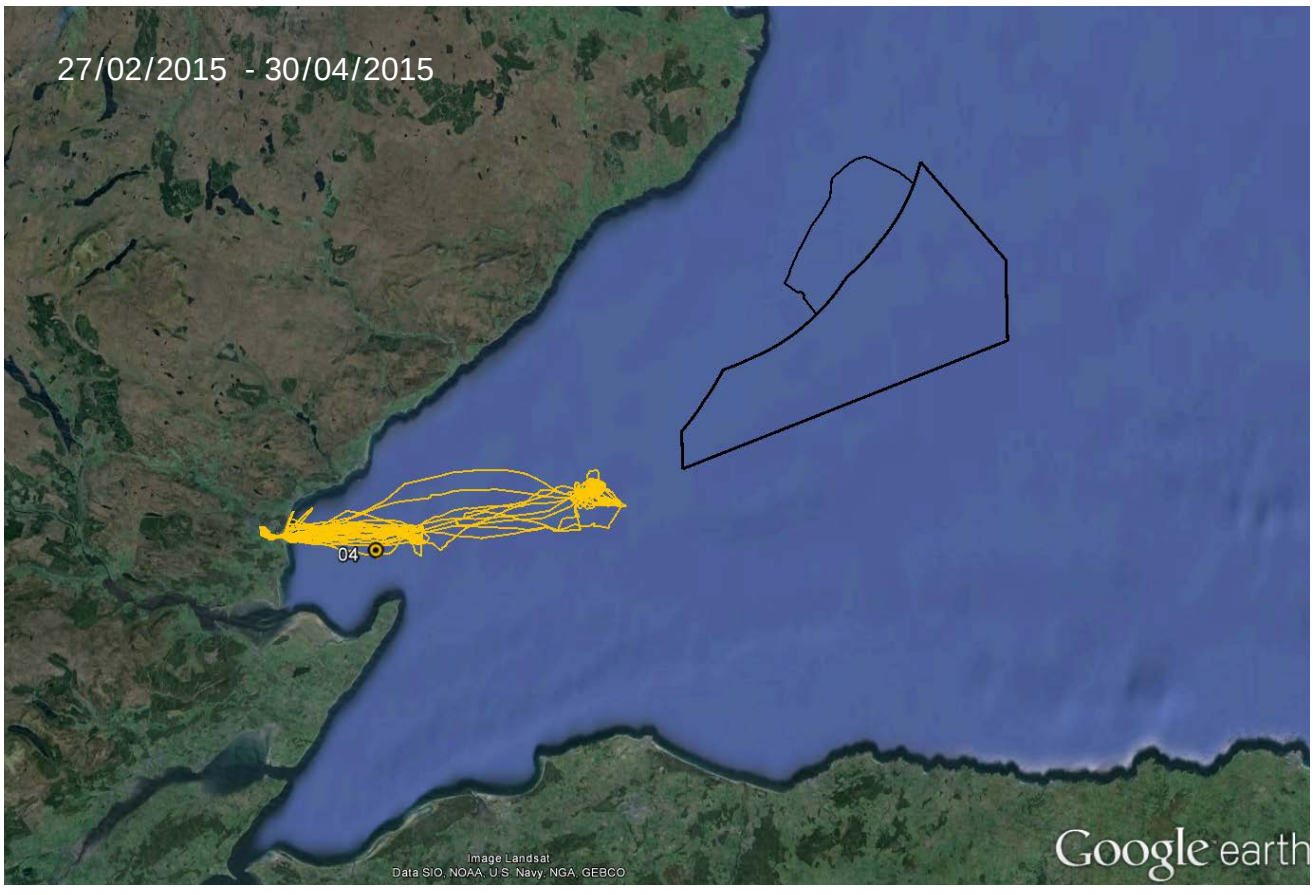
Best Right (2014)

Best Left (2014)

Capture Information

Date captured	27/02/2015
Location	Loch Fleet - SB2
Weight	83.2 kg
Length	144.0 cm
Girth	107.0 cm
Sex	Female
Flipper tag #	00558
GPS/GSM tag attached	Yes
GPS/GSM tag #	13120

Latest GPS Tracks



Seal ID # 076

Vital Stats

- Adult
- Female
- First seen 2006
- Breeding female
- 4 pups
- 19/09/2008 - captured at Loch Fleet and fitted with RFID tag

Sightings and Pupping History

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Seen	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pup	✗	✗	✓	✗	✓	✓	✗	✓	✗	-

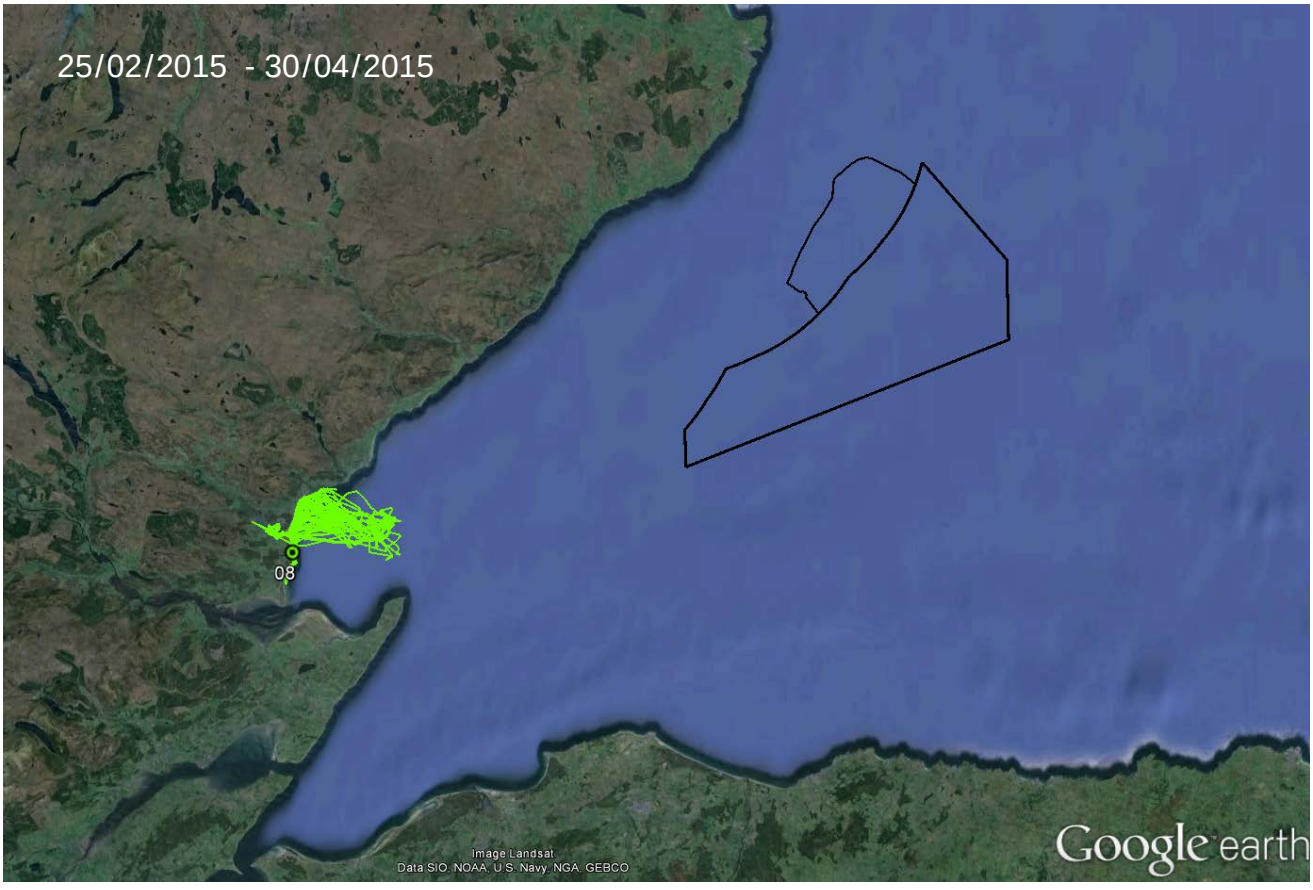
Best Right (2014)

Best Left (2014)

Capture Information

Date captured	25/02/2015
Location	Loch Fleet - SB2
Weight	71.7 kg
Length	135.0 cm
Girth	100.0 cm
Sex	Female
Flipper tag #	00554
GPS/GSM tag attached	Yes
GPS/GSM tag #	13314

Latest GPS Tracks



Seal ID # 105

Vital Stats

- Adult
- Female
- First seen 2006
- Breeding female
- 7 pups
- Not captured before.


2014

Sightings and Pupping History

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Seen	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pup	✗	✗	✓	✓	✓	✓	✓	✓	✓	-

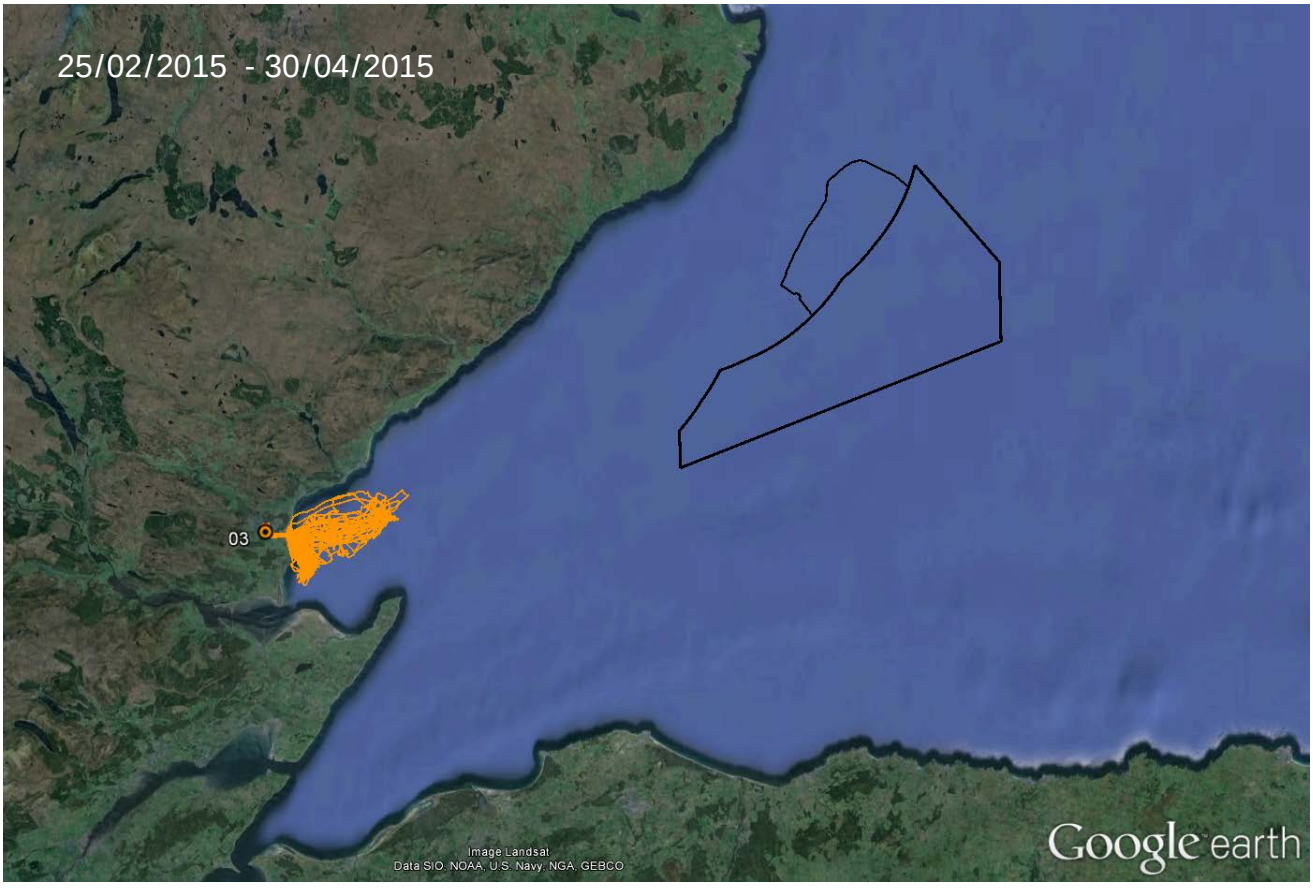
Best Right (2014)

Best Left (2014)

Capture Information

Date captured	25/02/2015
Location	Loch Fleet - SB2
Weight	86.3 kg
Length	139.0 cm
Girth	111.0 cm
Sex	Female
Flipper tag #	00545
GPS/GSM tag attached	Yes
GPS/GSM tag #	13203

Latest GPS Tracks



Seal ID # 127

Vital Stats

- Adult
- Female
- First seen 2006
- Breeding female
- 7 pups
- Not captured before

Sightings and Pupping History

	2006	2007	2008	2009	2010	2011	2012	2013	2014
Seen	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pup	✓	✗	✓	✗	✓	✓	✓	✓	✓

