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Appendix 10.2: Marine Mammal Technical Report – Annex B: Seal haul-out and telemetry data in relation to the Berwick Bank Wind Farm

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Contents

1	Introduction	1
1.1	Project area	1
2	Methods	3
2.1	Haul-out surveys	3
2.1.1	Harbour seals	3
2.1.2	Grey seals	4
2.1.3	Summary	5
2.2	Telemetry data	9
2.3	Legislation	9
3	August Haul-out Counts	13
3.1	Harbour seal	13
3.1.1	National counts	13
3.1.2	MU counts	13
3.2	Grey seal	18
3.2.1	National counts	18
3.2.2	MU counts	18
4	Grey Seal Pup Counts	23
5	Telemetry Data	27
5.1	Harbour seals	27
5.2	Grey seals	29
5.2.1	Adults	29
5.2.2	Pups and juveniles	29
6	Summary	34
6.1	Haul-out counts	34
6.2	Pup counts	34
6.3	Telemetry	34
7	Literature Cited	36

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Figures

FIGURE 1: THE PROJECT AREA: PROPOSED DEVELOPMENT MARINE MAMMALS STUDY AREA AND RELEVANT MUS	2
FIGURE 2: YEARS IN WHICH DIFFERENT PARTS OF SCOTLAND WERE SURVEYED BY HELICOPTER USING A THERMAL IMAGING CAMERA. A) 2006-2013 (SCOS 2015), B) 2007-2014 (SCOS 2016), C) 2011-2015 (SCOS 2017)	6
FIGURE 3: YEARS IN WHICH DIFFERENT PARTS OF SCOTLAND WERE SURVEYED BY HELICOPTER USING A THERMAL IMAGING CAMERA. A) 2011-2016 (SCOS 2018), B) 2011-2017 (SCOS 2019), C) 2011-2018 (SCOS 2020)	7
FIGURE 4: THE MOST RECENT AERIAL SURVEYS CARRIED OUT DURING THE HARBOUR SEAL MOULT IN AUGUST (SCOS 2021).....	8
FIGURE 5: HARBOUR AND GREY SEAL SACs – LABELS ARE PROVIDED FOR THOSE SACs MENTIONED IN THE REPORT TEXT	11
FIGURE 6: DESIGNATED HAUL-OUT SITES IN THE VICINITY OF THE PROPOSED DEVELOPMENT.....	12
FIGURE 7: AUGUST HAUL-OUT COUNTS OF HARBOUR SEALS IN THE EAST SCOTLAND MU AND THE FIRTH OF TAY AND EDEN ESTUARY SAC.....	14
FIGURE 8: ANNUAL AUGUST HAUL-OUT COUNTS OF HARBOUR SEALS IN THE NORTH-EAST ENGLAND MU	14
FIGURE 9: ALL HARBOUR SEAL AUGUST HAUL-OUT COUNTS BETWEEN 1997-2019, INSET: HAUL-OUT SITES WITHIN THE PROPOSED DEVELOPMENT MARINE MAMMALS STUDY AREA AND IN PROXIMITY TO THE PROPOSED DEVELOPMENT EXPORT CABLE CORRIDOR	16
FIGURE 10: HARBOUR SEAL AUGUST HAUL-OUT COUNTS BETWEEN 2014 AND 2019 IN THE EAST SCOTLAND AND NORTH-EAST ENGLAND MUS.....	17
FIGURE 11: AUGUST HAUL-OUT COUNTS OF GREY SEALS IN THE FIRTH OF TAY AND EDEN ESTUARY SAC, NORTHUMBERLAND AND THE TEES.....	19
FIGURE 12: ALL GREY SEAL AUGUST HAUL-OUT COUNTS BETWEEN 1997-2019, INSET: HAUL-OUT SITES WITHIN THE PROPOSED DEVELOPMENT MARINE MAMMALS STUDY AREA AND IN PROXIMITY TO THE PROPOSED DEVELOPMENT EXPORT CABLE CORRIDOR	21
FIGURE 13: GREY SEAL AUGUST HAUL-OUT COUNTS BETWEEN 2014 AND 2019 IN THE EAST SCOTLAND AND NE ENGLAND MUS.....	22
FIGURE 14: DISTRIBUTION AND SIZE OF THE MAIN GREY SEAL BREEDING COLONIES (SCOS, 2021)	24
FIGURE 15: ESTIMATED PUP PRODUCTION OF REGULARLY MONITORED COLONIES IN THE NORTH SEA (RUSSELL ET AL., 2019)	25
FIGURE 16: GREY SEAL PUP PRODUCTION COUNTS IN THE EAST SCOTLAND AND NORTH-EAST ENGLAND MUS .	26
FIGURE 17: TELEMETRY TRACKS FOR ALL 25 HARBOUR SEALS THAT ENTERED INTO THE PROPOSED DEVELOPMENT MARINE MAMMALS STUDY AREA (ALL TAGGED IN THE EAST SCOTLAND MU)	28
FIGURE 18: TELEMETRY TRACKS FOR ALL 59 ADULT GREY SEALS THAT ENTERED INTO THE PROPOSED DEVELOPMENT MARINE MAMMALS STUDY AREA (COLOURED BY THE MU THEY WERE TAGGED IN)	32
FIGURE 19: TELEMETRY TRACKS FOR ALL 38 PUP/JUVENILE GREY SEALS THAT ENTERED INTO THE PROPOSED DEVELOPMENT MARINE MAMMALS STUDY AREA (COLOURED BY THE MU THEY WERE TAGGED IN)	33

Tables

TABLE 1: DESIGNATED SEAL HAUL-OUT SITES IN THE VICINITY OF THE PROPOSED DEVELOPMENT BASED ON AUGUST SURVEY COUNTS (BOTH SPECIES)	10
TABLE 2: DESIGNATED SEAL HAUL-OUT SITES IN THE VICINITY OF THE PROPOSED DEVELOPMENT BASED ON GREY SEAL BREEDING COLONIES	10
TABLE 3: HARBOUR SEAL AUGUST HAUL-OUT COUNTS FOR VARIOUS SURVEY PERIODS	14
TABLE 4: AUGUST COUNTS OF HARBOUR SEALS WITHIN THE FIRTH OF TAY AND EDEN ESTUARY SAC (EAST SCOTLAND MU) AND THE NORTH-EAST ENGLAND MU BETWEEN 1996 AND 2019	15
TABLE 5: GREY SEAL AUGUST HAUL-OUT COUNTS FOR VARIOUS SURVEY PERIODS.....	19
TABLE 6: AUGUST COUNTS OF GREY SEALS WITHIN THE FIRTH OF TAY AND EDEN ESTUARY SAC (EAST SCOTLAND MU) AND THE NORTH-EAST ENGLAND MU BETWEEN 1996 AND 2019.....	20
TABLE 7: SUMMARY INFORMATION FOR ALL 50 HARBOUR SEALS TAGGED IN THE EAST SCOTLAND MU	27
TABLE 8: SUMMARY INFORMATION FOR THE 109 GREY SEALS TAGGED IN THE EAST SCOTLAND OR NORTH-EAST ENGLAND MUS.....	31

1 Introduction

SMRU Consulting was contracted by RPS on behalf of SSE Renewables (hereinafter referred to as the Applicant) to provide seal haul-out count and telemetry data in relation to the Berwick Bank Wind Farm (hereinafter referred to as the Proposed Development) marine mammals study area. The following data was requested:

- Harbour seal *Phoca vitulina* count data from August moult census surveys since 1996 to examine site specific abundance and interannual patterns in counts over time. This will cover all haul-outs within the area specified by the Applicant (Seal Management Unit (MU): 7 east Scotland and Seal MU: 8 north-east England).
- Associated grey seal *Halichoerus grypus* counts from these same August surveys (although please note that during the summer months grey seal distribution is highly variable and these counts, while giving a single snapshot of local summer distribution, are not a reliable census of population size).
- Provision of regional and national context for these counts.
- Grey seal pup production estimates from all regularly surveyed breeding sites within the area specified by the Applicant (Seal MU: 7 east Scotland and Seal MU: 8 north-east England).
- Provision of seal satellite tracking data from tagged harbour and grey seals - either animals tagged at the Special Areas of Conservation (SACs) and visiting the specified area (Proposed Development marine mammals study area) or visiting the specified area and also hauling out at the SACs.
- Provision of satellite tracking data from all harbour or grey seals which cross the specified area (Proposed Development marine mammals study area) regardless of where tagged, if not already included in the datasets specified above.
- A basic quantification of the degree of connectivity between the area specified by the Applicant (Proposed Development marine mammals study area) and protected haul out sites.

1.1 Project area

The Applicant specified that the area of interest was the Proposed Development marine mammals study area for the Berwick Bank Wind Farm development in addition to the east Scotland Seal MU and the north-east England Seal MU (Figure 1).

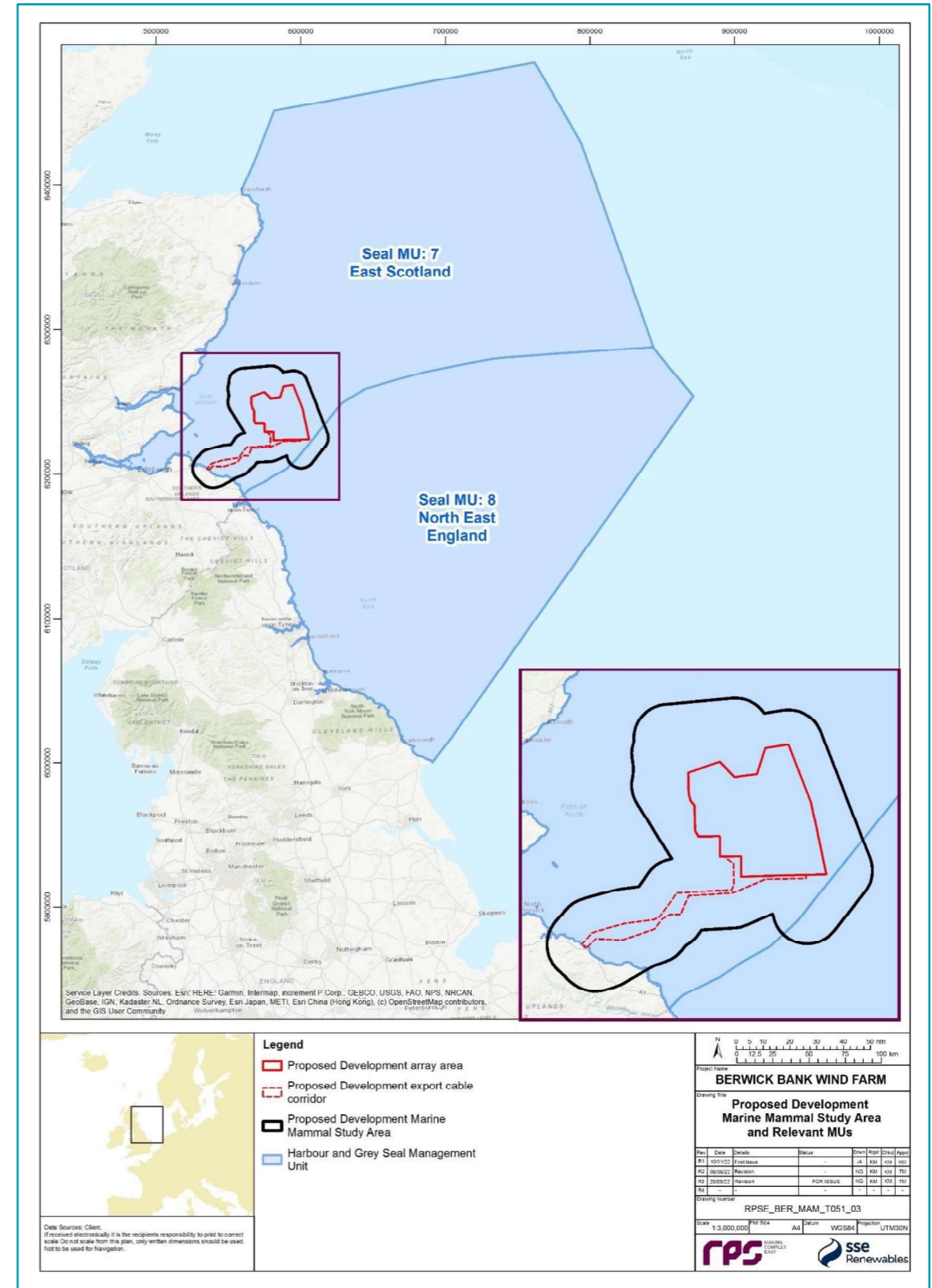


Figure 1: The Project Area: Proposed Development Marine Mammals Study Area and Relevant MUs

2 Methods

2.1 Haul-out surveys

The Sea Mammal Research Unit (SMRU) carries out surveys of harbour (or common) and grey seals in Scotland and on the east coast of England to contribute to the Natural Environment Research Council's (NERC's) statutory obligation under the Conservation of Seals Act 1970 'to provide the (UK government) with scientific advice on matters related to the management of seal populations'. These SMRU surveys, as well as surveys by a number of other organisations (including NatureScot, Natural England, the Countryside Council for Wales, the National Trust and the Lincolnshire Wildlife Trust) form the routine monitoring of seal populations around the UK. The annually submitted 'Advice', which includes information on recent changes in grey and harbour seal numbers, can be found in the Special Committee on Seals (SCOS) reports on SMRU's website¹.

Seals are widely distributed around the UK coast and most surveys are carried out from the air by either light aircraft or helicopter. SMRU does not survey the entire UK coast; surveys are concentrated in Scotland and on the east coast of England (Lincolnshire and Norfolk) where seals are relatively abundant and easy to survey. All surveys are of seals that are hauled out on shore.

On account of differences in the breeding behaviour of harbour and grey seals, the two species are surveyed at different times in their annual cycle. Harbour seals tend to be dispersed when breeding and aggregate, to an extent, when moulting so the main harbour seal surveys are carried out during their annual moult in August. In contrast, grey seals aggregate at traditional colonies when breeding and, therefore, grey seal surveys are designed to estimate the numbers of pups born at these colonies, during the autumn breeding season (between August and December). Harbour seals are also surveyed in a few areas during their breeding season in June and July. While grey seals are counted on all harbour seal surveys, harbour seals are very rarely seen on any of the grey seal breeding colony surveys.

2.1.1 Harbour seals

Surveys of harbour seals are carried out during the summer and early autumn months. There are two types of surveys conducted: breeding counts and moult counts.

2.1.1.1 Harbour seal breeding counts

Breeding seals are surveyed in June and July in a small number of areas. Breeding season surveys are carried out annually in the Moray Firth and, in recent years, in Lincolnshire and Norfolk. A very limited number of breeding season surveys have been carried out on behalf of NatureScot in areas designated as SACs for harbour seals in Scottish waters. Given that there are no breeding surveys conducted in the vicinity of the Proposed Development marine mammals study area, these are not considered further in this report.

2.1.1.2 Harbour seal August moult counts

The main population surveys are carried out when harbour seals are moulting, during the first three weeks of August. The greatest and most consistent numbers of harbour seals are believed to haul out ashore during their annual moult. To maximise the numbers of seals on shore and to reduce the effects

¹ <http://www.smru.st-andrews.ac.uk/research-policy/scos/>

of environmental variables, surveys are restricted to within two hours either side of afternoon low tides on days with no rain.

Areas differ in the frequency with which they are surveyed. In general, annual moult surveys are carried out in Lincolnshire and Norfolk (England), the Moray Firth and the Firth of Tay (Scotland). The remainder of the Scottish coast is surveyed approximately every four to five years, although there is considerable variation between areas.

Harbour seals inhabiting rocky shores are surveyed during the moult using a helicopter equipped with a thermal imaging camera that can detect seals hauled out ashore at a distance of up to 3 km. It is possible to differentiate between the two species using their thermal profiles, the group structure on shore, a 'real' image from a camcorder, directly using binoculars or retrospectively from high resolution digital photographs. In some instances, however, species identity is still uncertain and the seals are classified as 'species unknown'. Seals on sandbanks in the east coast estuaries (including annual counts of the Firth of Tay and Eden Estuary SAC) are usually surveyed from a fixed wing light aircraft using conventional, oblique photography.

The moult counts obtained represent the number of harbour seals that were on shore at the time of the survey and are an estimate of the minimum size of the population. They do not represent the total size of the local population since a number of seals would have been at sea at the time of the survey. Note that these data refer to the numbers of seals found within the surveyed areas only at the time of the survey; numbers and distribution are likely to differ at other times of the year.