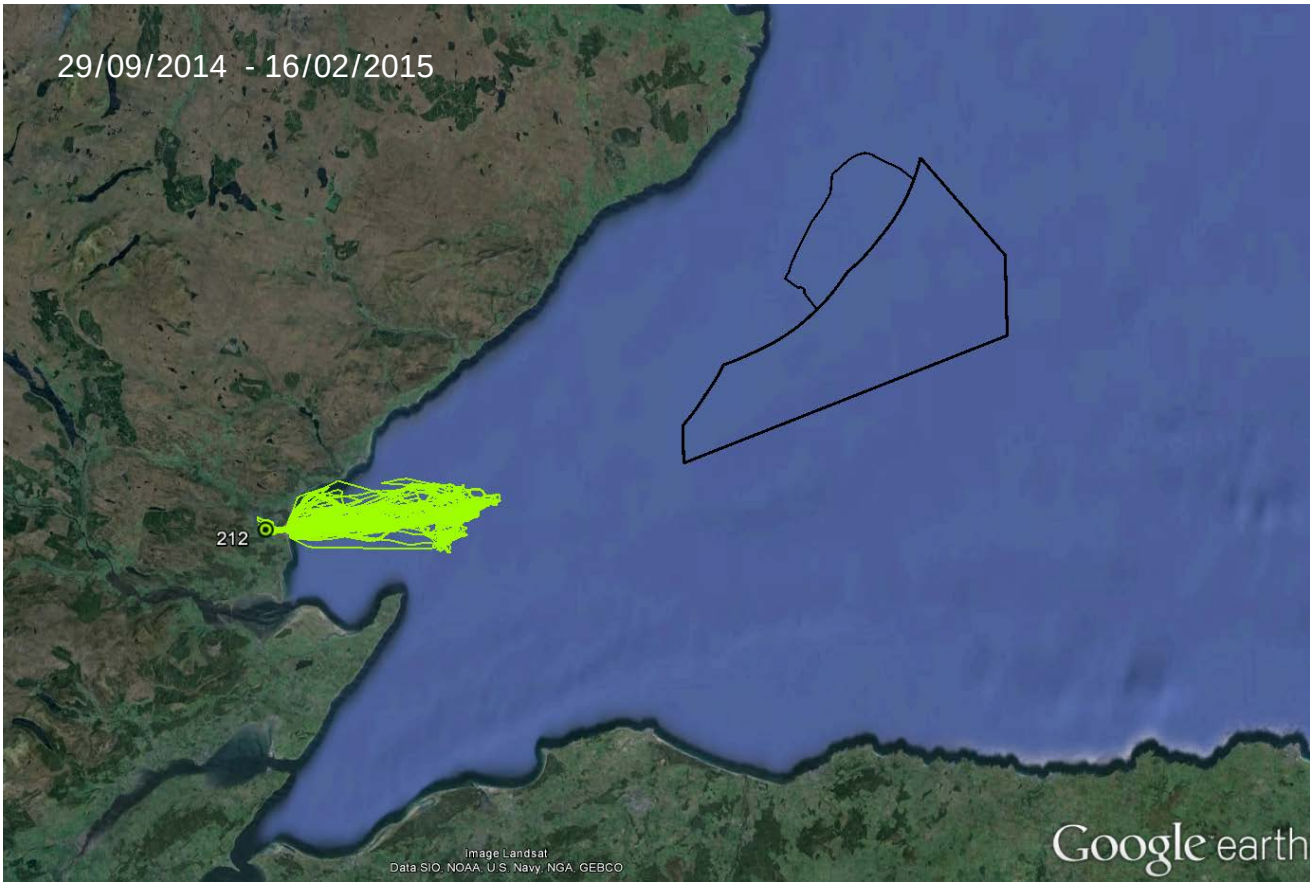
Best Right (2013)

Best Left (2013)

Capture Information

Date captured	29/09/2014
Location	Loch Fleet - SB1
Weight	72.7 kg
Length	143.0 cm
Girth	96.0 cm
Sex	Female
Flipper tag #	00527
GPS/GSM tag attached	Yes
GPS/GSM tag #	13212

Latest GPS Tracks



Seal ID # 158

Vital Stats

- Adult
- Female
- First seen 2006
- Breeding female
- 5 pups
- 18/09/2008 - captured at Loch Fleet and fitted with RFID tag

Sightings and Pupping History

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Seen	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pup	✗	✗	✓	✓	✓	✗	✓	✗	✓	-

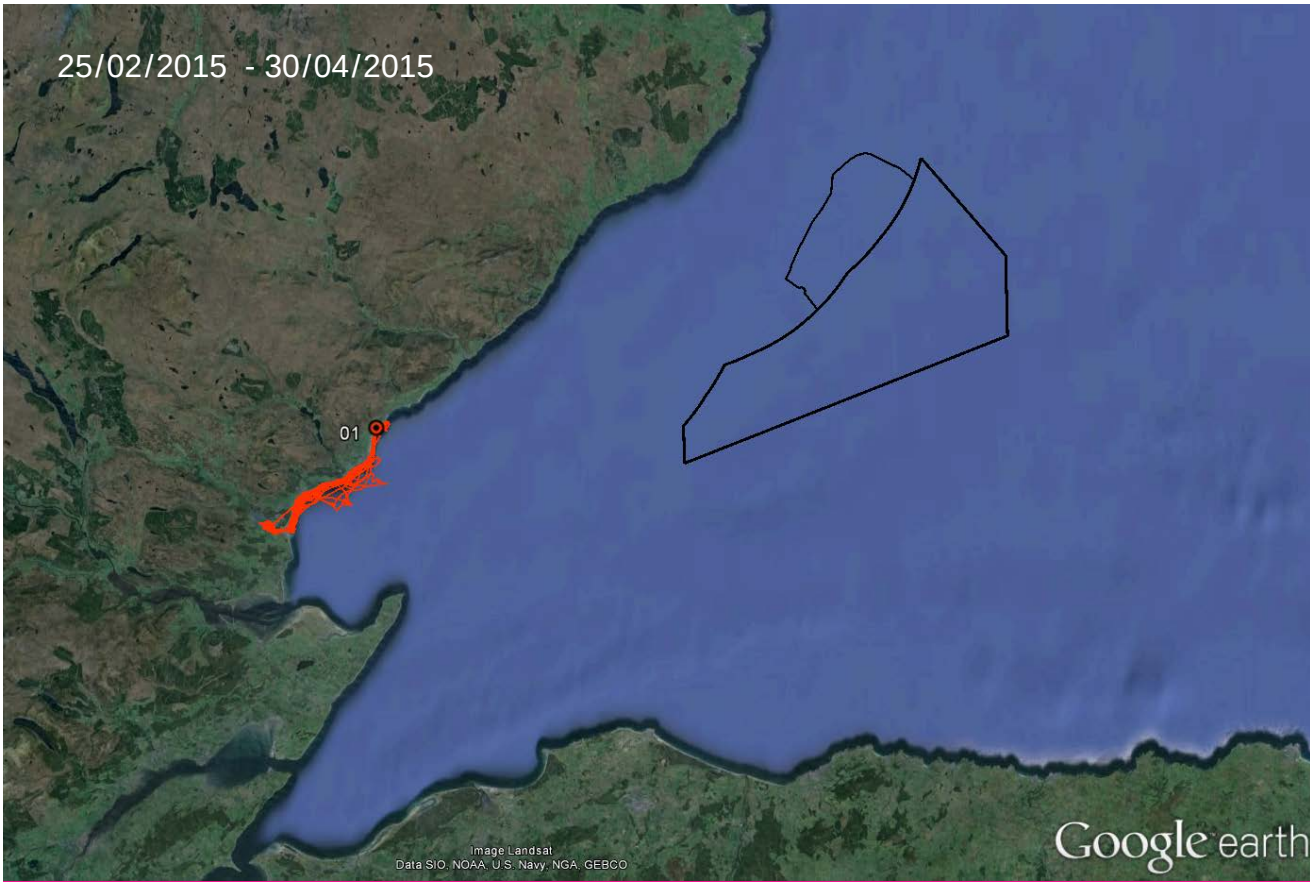
Best Right (2014)

Best Left (2014)

Capture Information

Date captured	25/02/2015
Location	Loch Fleet - SB2
Weight	94.5 kg
Length	145.0 cm
Girth	106.0 cm
Sex	Female
Flipper tag #	00548
GPS/GSM tag attached	Yes
GPS/GSM tag #	13286

Latest GPS Tracks



Seal ID # 242

Vital Stats

- Adult
- Female
- First seen in 2009
- Breeding female
- 3 pups
- Captured as a juvenile in 2009 at Loch Fleet

Sightings and Pupping History

	2006	2007	2008	2009	2010	2011	2012	2013	2014
Seen	✘	✘	✘	✓	✘	✘	✓	✓	✓
Pup	✘	✘	✘	✘	✘	✘	✓	✓	✓

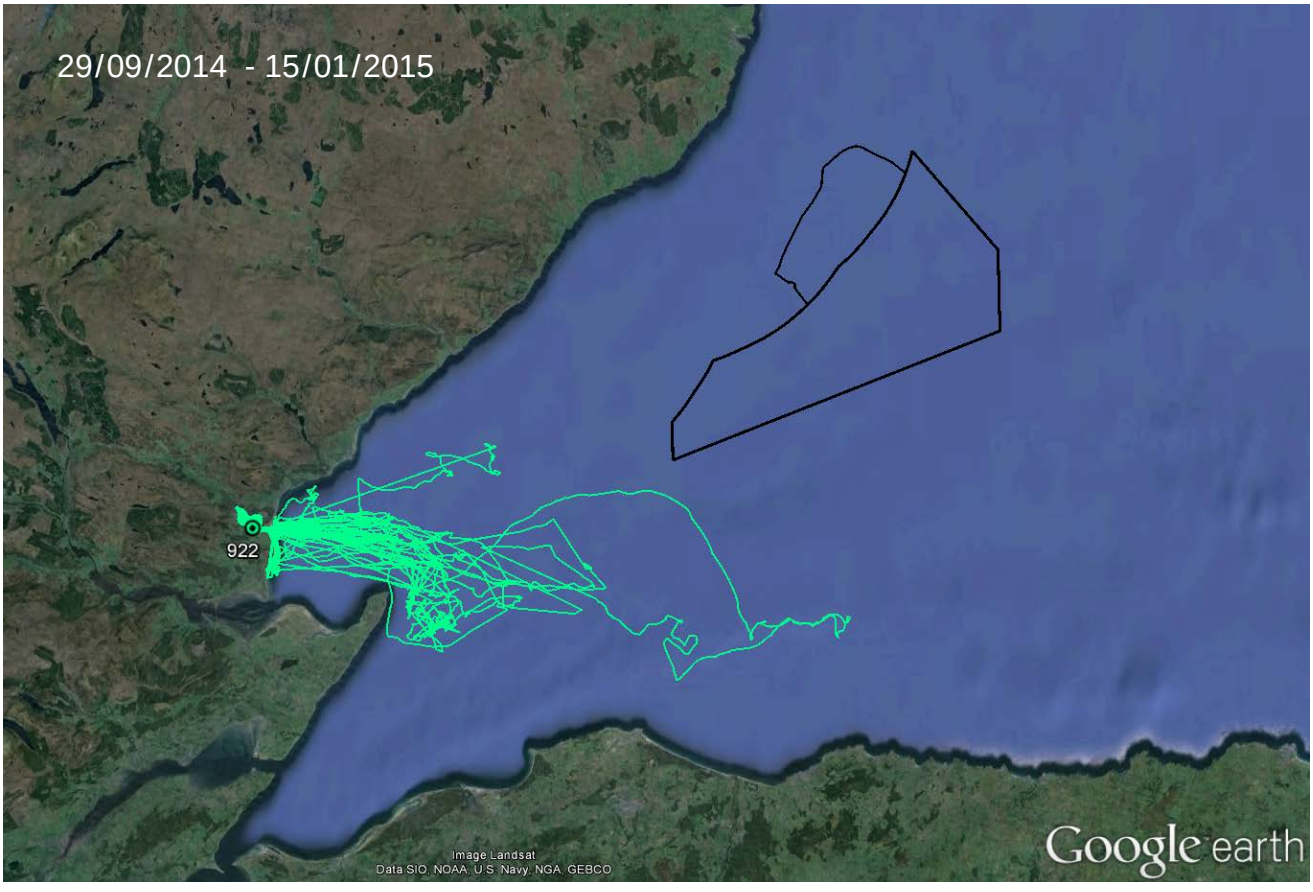
Best Right (2013)

Best Left (2013)

Capture Information

Date captured	29/09/2014
Location	Loch Fleet - SB1
Weight	65.7 kg
Length	130.0 cm
Girth	97.5 cm
Sex	Female
Flipper tag #	00528
GPS/GSM tag attached	Yes
GPS/GSM tag #	12922

Latest GPS Tracks



Seal ID # 253

Vital Stats

- Adult
- Female
- First seen 2012
- Never seen with a pup
- Not captured before

Sightings and Pupping History

	2006	2007	2008	2009	2010	2011	2012	2013	2014
Seen	✘	✘	✘	✘	✘	✘	✓	✓	✓
Pup	✘	✘	✘	✘	✘	✘	✘	✘	✘