Numbers of grey seals are also counted during these August moult surveys. Counts of greys seals during the summer months are highly variable and are not used as a population index in this species. It is possible to differentiate between the two species using their thermal profiles and their group structure on shore. Species identity is confirmed using a 'real' image from a camcorder and directly using binoculars. The most recent data for the area of interest are from 2019.

2.1.2 Grey seals

Grey seals aggregate in the autumn to breed at traditional colonies. Their distribution during the breeding season is very different to their distribution at other times of the year.

Grey seals are surveyed during their breeding season (Aug – Dec). Most breeding colonies are surveyed by SMRU by fixed wing aerial vertical photography (Hebrides, Orkney, north Scotland the north-east Scotland, and most of the Firth of Forth) while others are surveyed by ground count by other organisations (Shetland, Inchcolm in the Firth of Forth and England). The grey seal pup production database contains data from 1989 to 2019 and includes 74 breeding colonies (though not all colonies have been surveyed since 1989 and some smaller colonies are surveyed more sporadically than others). Most breeding colonies used to be surveyed annually, however from 2010 most colonies switched to biennial surveys instead. A few colonies are still monitored annually (Shetland, Inchcolm in the Firth of Forth and England). Most breeding colonies are surveyed four or five times within a survey year², and total pup production is estimated from the series of counts of pups at each colony. The last major survey for which data has been processed and is available is 2016, where 67 colonies were counted. The most recent grey seal pup production survey was conducted in 2019.

Grey seals are also counted during SMRU's harbour seal surveys. However, counts of greys seals during

² For example, the Isle of May is surveyed biennially (every 2 years), but within a survey year it is surveyed 4 or 5 times. With regards to the breeding colonies in the East Scotland MU: Craighleith is surveyed 3 or 4 times in a survey year, Fast Castle is surveyed 4 or 5 times in a survey year, Inchcolm is surveyed 1 to 3 times in a survey year, Inchkeith is surveyed 3 or 4 times in a survey year and Isle of May is surveyed 4 or 5 times in a survey year.

the summer months can be highly variable and, although these counts are not used as a population index, they provide useful information on the summer and non-breeding season distribution of grey seals.

2.1.3 Summary

1. Population surveys of harbour seals are carried out during their annual moult in August.
2. Harbour seal August moult surveys provide an estimate of the minimum size of the population, not the total population size.
3. In general, harbour seal population (August moult) surveys are carried out once every four to five years in most of Scotland but annually in Lincolnshire, Norfolk, the Moray Firth and the Firth of Tay. The frequency of surveys is determined by availability of funds.
4. The main grey seal surveys are conducted in the autumn to estimate the number of pups born at the main breeding colonies around the UK.
5. Grey seals are also counted during harbour seal August moult surveys. Their numbers are highly variable in the summer months and, while these surveys provide information on the summer distribution and abundance of grey seals, the numbers are not used to estimate total population size.
6. Results of all surveys are presented annually to the UK Government as part of NERC's statutory obligation under the Conservation of Seals Act 1970. These results are available in the SCOS documents on SMRU's website³.

The haul out count data from the annual SMRU surveys are not appropriate for assessing fine scale distribution of haul out sites – the data we have are a snapshot of a single day in August in each of the surveyed years and it is only appropriate to interpret these on a regional scale. The numbers present at any one location can be highly variable between months and years and as such the data should not be used to inform decisions relating to micro-siting infrastructure.

Note: The East Scotland MU is not surveyed in its entirety every year. Only a part of the Scottish coast can be surveyed in one year, resulting in big differences in the area covered annually. Ideally, the entire Scottish coast is completed every 5 years. The exception to this is the Firth of Tay SAC which is surveyed annually. Figures are provided in SCOS reports (and are duplicated here for information - Figure 2, Figure 3 and Figure 4) to highlight which part of the Scottish coastline has been surveyed each year. In SCOS reporting, tables of the most recent haul-out counts are provided by "survey period" (1996-1997, 2000-2006, 2007-2009, 2011-2015 and 2016-2019) as these represent periods within which the entire Scottish coastline was surveyed.

³ <http://www.smru.st-andrews.ac.uk/research-policy/scos/>

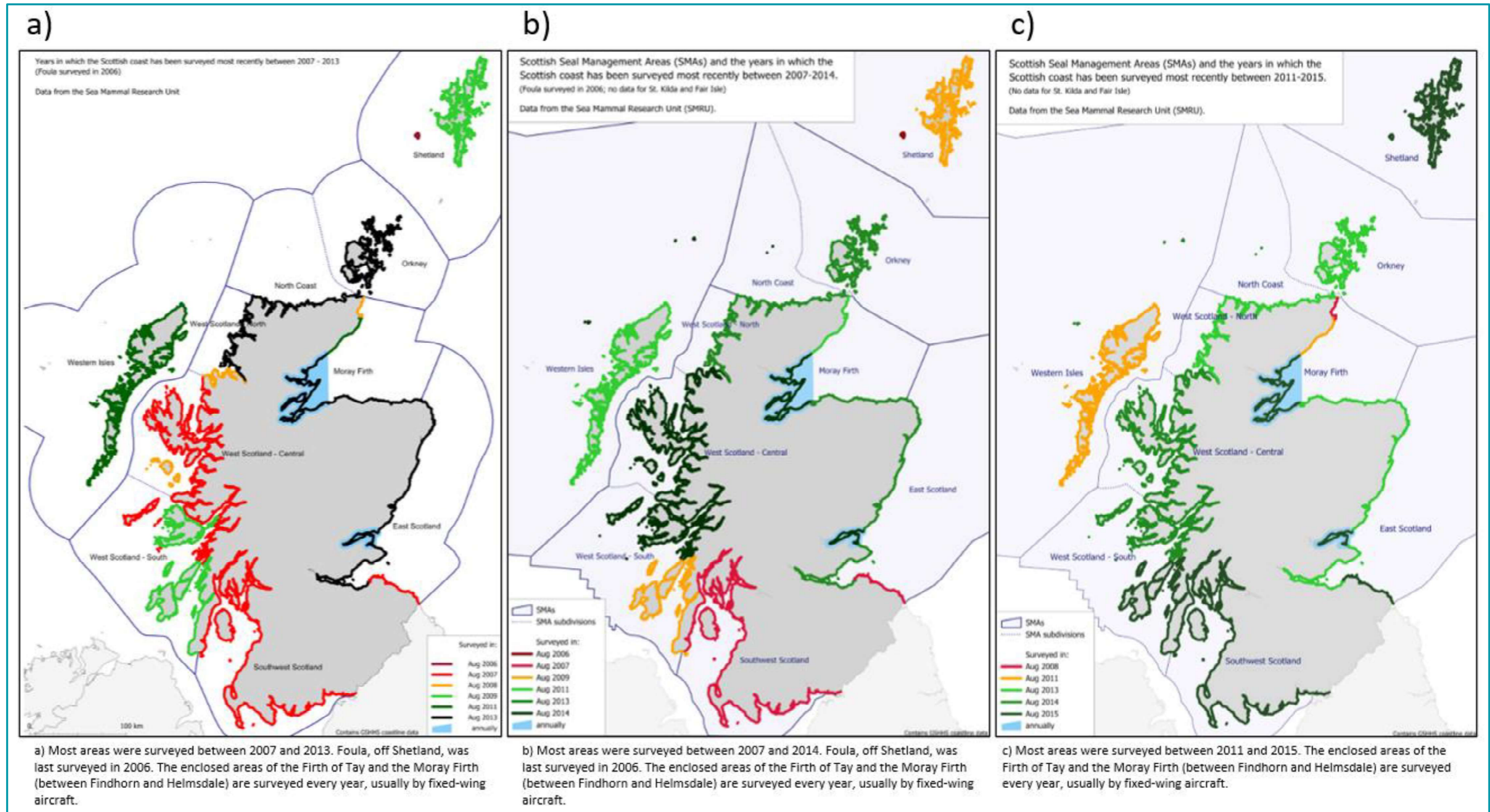


Figure 2: Years in which Different Parts of Scotland Were Surveyed by Helicopter using a Thermal Imaging Camera. a) 2006-2013 (SCOS 2015), b) 2007-2014 (SCOS 2016), c) 2011-2015 (SCOS 2017)