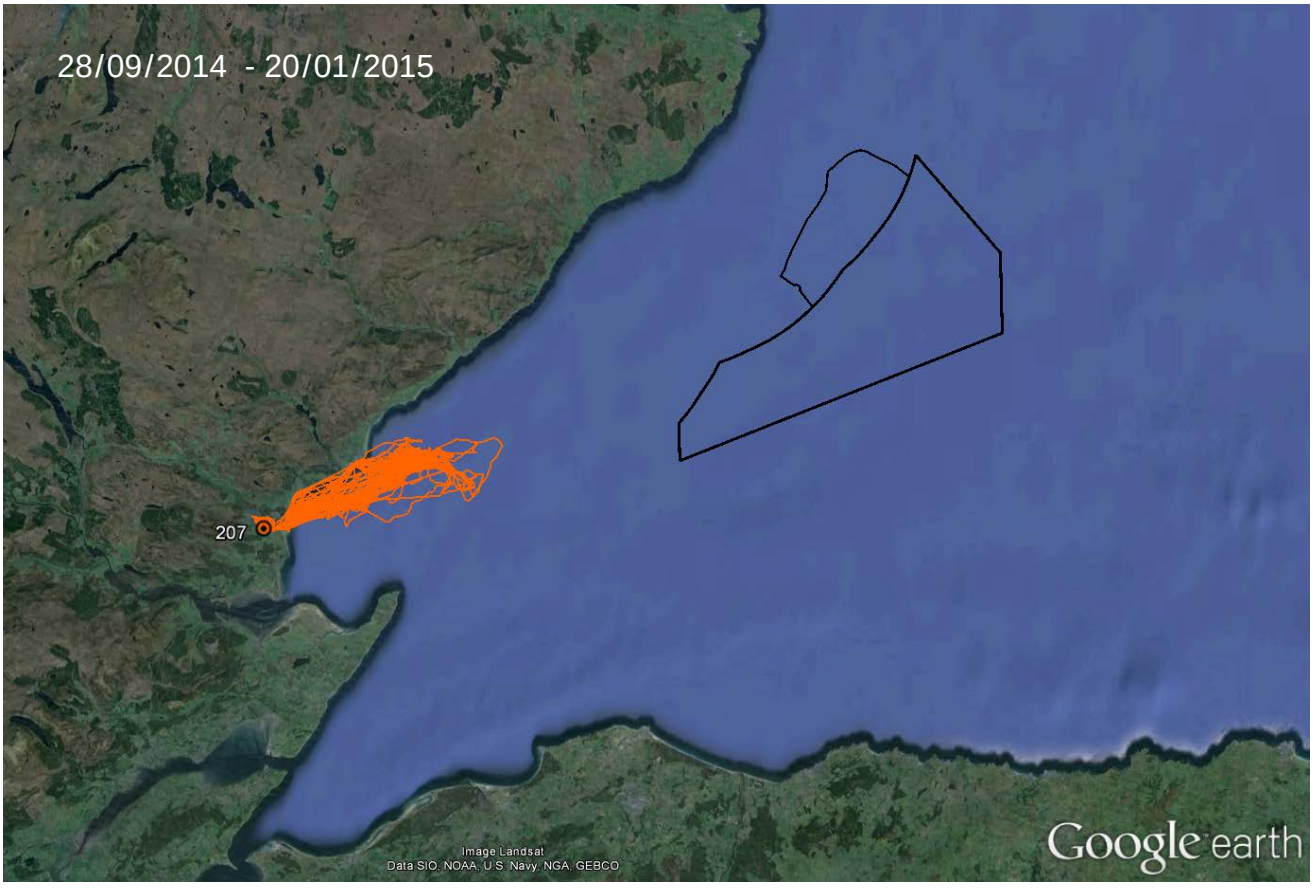
Best Right (2013)

Best Left (2013)

Capture Information

Date captured	28/09/2014
Location	Loch Fleet - SB2
Weight	64.7 kg
Length	135.0 cm
Girth	100.0 cm
Sex	Female
Flipper tag #	00522
GPS/GSM tag attached	Yes
GPS/GSM tag #	13207

Latest GPS Tracks



Seal ID # 294

Vital Stats

- Adult
- Female
- First seen 2012
- Never seen with a pup
- Not captured before

Sightings and Pupping History

	2006	2007	2008	2009	2010	2011	2012	2013	2014
Seen	✘	✘	✘	✘	✘	✘	✓	✓	✓
Pup	✘	✘	✘	✘	✘	✘	✘	✘	✘

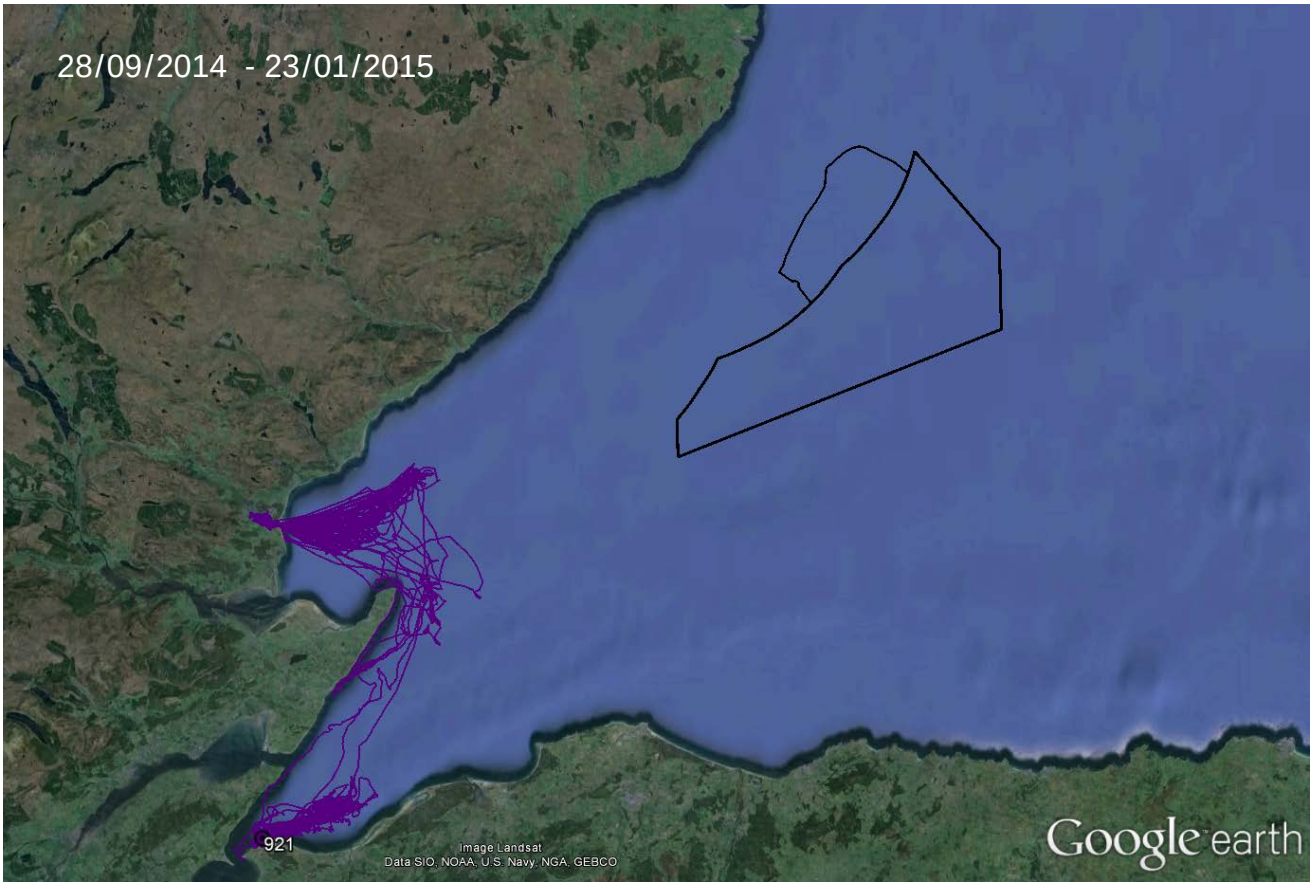
Best Right (2013)

Best Left (2013)

Capture Information

Date captured	28/09/2014
Location	Loch Fleet -SB2
Weight	60.5 kg
Length	130.0 cm
Girth	98.0 cm
Sex	Female
Flipper tag #	00523
GPS/GSM tag attached	Yes
GPS/GSM tag #	12921

Latest GPS Tracks



Seal ID # 317

Vital Stats

- Adult
- Female
- First seen 2013
- Never seen with a pup
- Not captured before

Sightings and Pupping History

	2006	2007	2008	2009	2010	2011	2012	2013	2014
Seen	✘	✘	✘	✘	✘	✘	✘	✓	✓
Pup	✘	✘	✘	✘	✘	✘	✘	✘	✘

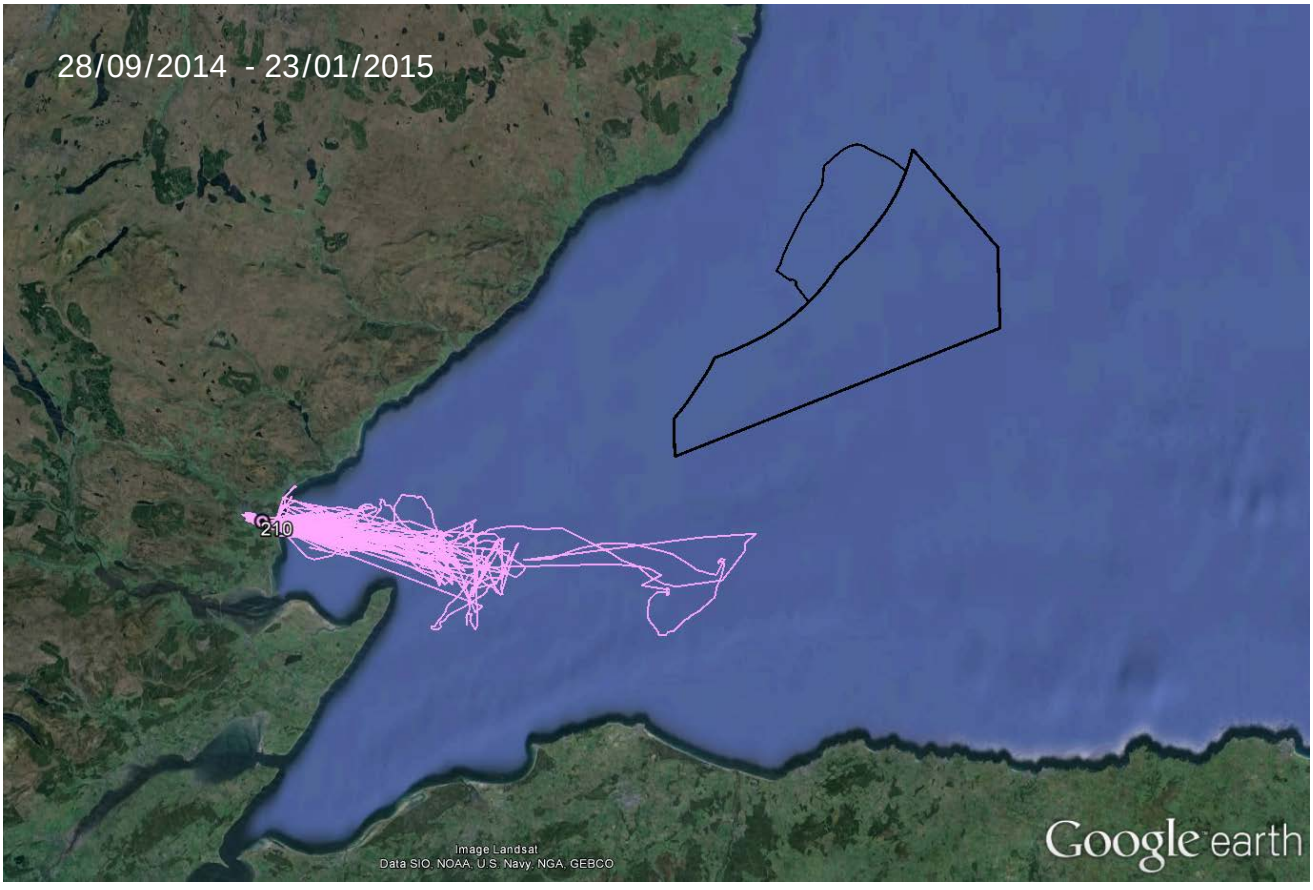
Best Right (2013)

Best Left (2013)

Capture Information

Date captured	28/09/2014
Location	Loch Fleet -SB2
Weight	55.5 kg
Length	132.6 cm
Girth	90.0 cm
Sex	Female
Flipper tag #	00520
GPS/GSM tag attached	Yes
GPS/GSM tag #	13210

Latest GPS Tracks



Seal ID # 341

Vital Stats

- Adult
- Female
- First seen 2014
- Never seen with a pup
- Not captured before

Sightings and Pupping History

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Seen	✘	✘	✘	✘	✘	✘	✘	✘	✓	✓
Pup	✘	✘	✘	✘	✘	✘	✘	✘	✘	-

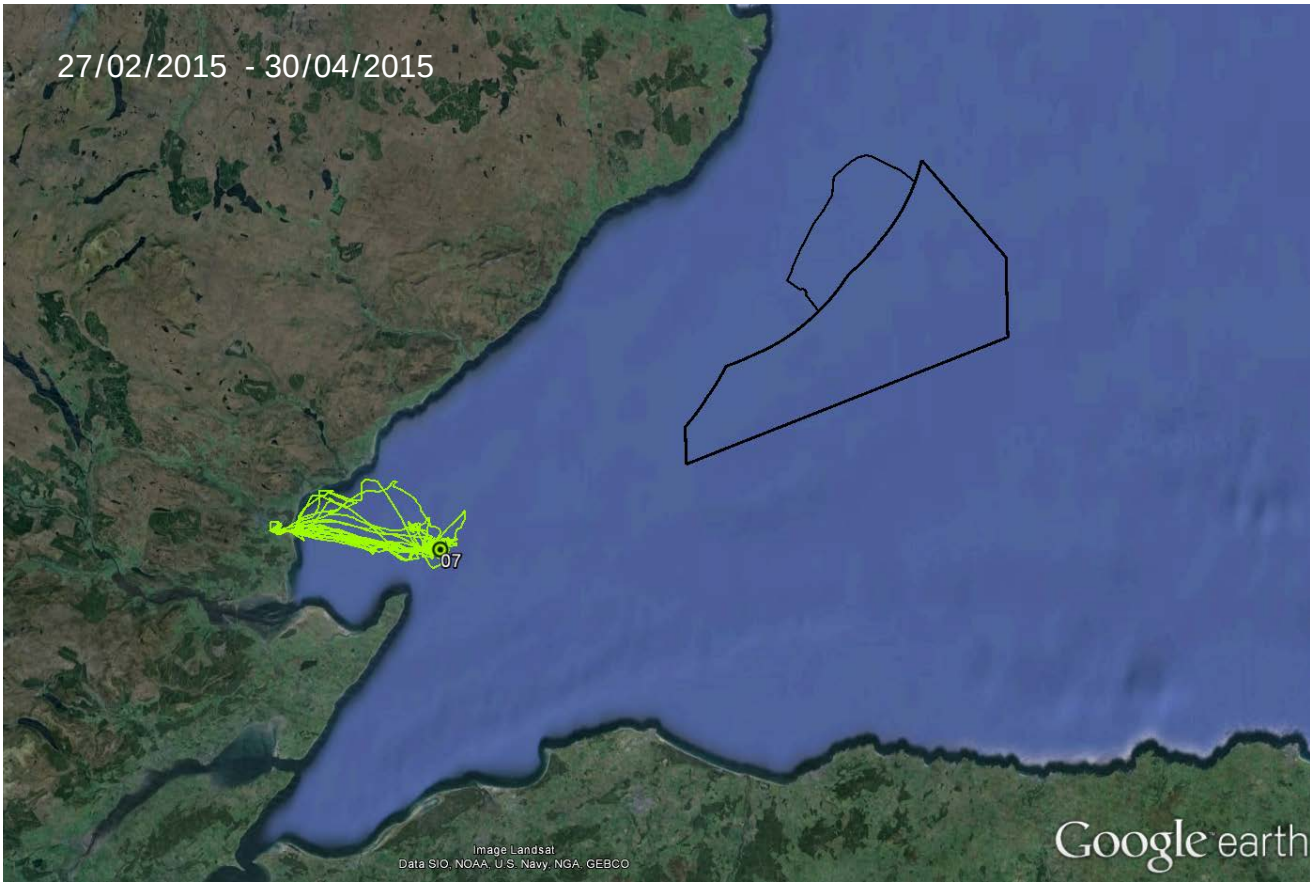
Best Right (2014)

Best Left (2014)

Capture Information

Date captured	27/02/2015
Location	Loch Fleet - SB2
Weight	73.1 kg
Length	141.0 cm
Girth	108.0 cm
Sex	Female
Flipper tag #	00550
GPS/GSM tag attached	Yes
GPS/GSM tag #	13318

Latest GPS Tracks



Seal ID # 383

Vital Stats

- Adult
- Female
- No ID before capture
- Not captured before

Sightings and Pupping History

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Seen	✘	✘	✘	✘	✘	✘	✘	✘	✘	✓
Pup	✘	✘	✘	✘	✘	✘	✘	✘	✘	-

Best Right

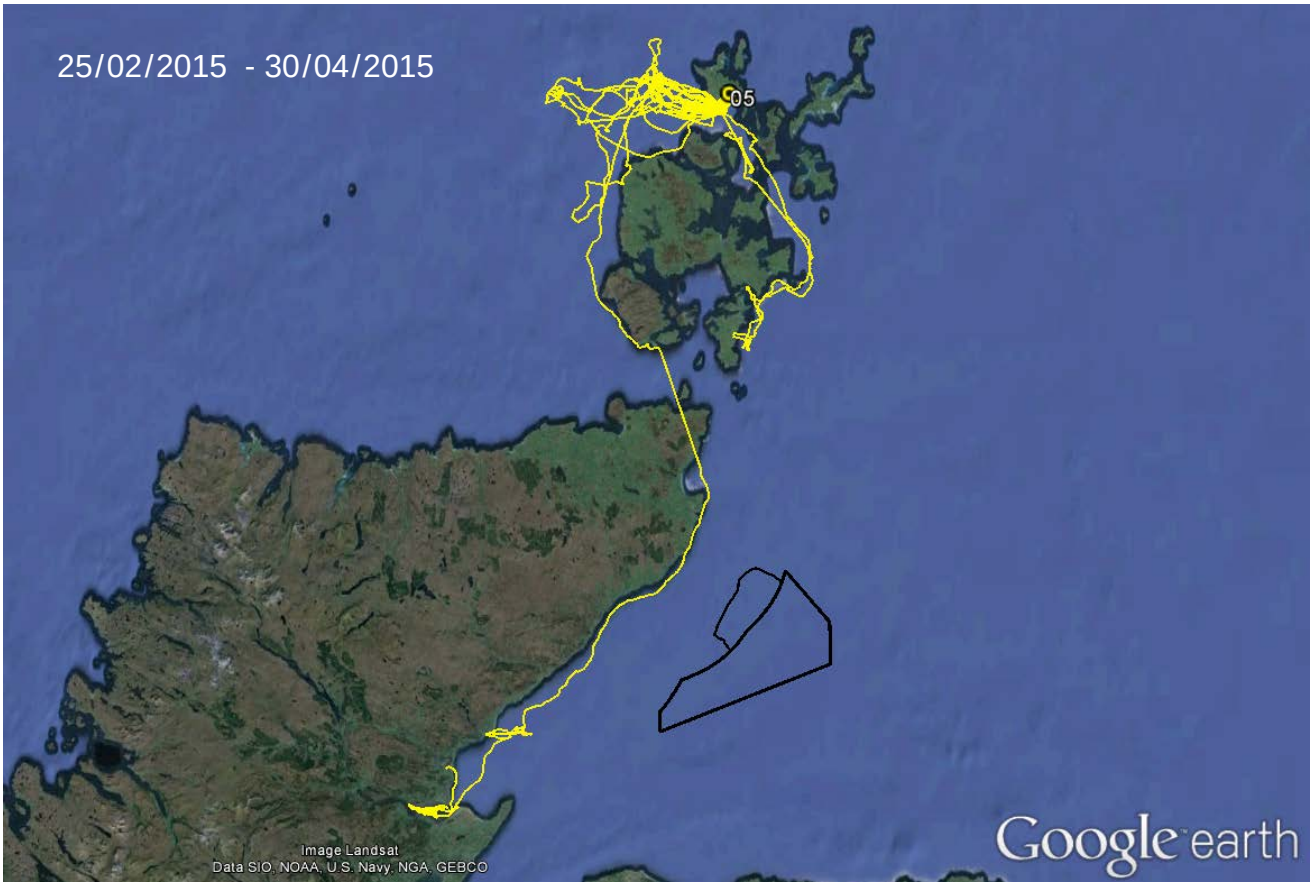
Best Left

- Before capture this seal had no ID number.

Capture Information

Date captured	25/02/2015
Location	Loch Fleet - SB2
Weight	89.7 kg
Length	144.0 cm
Girth	103.0 cm
Sex	Female
Flipper tag #	00531
GPS/GSM tag attached	Yes
GPS/GSM tag #	13322

Latest GPS Tracks



Seal ID # 384

Vital Stats

- Adult
- Female
- No ID before capture
- Not captured before

Sightings and Pupping History

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Seen	✘	✘	✘	✘	✘	✘	✘	✘	✘	✓
Pup	✘	✘	✘	✘	✘	✘	✘	✘	✘	-

Best Right

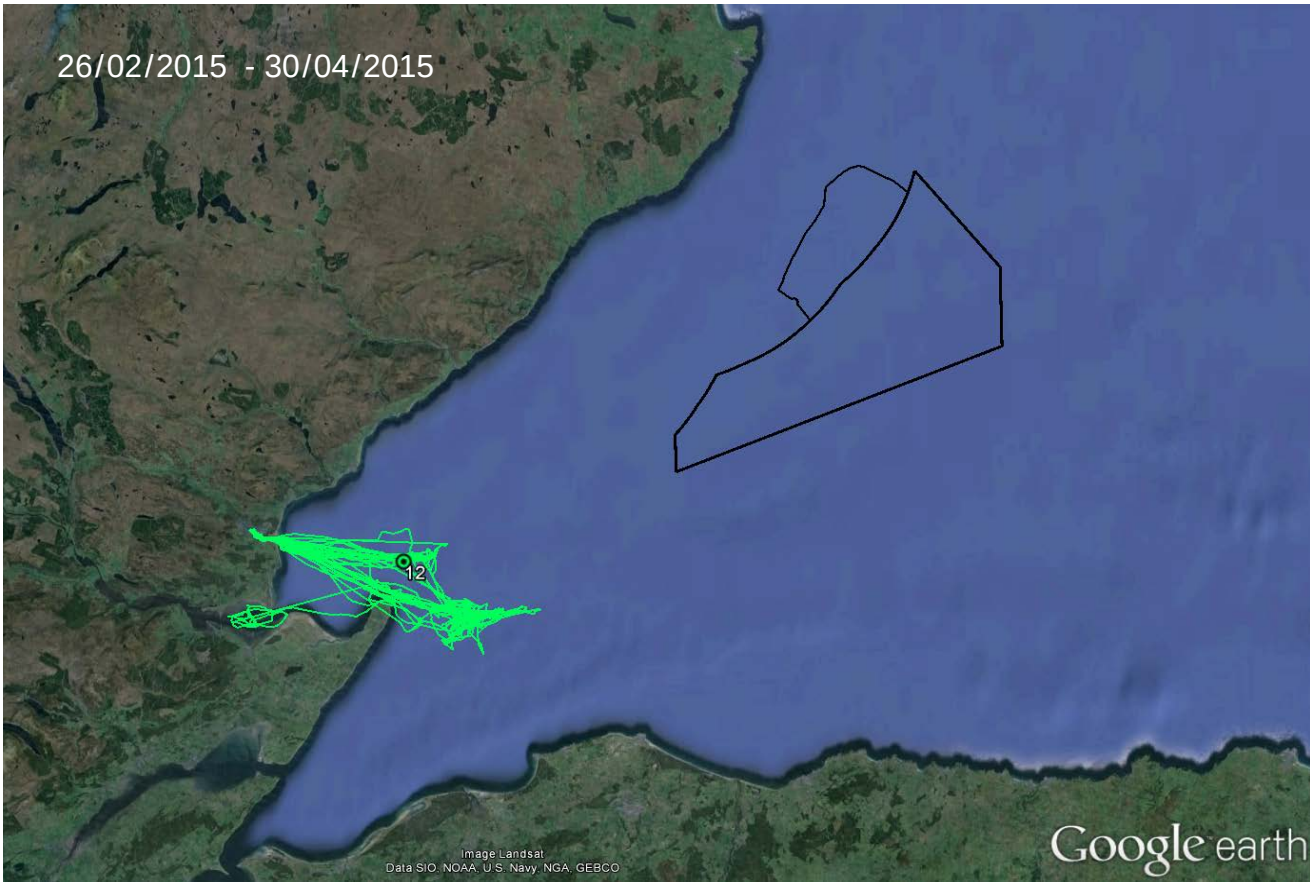
Best Left

- Before capture this seal had no ID number.

Capture Information

Date captured	26/02/2015
Location	Loch Fleet - SB2
Weight	94.0 kg
Length	143.0 cm
Girth	112.0 cm
Sex	Female
Flipper tag #	00555
GPS/GSM tag attached	Yes
GPS/GSM tag #	13320

Latest GPS Tracks



Seal ID # 072

Vital Stats

- Adult
- Male
- First seen 2006
- Not captured before

Sightings History

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Seen	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

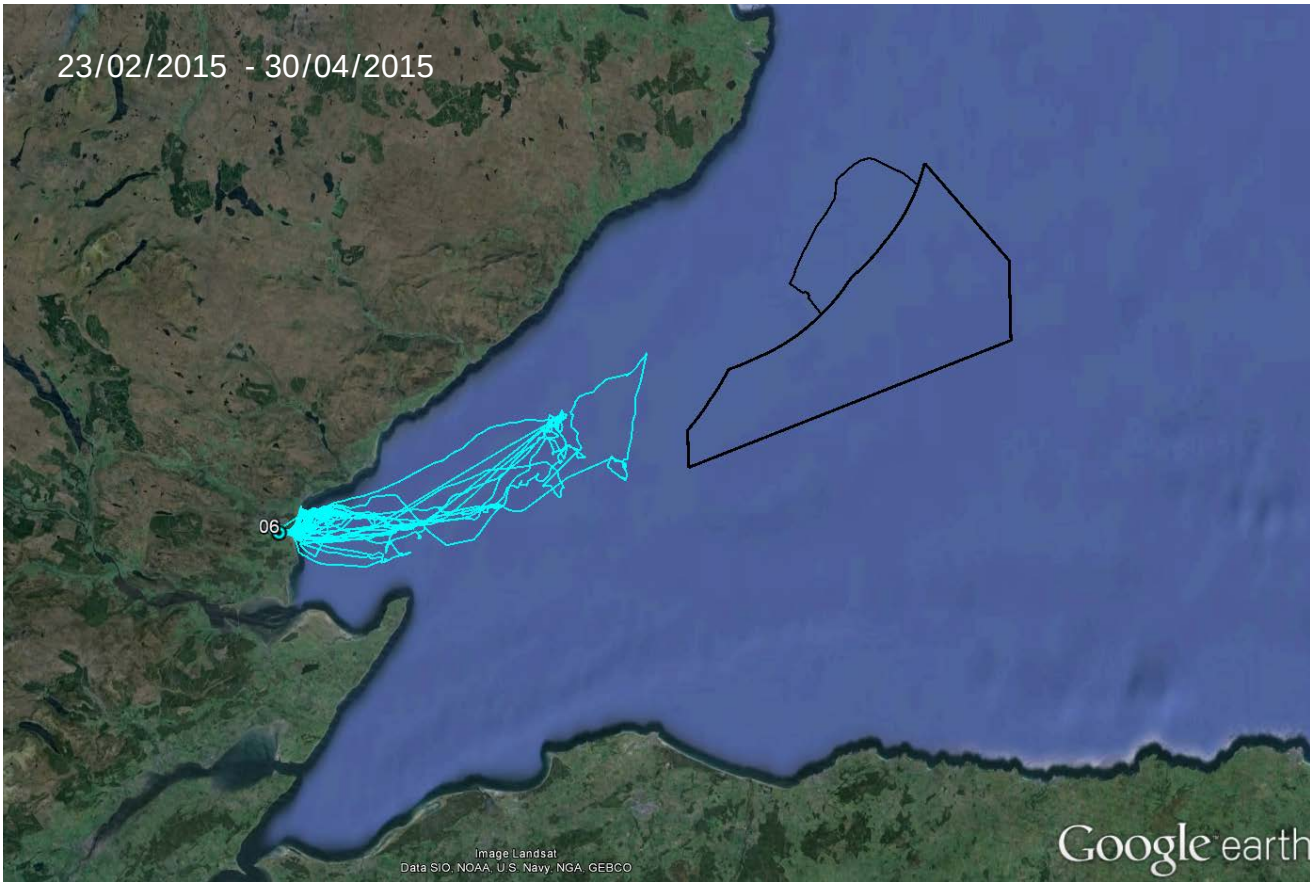
Best Right (2014)