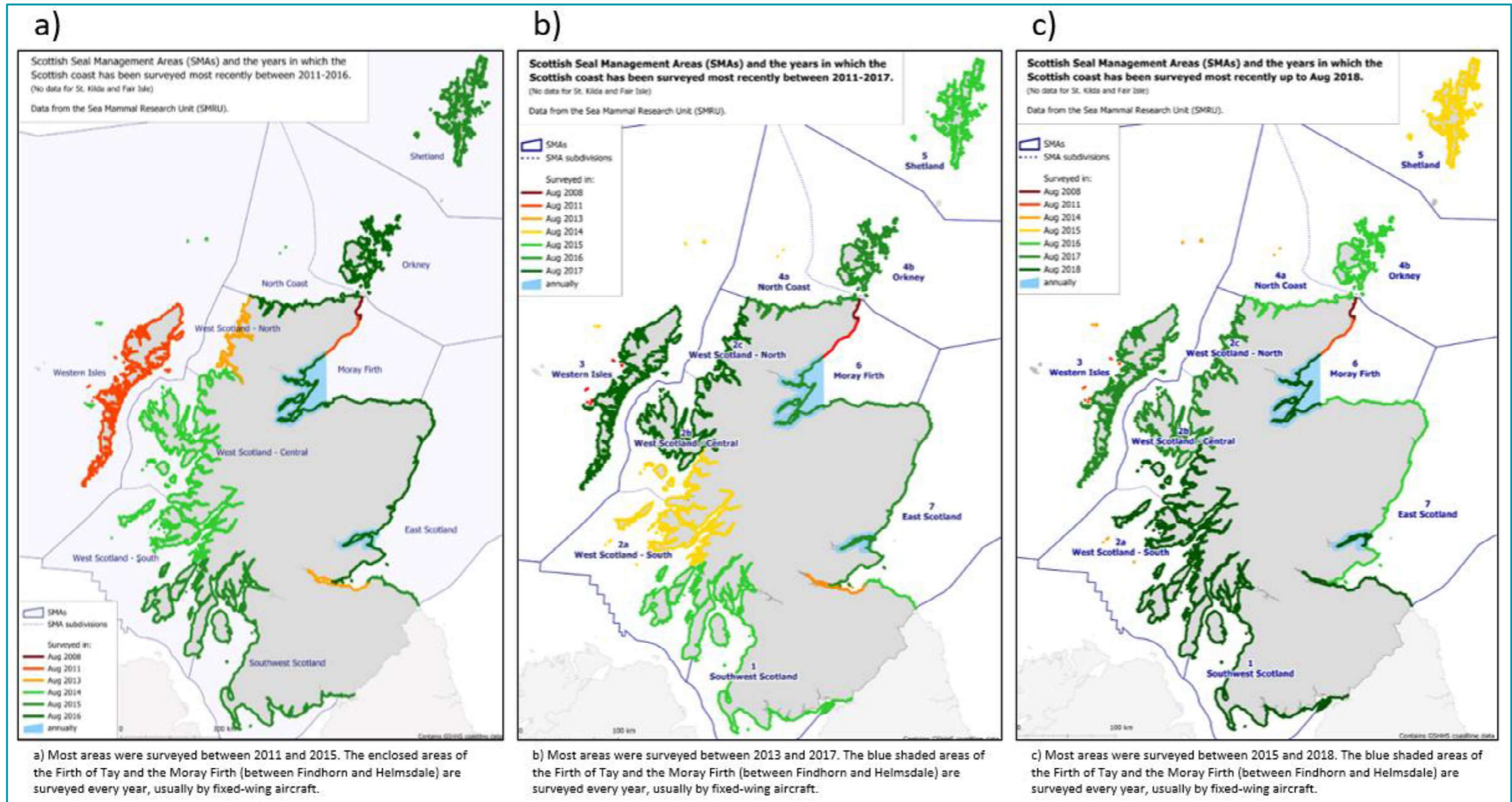


Figure 3: Years in which Different Parts of Scotland Were Surveyed by Helicopter using a Thermal Imaging Camera. a) 2011-2016 (SCOS 2018), b) 2011-2017 (SCOS 2019), c) 2011-2018 (SCOS 2020)

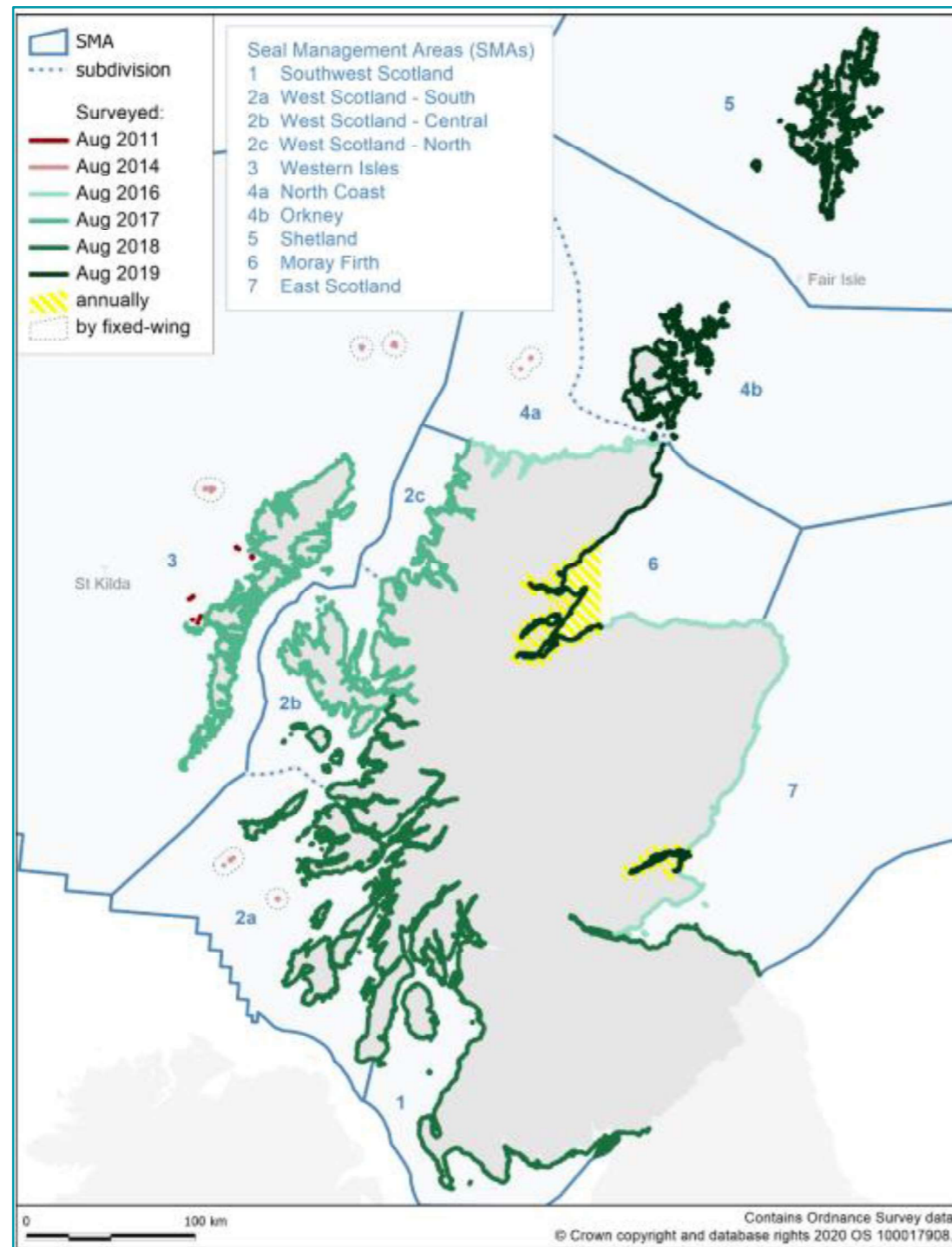


Figure 4: The Most Recent Aerial Surveys Carried out during the Harbour Seal Moulting in August (SCOS 2021)

Most areas were last surveyed between 2016 and 2019. The yellow shaded areas of the Firth of Tay and the Moray Firth (between Helmsdale and Findhorn) are surveyed every year, usually by fixed-wing aircraft. Offshore islands were last surveyed in 2014 by fixed-wing aircraft. However, only very small numbers of harbour seals are found on islands last surveyed pre-2016. St Kilda and Fair Isle have not been covered properly by aerial surveys.