Best Left (2014)

Capture Information

Date captured	23/02/2015
Location	Loch Fleet - SB2
Weight	83.4 kg
Length	142.0 cm
Girth	111.0 cm
Sex	Male
Flipper tag #	00544
GPS/GSM tag attached	Yes
GPS/GSM tag #	13282

Latest GPS Tracks



Seal ID # 090

Vital Stats

- Adult
- Male
- First seen 2006
- Captured in May 2014 by SMRU at Ardersier, Moray Firth

Sightings History

	2006	2007	2008	2009	2010	2011	2012	2013	2014
Seen	✓	✓	✓	✓	✓	✓	✓	✗	✓

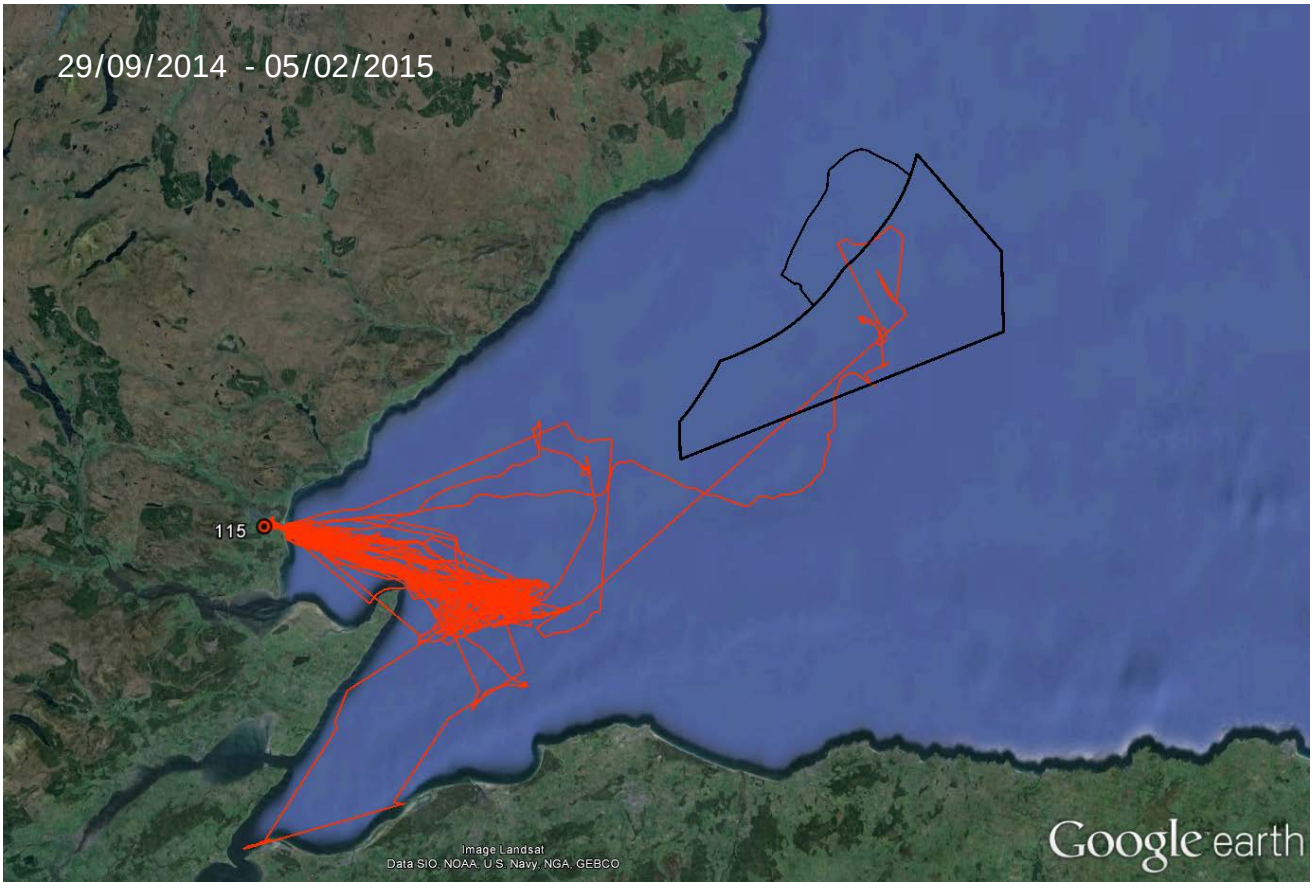
Best Right (2014)

Best Left (2014)

Capture Information

Date captured	29/09/2014
Location	Loch Fleet - SB1
Weight	72.3 kg
Length	142.0 cm
Girth	102.0 cm
Sex	Male
Flipper tag #	00503
GPS/GSM tag attached	Yes
GPS/GSM tag #	13115

Latest GPS Tracks



Seal ID # 099

Vital Stats

- Adult
- Male
- First seen 2006
- Not captured before

Sightings History

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Seen	✓	✓	✓	✓	✓	✗	✗	✗	✓	✓

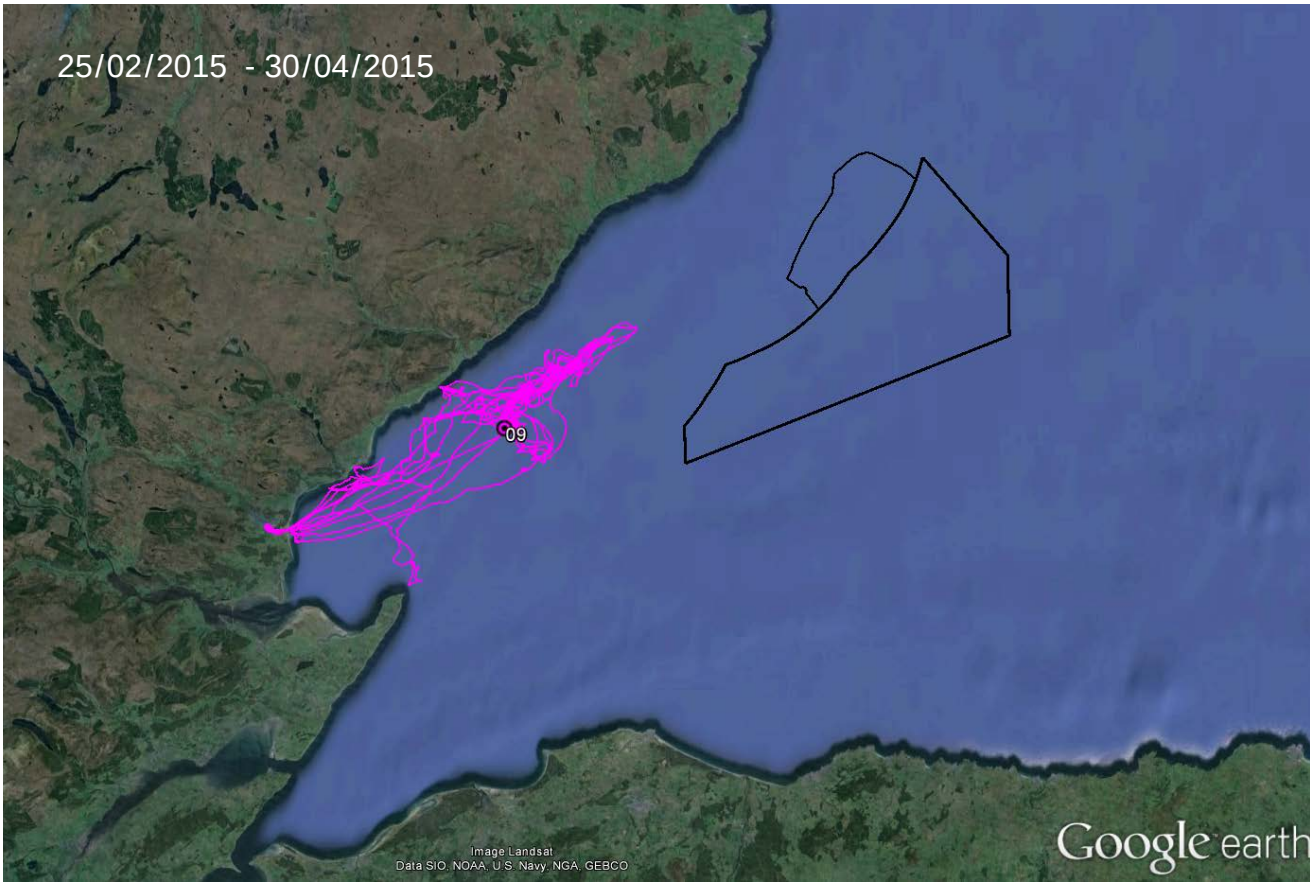
Best Right (2014)

Best Left (2014)

Capture Information

Date captured	25/02/2015
Location	Loch Fleet - SB2
Weight	94.9 kg
Length	154.0 cm
Girth	115.0 cm
Sex	Male
Flipper tag #	00543
GPS/GSM tag attached	Yes
GPS/GSM tag #	13313

Latest GPS Tracks



Seal ID # 230

Vital Stats

- Adult
- Male
- First seen 2009
- Not captured before

Sightings History

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Seen	✘	✘	✘	✓	✘	✓	✓	✓	✓	✓

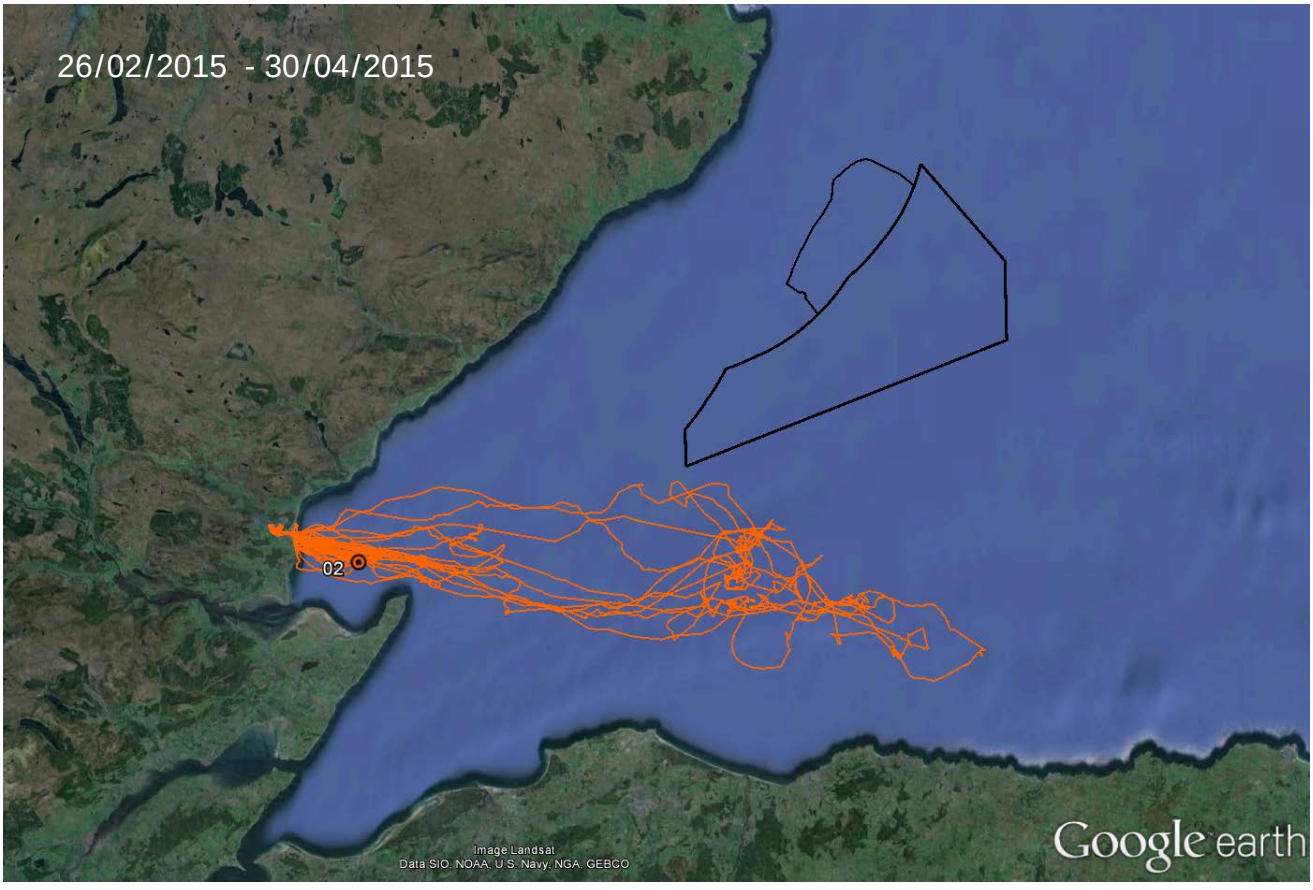
Best Right (2014)

Best Left (2014)

Capture Information

Date captured	26/02/2015
Location	Loch Fleet - SB2
Weight	90.6 kg
Length	149.0 cm
Girth	115.0 cm
Sex	Male
Flipper tag #	00553
GPS/GSM tag attached	Yes
GPS/GSM tag #	13284

Latest GPS Tracks



Seal ID # 260

Vital Stats

- Adult
- Male
- First seen 2012
- Not captured before

Sightings History

	2006	2007	2008	2009	2010	2011	2012	2013	2014
Seen	✘	✘	✘	✘	✘	✘	✓	✓	✓

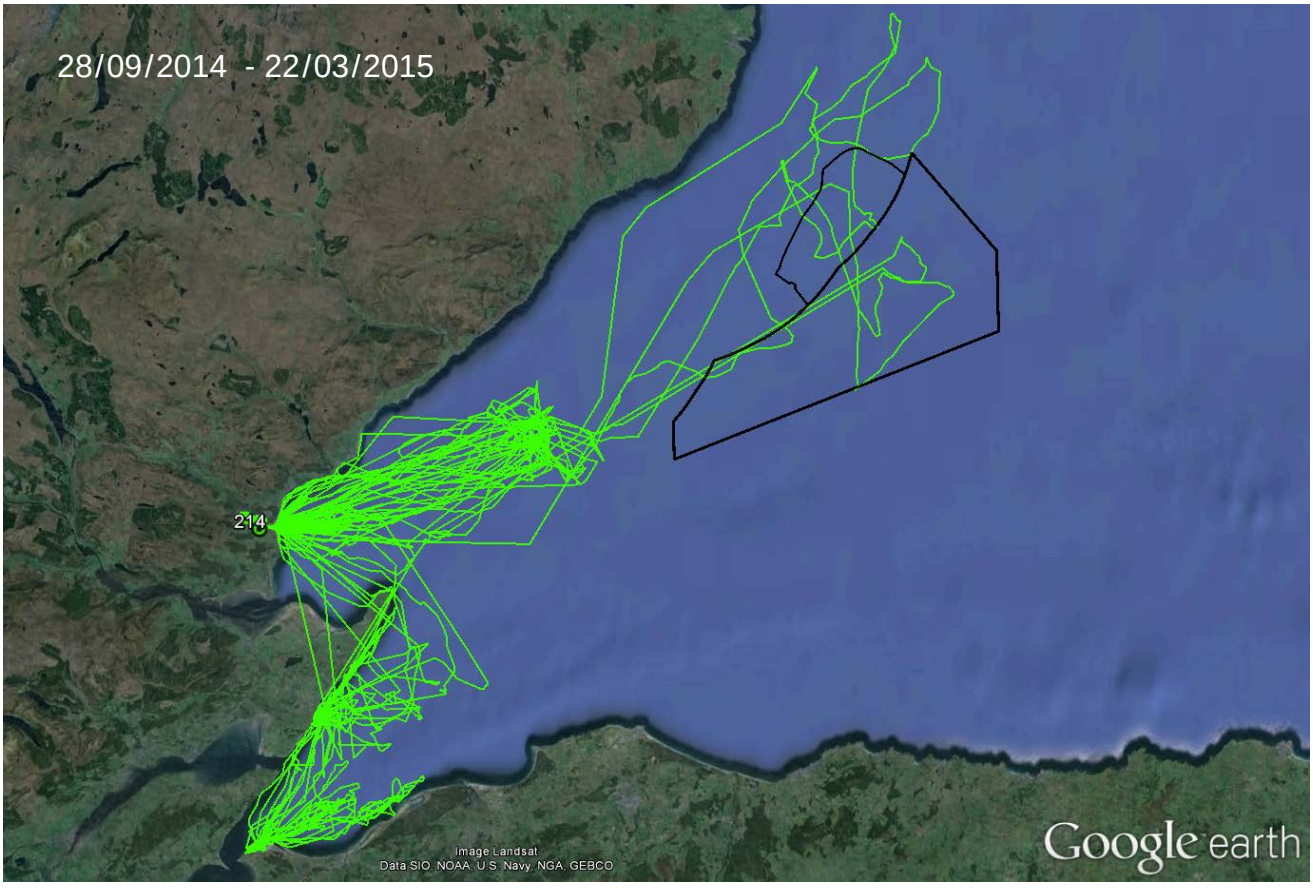
Best Right (2013)

Best Left (2013)

Capture Information

Date captured	28/09/2014
Location	Loch Fleet - SB2
Weight	63.5 kg
Length	133.4 cm
Girth	100.0 cm
Sex	Male
Flipper tag #	00519
GPS/GSM tag attached	Yes
GPS/GSM tag #	13214

Latest GPS Tracks



Seal ID # 264

Vital Stats

- Adult
- Male
- First seen 2012
- Not captured before

Sightings History

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Seen	✘	✘	✘	✘	✘	✘	✓	✓	✓	✓

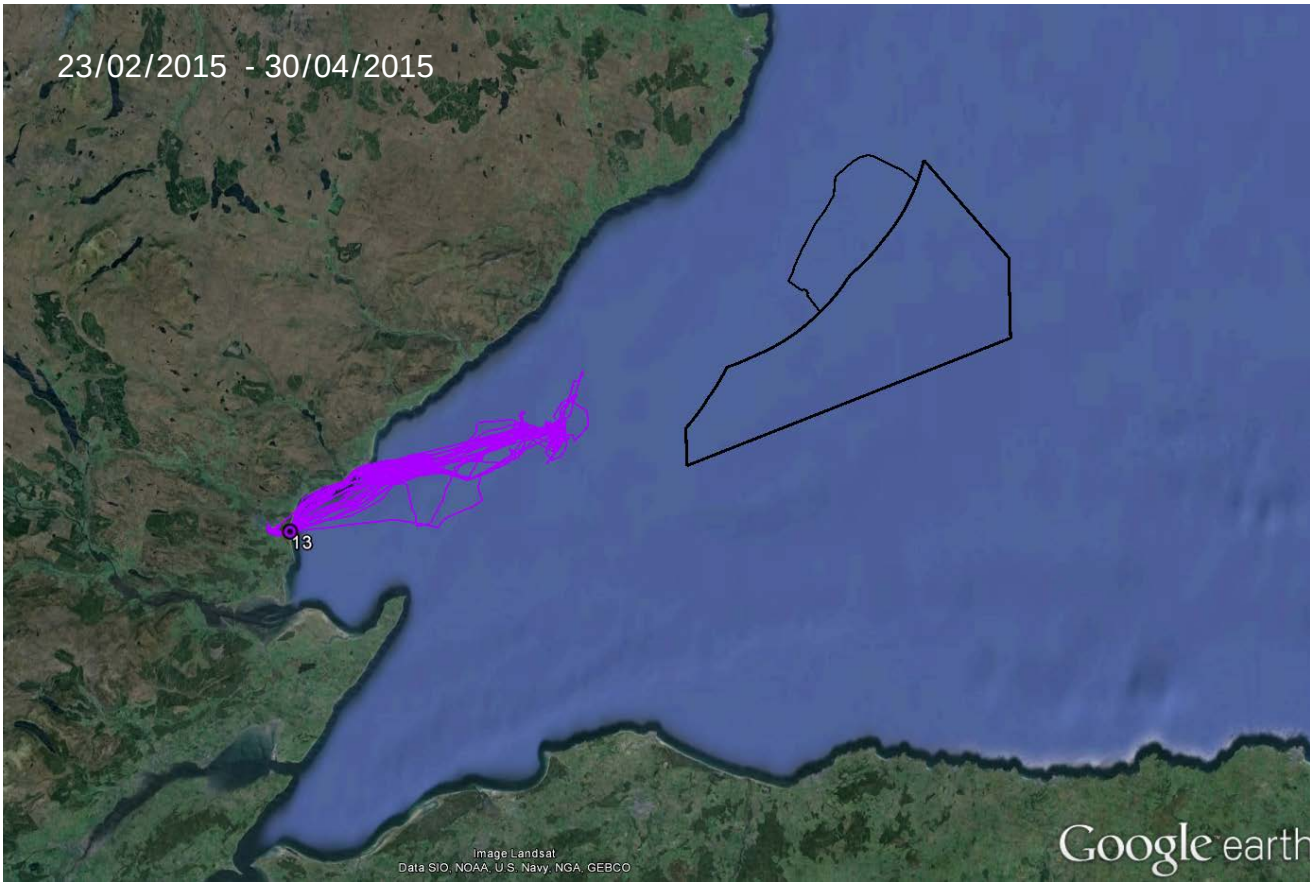
Best Right (2014)

Best Left (2014)

Capture Information

Date captured	23/02/2015
Location	Loch Fleet - SB2
Weight	64.2 kg
Length	140.0 cm
Girth	99.0 cm
Sex	Male
Flipper tag #	00541
GPS/GSM tag attached	Yes
GPS/GSM tag #	13255

Latest GPS Tracks



Seal ID # 267

Vital Stats

- Adult
- Male
- First seen 2012
- Not captured before

Sightings History

	2006	2007	2008	2009	2010	2011	2012	2013	2014
Seen	✘	✘	✘	✘	✘	✘	✓	✓	✓

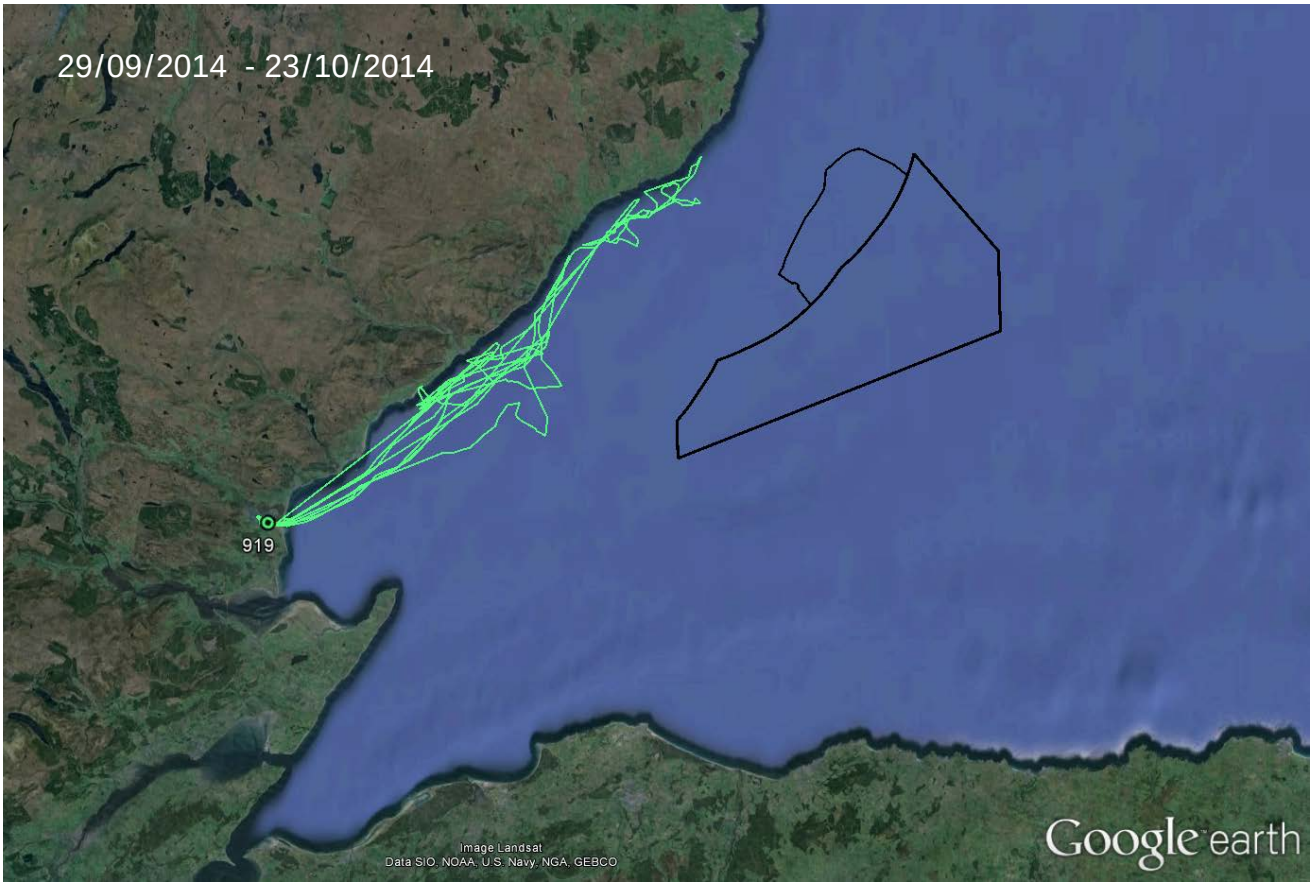
Best Right (2013)