2.2 Telemetry data

Data, relevant to this report, were available for harbour and grey seals from telemetry tags deployed by SMRU. Tags are glued to the fur on the back of the seal's neck and fall off with the fur during the annual moult, if not before. These tags transmit data on seal locations with the tag duration (number of days) varying between individual deployments. It is worth noting that the timing of the tag deployment can be important, especially for grey seals, since movement patterns can differ between the breeding and non-breeding seasons (Russell *et al.*, 2013).

There are data from two types of telemetry tag presented in this report which differ by their data transmission methods. Data transmission can be through the Argos satellite system (Argos tags) or Global Positioning System (GPS) phone tags which combine GPS quality locations with transmission of data using the Global System for Mobile communication (GSM) phone network. Both types of transmission result in location estimates, but the spatial and temporal resolution of the locational data varies with deployment, Argos location tags can have an error of >2.5 km (Vincent *et al.*, 2002) while GPS location tags are better quality, with a typical error of <50 m (Patterson *et al.*, 2010). Data from GPS phone tags also provide more frequent locations by incorporating the Fastloc GPS system (Wildtrack Telemetry Systems, UK) which obtains locational data within a fraction of a second and therefore can collect data even when the animal surfaces for a short period. The GPS tags attempt to collect location data every 5-20 minutes (depending on the parametrisation at set-up). The tags use precision wet/dry sensors as well as pressure and temperature sensors to obtain detailed individual dive (max depth, shape, time at depth, etc.) and haul-out records. Data are stored on board the tags and then relayed by a satellite (Argos tags) or by quad-band GSM mobile phone module to SMRU when the animal is within range of the GSM mobile phone network. The data are then stored in databases, cleaned according to methods described in Russell *et al.* (2011) and processed for analysis.

2.3 Legislation

In Scotland, seals are protected under the Marine (Scotland) Act 2010. Section 6 of this Act prohibits the taking of seals except under licence. Licences can be granted for the protection of fisheries and aquaculture and for scientific and welfare reasons. NERC, through the SCOS and the NERC sponsored SMRU, provides advice on all licence applications and haul out designations. Section 6 of this Act also prohibits harassment and injury to seals. The Protection of Seals (Designation of Haul-Out Sites) (Scotland) Order 2014 laid in the Scottish Parliament on 26 June 2014 which, from 30th September 2014, makes it an offence to harass seals at these sites. Harassment involves any activity that pesters, torments, troubles or attacks a seal on a designated haul-out site. In particular, it would include any action that causes a considerable proportion of seals on a haul-out site to leave that site either more than once or repeatedly or, in the worst cases, to abandon it permanently (Marine Scotland, 2014a, b).

Within or in the vicinity of the Proposed Development marine mammals study area, there are two seal haul out sites and three grey seal breeding colony sites designated under this order (Table 1 and Table 2 and Figure 6).

Table 1: Designated Seal Haul-out Sites in the Vicinity of the Proposed Development Based on August Survey Counts (Both Species)

Site ID	Site Name	Location
EC-001	Kinghorn Rocks	Firth of Forth North
Intertidal mudbanks and rocky coastline between Long Craig and Linton Court and associated rocky outcrops.		
EC-002	Inchmickery and Cow & Calves	Firth of Forth
Rocky coastline around Inchmickery and entire islands of Cow, Calves and Oxcars.		

Table 2: Designated Seal Haul-out Sites in the Vicinity of the Proposed Development Based on Grey Seal Breeding Colonies

Site ID	Site Name	Location
BC-043	Fast Castle	between Dunbar and Eyemouth
Rocky coastline at the foot of the cliffs between Coldingham Loch and Cove Harbour.		
BC-044	Inchkeith	halfway between Kinghorn and Leith
Entire coast of Inchkeith.		
BC-045	Craigleith	off North Berwick
Southern half of Craigleith.		

The European Union's Council Directive 92/43/EEC (commonly known as the 'Habitats Directive') requires the creation of a Europe-wide network of SACs for designated species. This network of SACs is designed to ensure that the species listed in Annex II of the Habitats Directive, which includes both grey and harbour seals, are maintained in a favourable conservation status in their natural range (Article 3(1)). Information on the SACs which have been designated for harbour seals can be found on the JNCC website⁴. Information on the SACs which have been designated for grey seals can be found on the JNCC website⁵.

The Habitats Directive requires the creation of a Europe-wide network of SACs. The network of SACs is designed to ensure that the species listed in Annex II of the Directive are restored at a favourable conservation status in their natural range (Article 3(1)). The EU Habitats Directive (1992) lists both grey and harbour seals in Annex II and Annex V and requires that SACs be established for their protection. Within the East Scotland and North-east England MUs there are three seal SACs: The Isle of May SAC and the Berwickshire and North Northumberland Coast SAC for grey seals, and the Firth of Tay and Eden Estuary SAC for harbour seals (Figure 5).

⁴ <https://sac.jncc.gov.uk/species/S1365/>

⁵ <https://sac.jncc.gov.uk/species/S1364/>

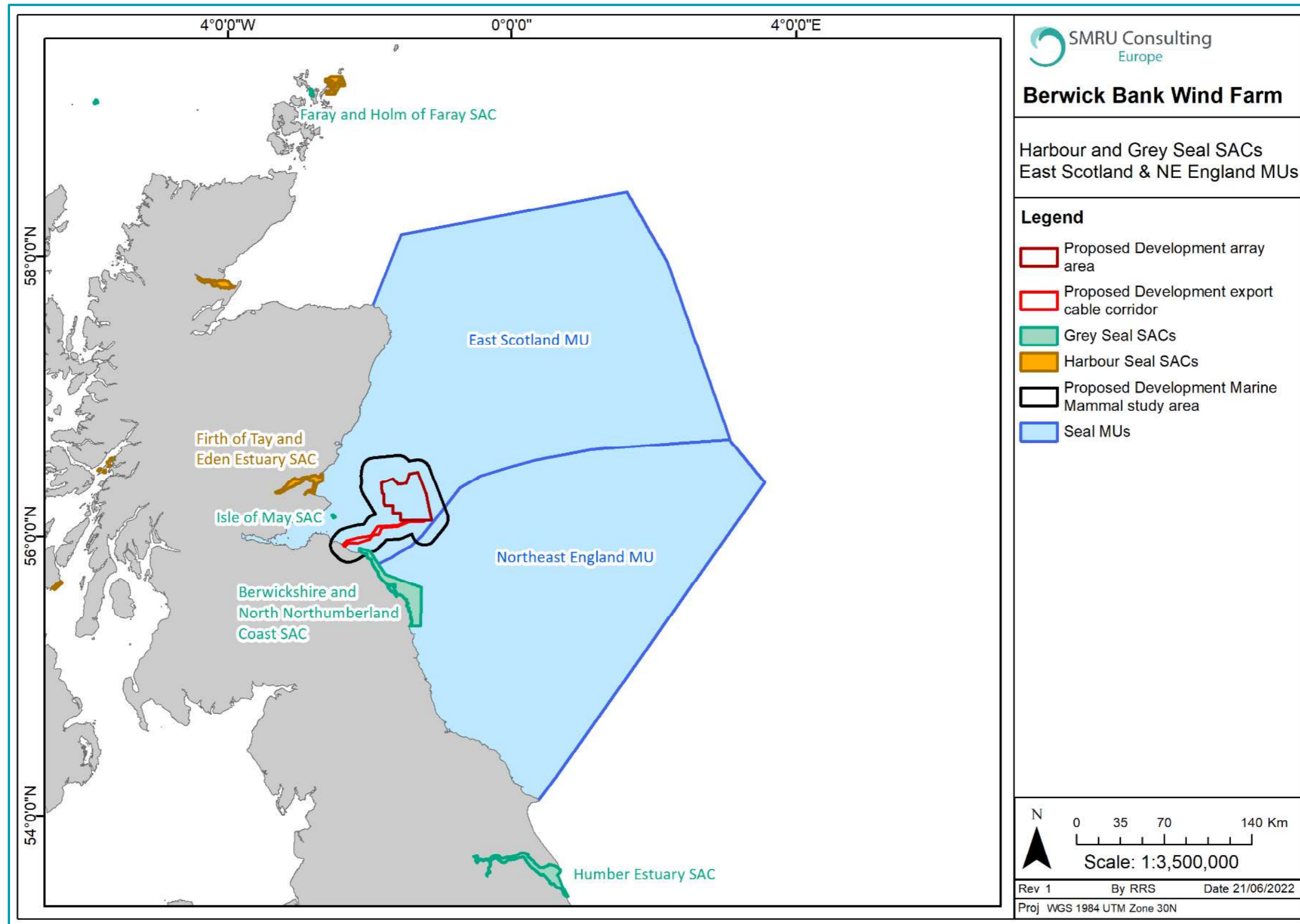


Figure 5: Harbour and Grey Seal SACs – Labels are Provided for those SACs Mentioned in the Report Text

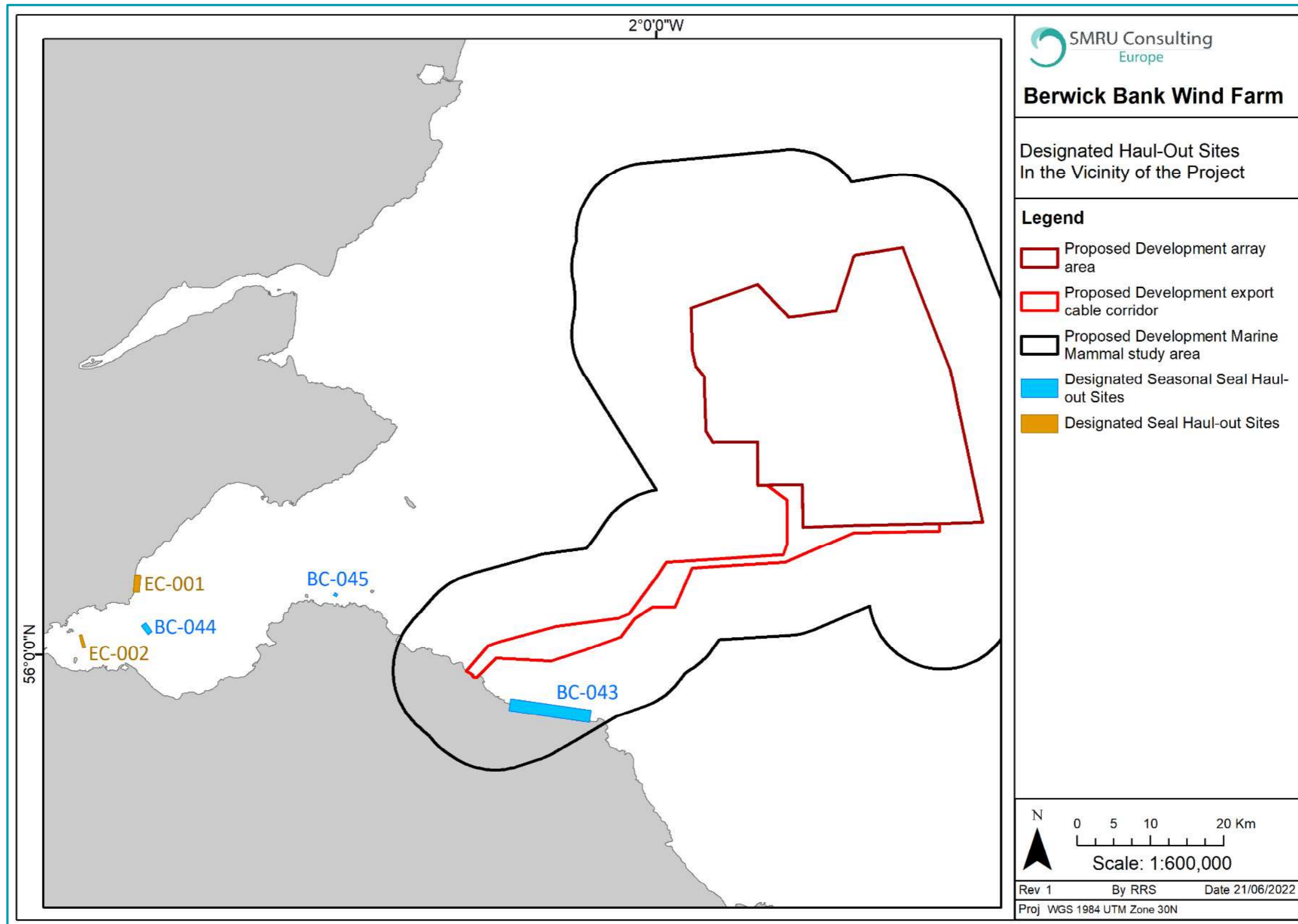


Figure 6: Designated Haul-out Sites in the Vicinity of the Proposed Development

3 August Haul-out Counts

All August haul-out count data for the East Scotland and North-east England MUs can be found in the Excel Workbook: **August Haulout Counts East Scot and NE Eng MUs.xls** found on <https://smrumarine.box.com/s/bwft0c8j9ag8k5vmq60iimwvi2l07pls>.

3.1 Harbour seal

3.1.1 National counts

The most recent August haul-out count for the whole of Scotland is for the count period 2016-2019, where a total of 26,846 harbour seals were counted; for England and Wales a further 3,886 harbour seals were counted. This results in a total count of 31,744 harbour seals in the UK (and 35,751 including Ireland) (SCOS 2021). It is estimated that 72% of the total harbour seal population are hauled-out and available to count during August surveys (Loneragan *et al.*, 2013) and therefore the total number of harbour seals in the population for the count period of 2016-2019, accounting for those at-sea at the time of the August count, is estimated to be ~44,100 harbour seals⁶ in the UK (~49,700 including Ireland).

3.1.2 MU counts

Not all sites within the East Scotland MU are surveyed annually, however annual counts have been conducted in the Firth of Tay and Eden Estuary SAC on an annual basis since 2005 (Table 4). The SAC counts were stable between 1990 and 2002, however after the 2002 PVD epidemic, counts declined rapidly and monotonically between 2002 and 2017 at a rate of -18.6% p.a. (Thompson *et al.*, 2019) with no signs of recovery in recent years (Figure 7). Though surveyed with less frequency, overall counts for the East Scotland MU have also shown a decline since the 1996-1997 count period from 764 seals to 343 in the 2016-2019 count period (Table 3) (SCOS 2021). The most recent haul-out count of 343 harbour seals for the 2016-2019 count period can be scaled by the proportion of seals hauled-out at the time of the count to resulting in a total East Scotland MU population size estimate of 476 harbour seals.

All sites within the Tees Estuary (North-east England MU) have been surveyed annually between 1996 and 2019 by the Industry Nature Conservation Agency (INCA) (Table 4), and, additionally, SMRU have carried out surveys in the wider MU in 1997, 2005, 2007, 2008, 2015, 2016 and 2018. Harbour seal August haul-out counts in the North-east England MU are low (Table 3), with annual counts up to a maximum of 91 (Figure 8) (SCOS 2021). The most recent haul-out count of 79 harbour seals for the 2016-2019 count period can be scaled by the proportion of seals hauled-out at the time of the count to resulting in a total North-east England MU population size estimate of ~110 harbour seals.

Figure 9 and Figure 10 show the distribution of harbour seal haul-out counts across the MUs. There are no harbour seal haul-outs within the Proposed Development marine mammals study area (Figure 9).

⁶ Calculated as: $(31,744/72)*100$

Table 3: Harbour Seal August Haul-out Counts for Various Survey Periods

HARBOUR SEAL	1996-1997	2000-2006	2007-2009	2011-2015	2016-2019
East Scotland	764	667	283	224	343
North-east England	54	62	58	91	79

The Tees data collected and provided by the Industry Nature Conservation Association (Bond, 2019). Northumberland coast south of Farne Islands not surveyed pre-2008; no harbour seal sites known here. The 2008 survey from Coquet Island to Berwick funded by the Department of Energy and Climate Change (DECC, previously DTI).