Best Left (2013)

Capture Information

Date captured	29/09/2014
Location	Loch Fleet - SB1
Weight	93.1 kg
Length	137.0 cm
Girth	95.5 cm
Sex	Male
Flipper tag #	00529
GPS/GSM tag attached	Yes
GPS/GSM tag #	12919

Latest GPS Tracks



Seal ID # 270

Vital Stats

- Adult
- Male.
- First seen 2012
- Not captured before

Sightings History

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Seen	✘	✘	✘	✘	✘	✘	✓	✓	✓	✓

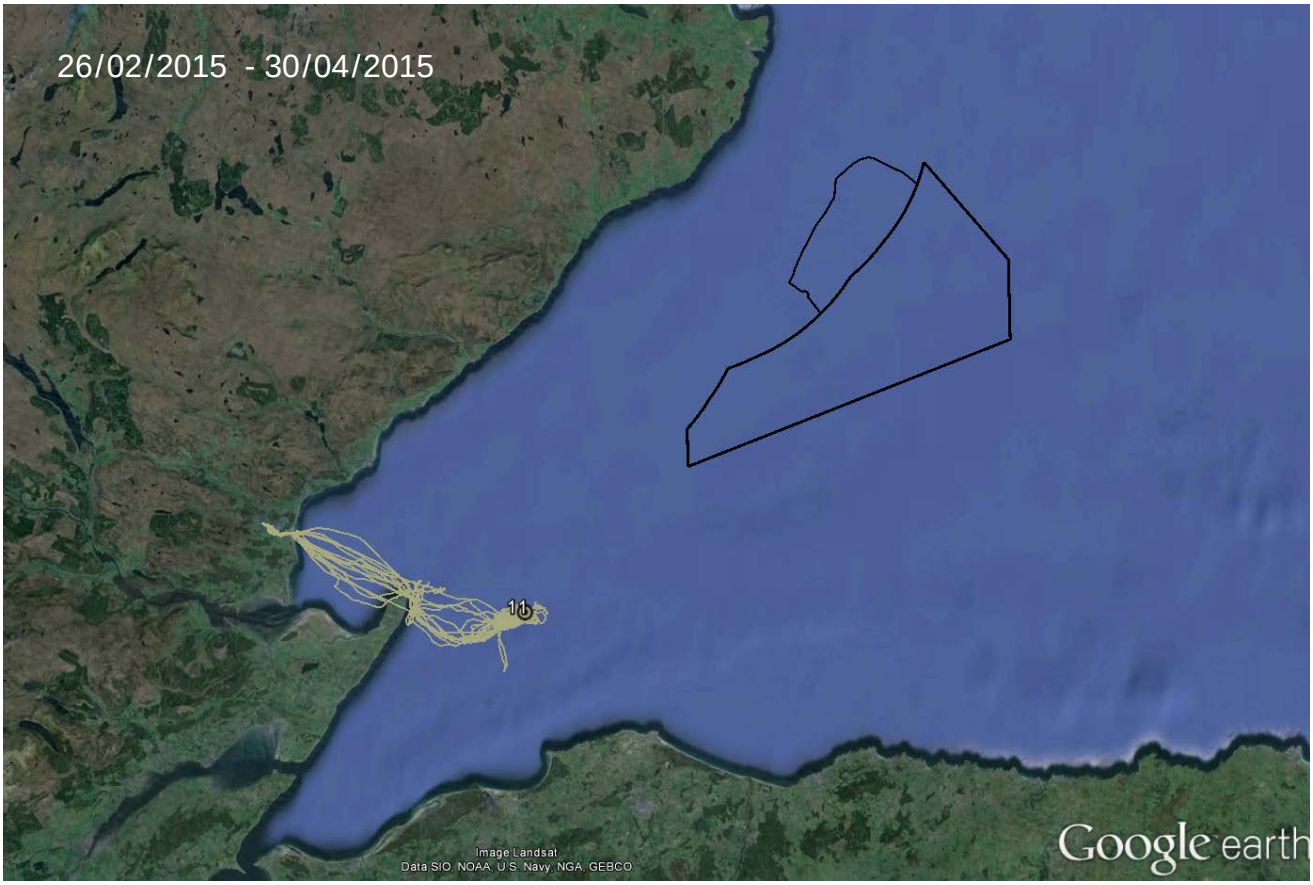
Best Right (2014)

Best Left (2014)

Capture Information

Date captured	26/02/2015
Location	Loch Fleet - SB2
Weight	76.3 kg
Length	142.0 cm
Girth	105.0 cm
Sex	Male
Flipper tag #	00556
GPS/GSM tag attached	Yes
GPS/GSM tag #	13316

Latest GPS Tracks



Seal ID # 274

Vital Stats

- Adult
- Male
- First seen 2012
- Not captured before

Sightings History

	2006	2007	2008	2009	2010	2011	2012	2013	2014
Seen	✘	✘	✘	✘	✘	✘	✓	✓	✓

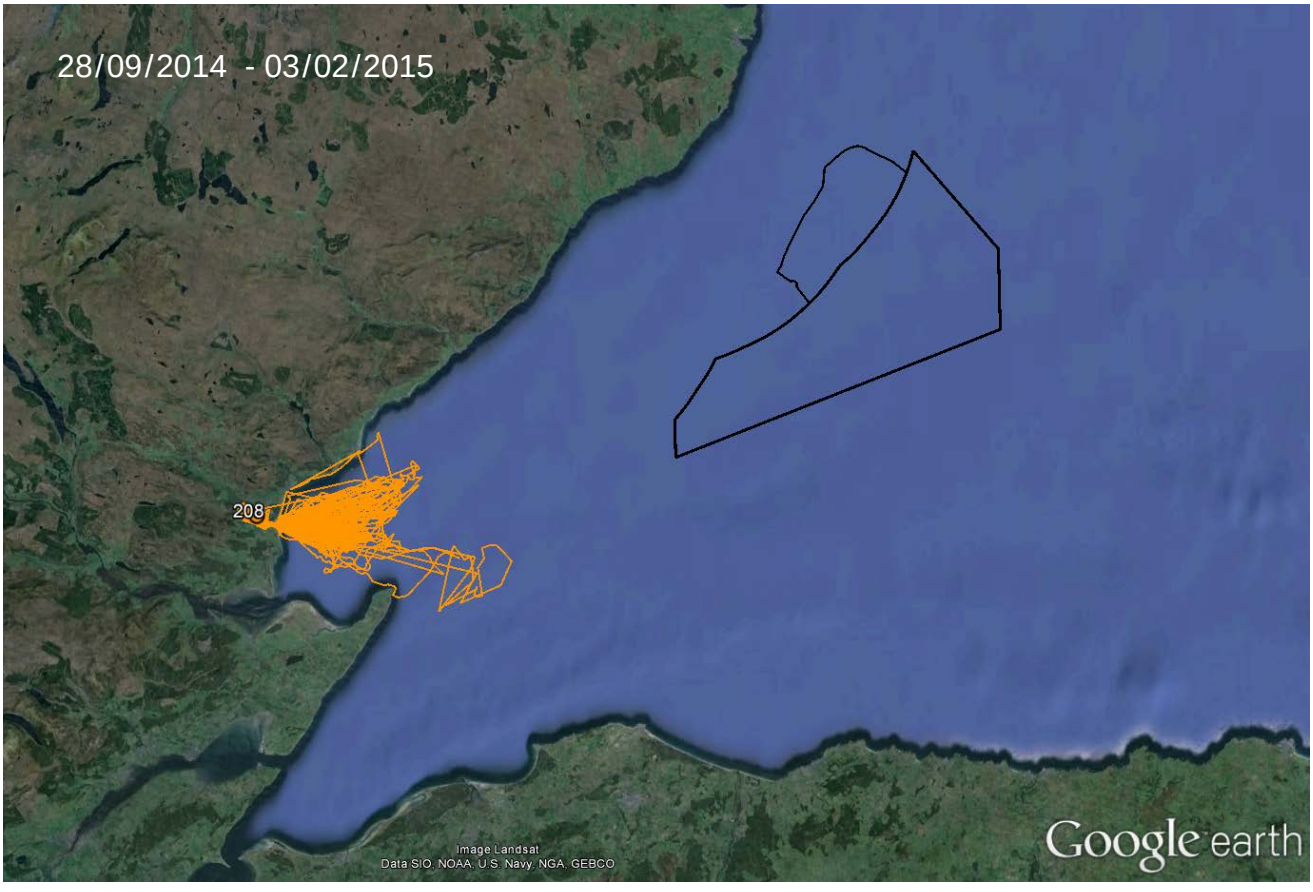
Best Right (2013)

Best Left (2013)

Capture Information

Date captured	28/09/2014
Location	Loch Fleet - SB2
Weight	49.5 kg
Length	129.0 cm
Girth	91.0 cm
Sex	Male
Flipper tag #	00521
GPS/GSM tag attached	Yes
GPS/GSM tag #	13208

Latest GPS Tracks



Seal ID # 307

Vital Stats

- Adult
- Male
- First seen 2013
- Not captured before

Sightings History

	2006	2007	2008	2009	2010	2011	2012	2013	2014
Seen	✘	✘	✘	✘	✘	✘	✘	✓	✓

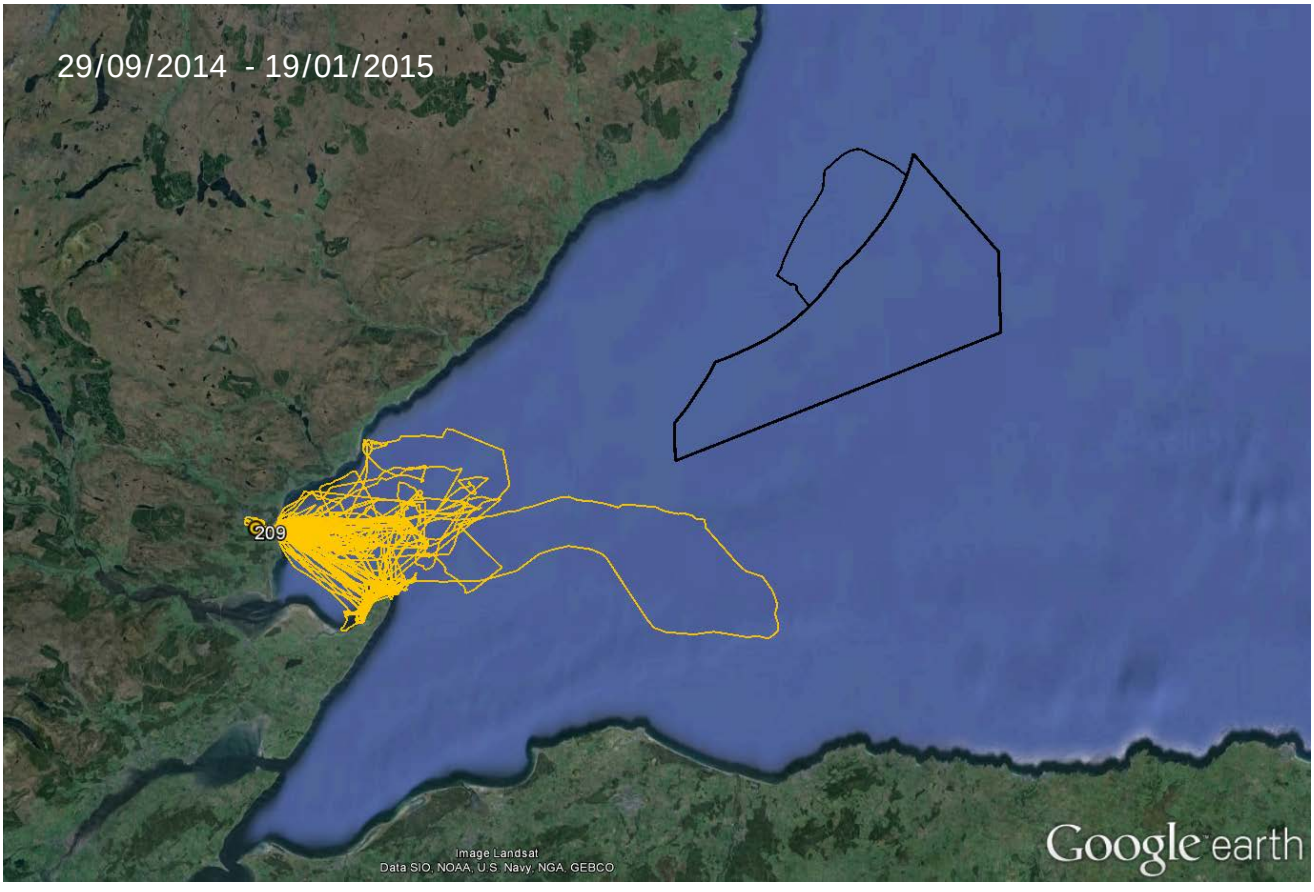
Best Right (2013)

Best Left (2013)

Capture Information

Date captured	29/09/2014
Location	Loch Fleet - SB1
Weight	72.5 kg
Length	147.0 cm
Girth	99.0 cm
Sex	Male
Flipper tag #	00526
GPS/GSM tag attached	Yes
GPS/GSM tag #	13209