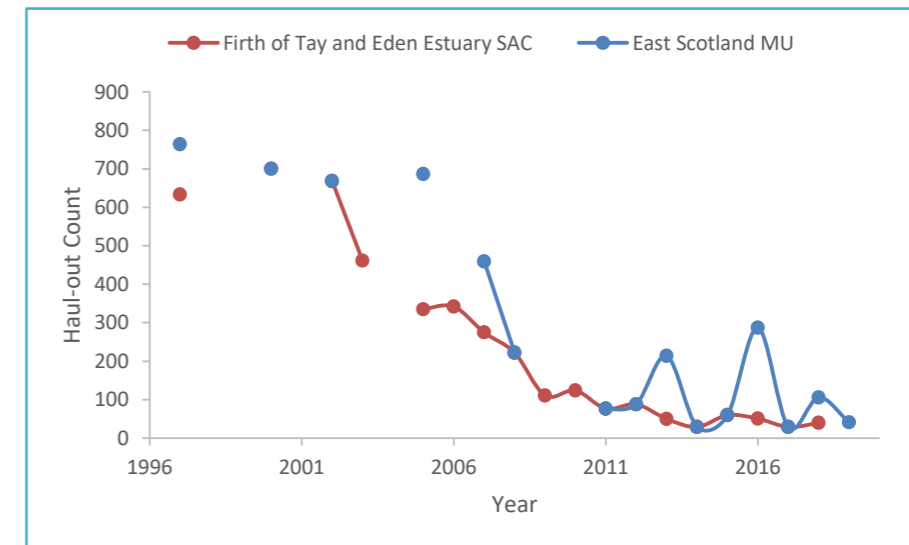


Figure 7: August Haul-out Counts of Harbour Seals in the East Scotland MU and the Firth of Tay and Eden Estuary SAC

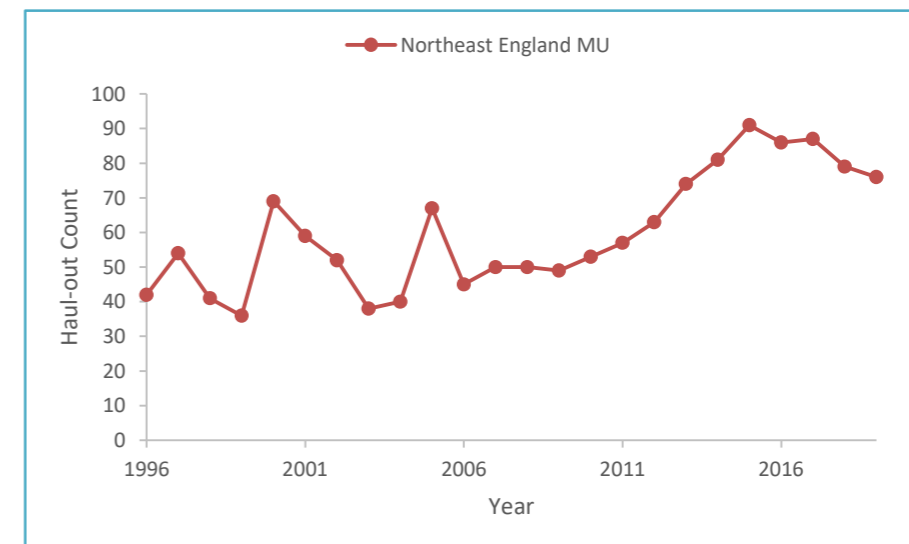


Figure 8: Annual August Haul-out Counts of Harbour Seals in the North-east England MU

Table 4: August Counts of Harbour Seals within the Firth of Tay and Eden Estuary SAC (East Scotland MU) and the North-east England MU between 1996 and 2019

Year	East Scotland MU						North-east England MU	
	Survey method	Upper Tay	Broughty Ferry	Buddon Ness	Abertay & Tentsmuir	Eden Estuary	N'umberland	Tees
1996	n/s							42
1997	1ti	113	35	0	262	223	12	42
1998	n/s							41
1999	n/s							36
2000	1fw	115	52	113	153	267	10	59
2001	n/s							59
2002	1fw	51	0	109	167	341		52
2003	1fw	83	90	142	53	93		38
2004	1fw	134	55	66	126	78		40
2005	2fw,1ti	91	51	25	63	105	17	50
2006	1fw	91	31	96	34	90		45
2007	1fw,1ti	63	27	64	31	90	7	43
2008	2fw	49	13	27	50	83	9	41
2009	1fw	45	28	8	8	22		49
2010	1fw	41	15	23	9	36		53
2011	1fw	16	18	11	0	32		57
2012	1fw	40	16	8	5	19		63
2013	1ti	36	3	10	0	1		74
2014	1fw	21	0	1	0	7		81
2015	1fw	51	2	3	0	4	0	91
2016	1ti	41	4	0	1	5		86
2017	1fw	28	0	0	0	1		87
2018	1fw	32	4	2	0	2	3	76
2019	1fw	36	2	0	0	3		76

fw, fixed-wing survey; ti, thermal imager helicopter survey

All east Scotland: Counts from SMRU aerial surveys using a fixed wing aircraft funded by NERC.

Northumberland: One complete survey in 2008 (funded by DECC). Helicopter surveys with thermal imager from Farne islands to Scottish Border in 1997, 2005, 2007, 2015, 2018. Fixed wing surveys of Holy Island only in 1994 & 2000.

The Tees: Ground counts by Industry Nature Conservation Agency (Bond, 2018). Single SMRU fixed-wing count in 1994.

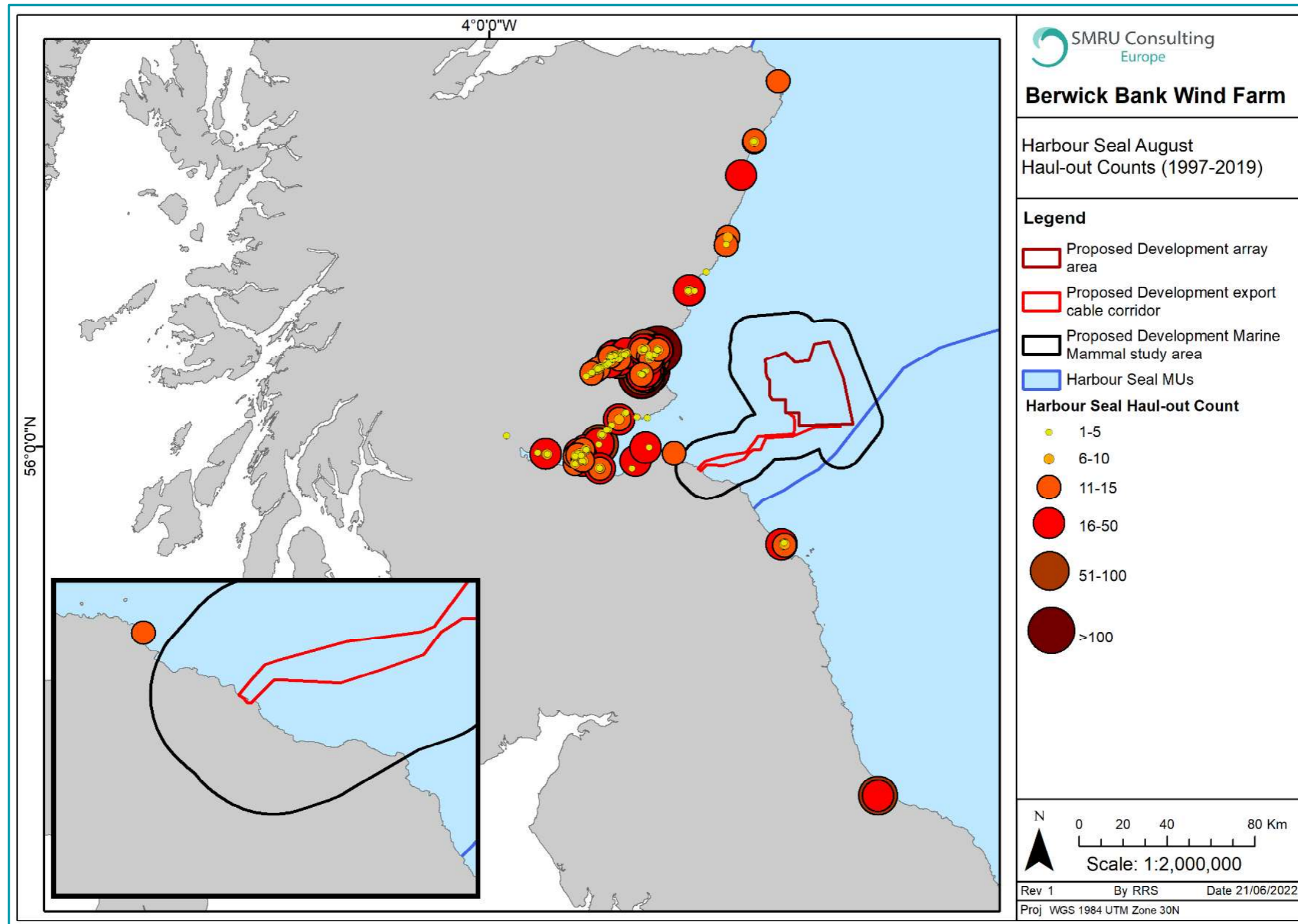


Figure 9: All Harbour Seal August Haul-out Counts between 1997-2019, Inset: Haul-out Sites within the Proposed Development Marine Mammals Study Area and in Proximity to the Proposed Development Export Cable Corridor