Latest GPS Tracks



Seal ID # 322

Vital Stats

- Adult
- Male
- No ID before capture
- Not captured before

Sightings History

	2006	2007	2008	2009	2010	2011	2012	2013	2014
Seen	✘	✘	✘	✘	✘	✘	✘	✘	✓

Best Right

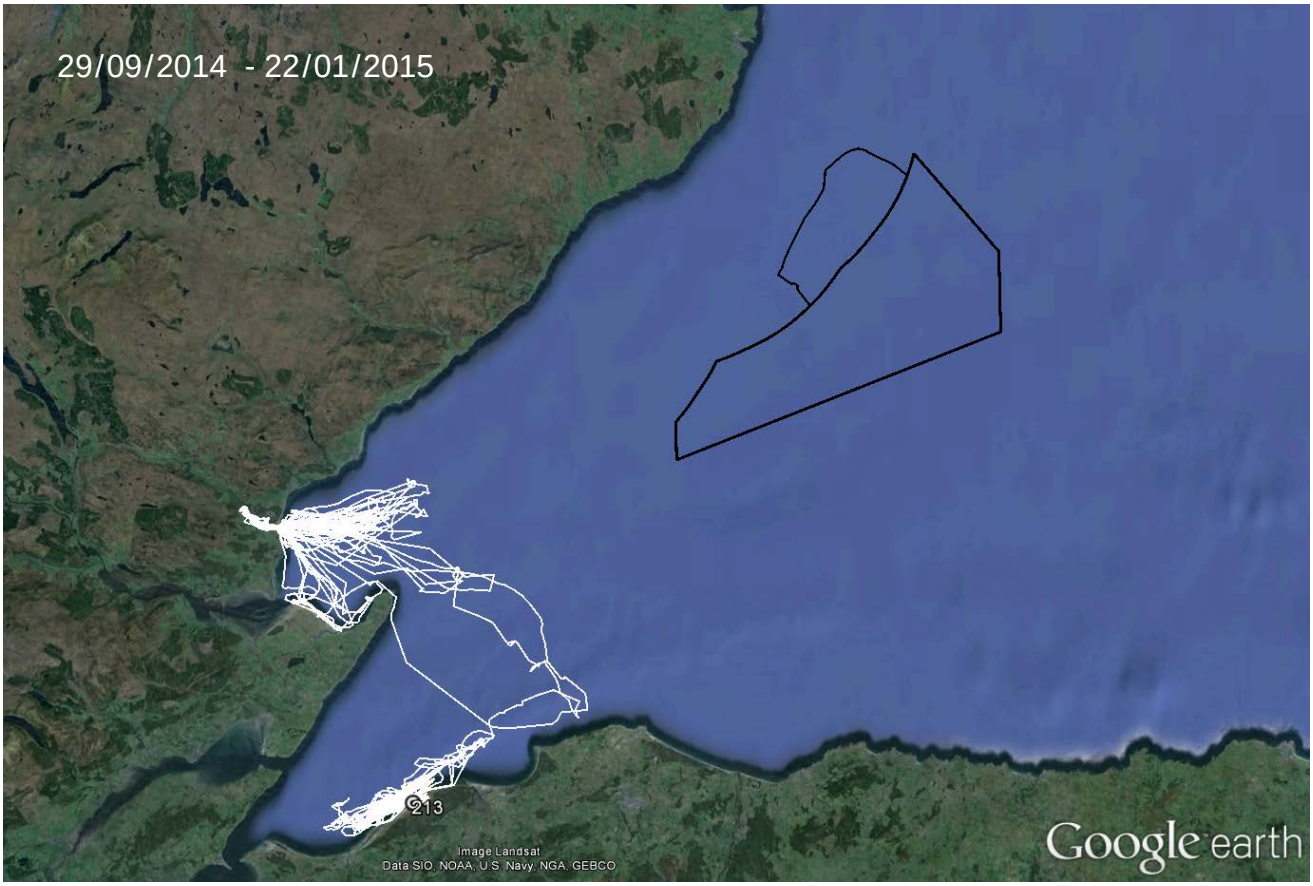
Best Left

- Before capture this seal had no ID number.

Capture Information

Date captured	29/09/2014
Location	Loch Fleet - SB1
Weight	54.7 kg
Length	120.0 cm
Girth	96.0 cm
Sex	Male
Flipper tag #	00525
GPS/GSM tag attached	Yes
GPS/GSM tag #	13213

Latest GPS Tracks



Seal ID # 338

Vital Stats

- Adult
- Male
- First seen 2014
- Not captured before

Sightings History

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Seen	✘	✘	✘	✘	✘	✘	✘	✘	✓	✓

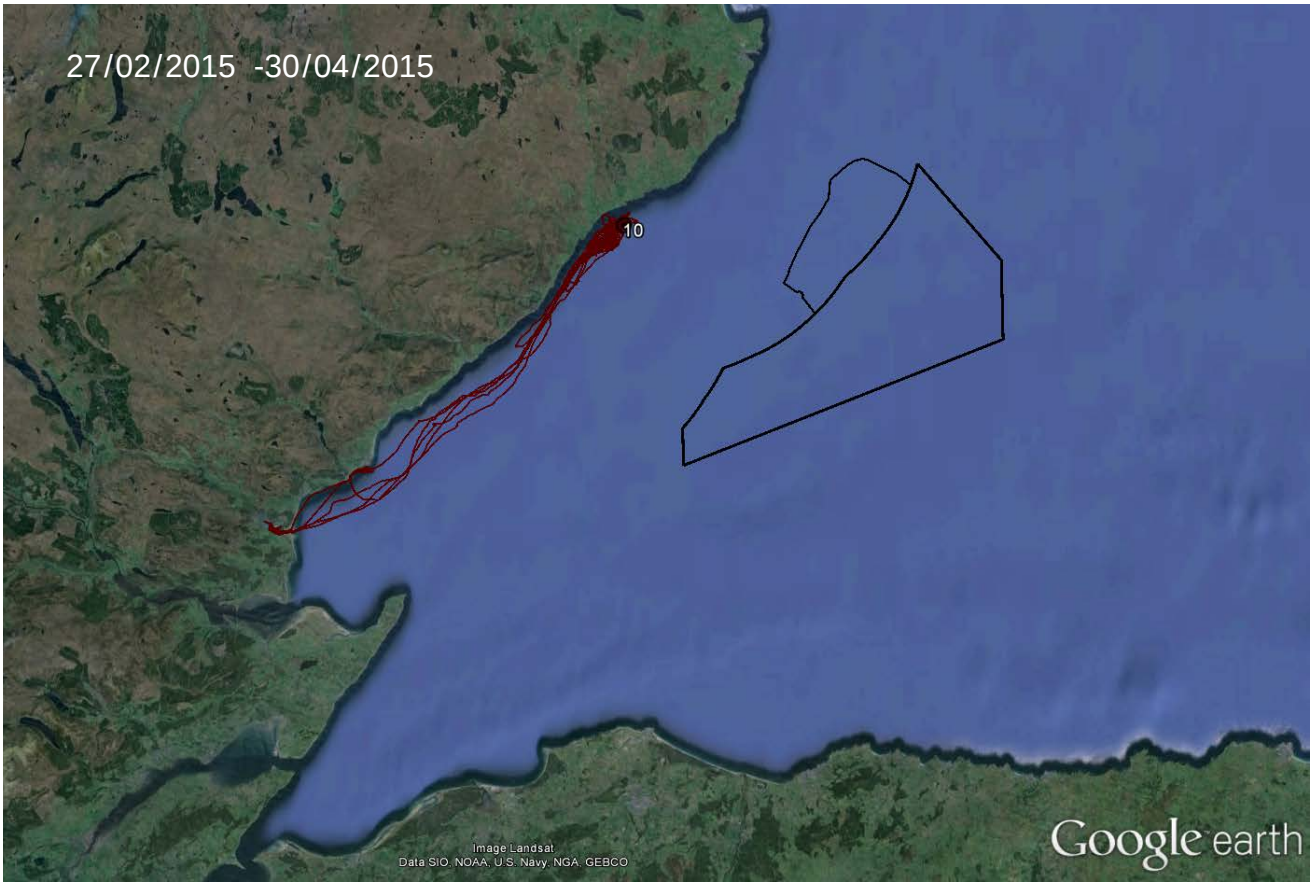
Best Right (2014)

Best Left (2014)

Capture Information

Date captured	27/02/2015
Location	Loch Fleet - SB2
Weight	100.6 kg
Length	157.0 cm
Girth	118.0 cm
Sex	Male
Flipper tag #	00551
GPS/GSM tag attached	Yes
GPS/GSM tag #	13204

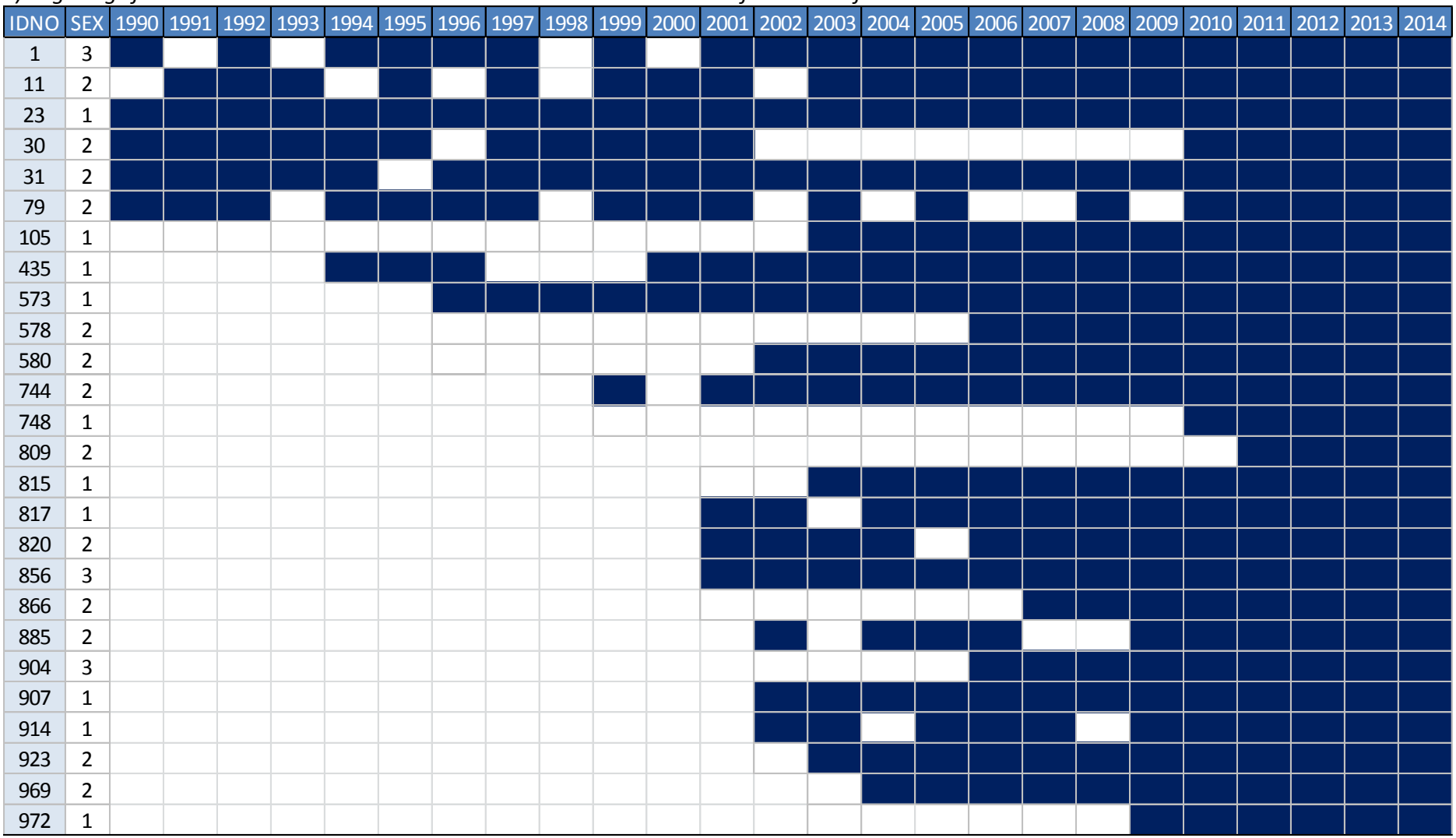
Latest GPS Tracks



ANNEX 6. *Reproductive histories of female bottlenose dolphins seen with new-born calves in the SAC in 2014 (ticks = year a calf was born, green box = calf survived to at least age 3, red tick = calf died).*

IDNO	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
433							✓							✓
440			✓			✓			✓			✓		✓
580			✓							✓				✓
872					✓							✓		✓
913				✓			✓			✓				✓
932						✓			✓		✓			✓
969							✓				✓			✓
1028									✓					✓
1030					✓			✓						✓

ANNEX 7. *Sighting histories of all well-marked (dorsal fin nick) bottlenose dolphins seen in the SAC in 2014 (male = 1, female = 2, unknown sex = 3). Sightings from 1990 to 2014 in the SAC once an individual received its first dorsal fin nick.*



IDNO	SEX	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
989	1																								■	■
991	2																■	■	■	■	■	■	■	■	■	■
1011	3																									■
1012	3																									■
1022	1																				■	■	■	■	■	■
1023	2																							■	■	■
1025	1																				■	■	■	■	■	■
1027	2																					■	■	■	■	■
1028	2																				■	■	■	■	■	■
1042	1																				■	■	■	■	■	■
1063	3																					■	■	■	■	■
1086	2																								■	■
1101	2																								■	■
1110	3																							■	■	■
1130	2																						■	■	■	■