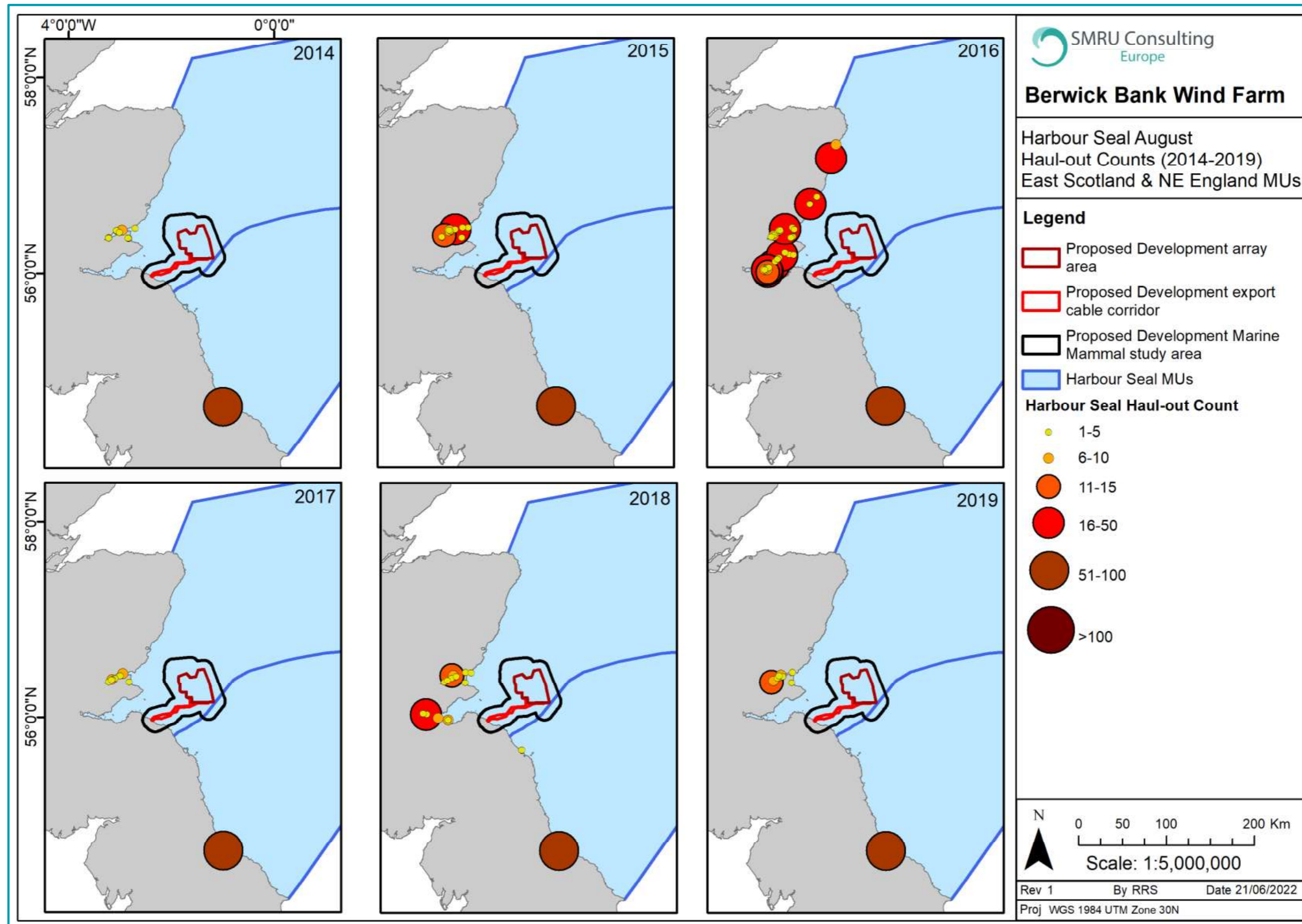


Figure 10: Harbour Seal August Haul-out Counts between 2014 and 2019 in the East Scotland and North-east England MUs

3.2 Grey seal

3.2.1 National counts

The most recent August haul-out count for the whole of Scotland is for the count period 2016-2019, where a total of 25,412 grey seals were counted, in addition in England and Wales a further 16,848 grey seals were counted. This results in a total count of 42,260 grey seals in Britain (42,765 in the UK and 46,463 including Ireland) (SCOS 2021). It is estimated that 23.9% of the total grey seal population are hauled-out and available to count during August surveys (Russell *et al.*, 2016) and therefore the total number of grey seals in the population for the count period of 2016-2019, accounting for those at-sea at the time of the August count, is estimated to be ~176,800 grey seals⁷ in Britain (~179,000 in the UK and ~194,500 including Ireland).

3.2.2 MU counts

Grey seal August haul-out counts in the East Scotland MU have been much higher than harbour seal counts, ranging between 1,238 and 3,683 grey seals (Table 5). This reflects the varying levels of survey effort throughout the MU, however in the Firth of Tay and Eden Estuary, which is counted almost annually, counts are still highly variable, ranging between the lowest count of 450 in 2009 and the highest count of 2,253 in 2000 (Table 6 and Figure 11). Though surveyed less frequently, overall counts for the East Scotland MU have shown an increase in grey seals from 2,328 in the 1996-1997 period to 3,683 in the 2016-2019 period (Table 5) (SCOS 2021). The counts at the East Scotland MU account for 9% of the grey seals hauled-out in Britain and 14% of the grey seals hauled-out in Scotland between 2016-2019. Since it is estimated that 23.9% of the total grey seal population are hauled-out and available to count during August surveys (Russell *et al.*, 2016), the August haul-out count of 3,683 can be scaled to account for the proportion of the population at seal at the time of the survey to result in a population estimate within the East Scotland MU of ~15,400 grey seals.

In the North-east England MU, grey seals are primarily present in the Northumberland area. While counts of this area are infrequent, they do show a considerable increase in counts from 603 grey seals in 1997 to 6,427 in 2018 (Table 6 and Figure 11) (SCOS 2021). Comparatively, counts in the Tees which are surveyed annually, have remained low and stable, ranging from 10 in 1995 to 14 in 2019 (Table 6 and Figure 11). The total August haul-out count of grey seals in the North-east England MU in the count period 2016-2019 was 6,501 grey seals (Table 5), which accounts for 15% of the grey seals hauled-out in Britain between 2016-2019. Since it is estimated that 23.9% of the total grey seal population are hauled-out and available to count during August surveys (Russell *et al.*, 2016), the August haul-out count of 6,501 can be scaled to account for the proportion of the population at seal at the time of the survey to result in a population estimate within the North-east England MU of ~27,200 grey seals.

There are four haul-out sites within the Proposed Development marine mammals study area where grey seals have been counted during August haul-out count surveys (though numbers were low at these sites):

- Long Craigs, Dunbar: 2018 n=10;
- Scart Rock, Dunbar: 2018 n=3;
- Black Bull, by Fast Castle, St Abbs: 2018 n=10; and
- Fast Castle: 1997 n=1.

⁷ Calculated as: (6,501/23.9)*100

These sites are all approximately 6 km to 12 km from the coastal boundary of the Proposed Development export cable corridor (Figure 12).

Table 5: Grey Seal August Haul-out Counts for Various Survey Periods

GREY SEAL	1996-1997	2000-2006	2007-2009	2011-2015	2016-2019
East Scotland	2,328	1,898	1,238	2,296	3,683
North-East England	613	1,100	2,350	6,942	6,501

The Tees data collected and provided by the Industry Nature Conservation Association (Bond, 2019). N'umberland coast south of Farne Islands not surveyed pre-2008, so earlier counts may be incomplete. The 2008 survey from Coquet Island to Berwick funded by the Department of Energy and Climate Change (DECC, previously DTI).

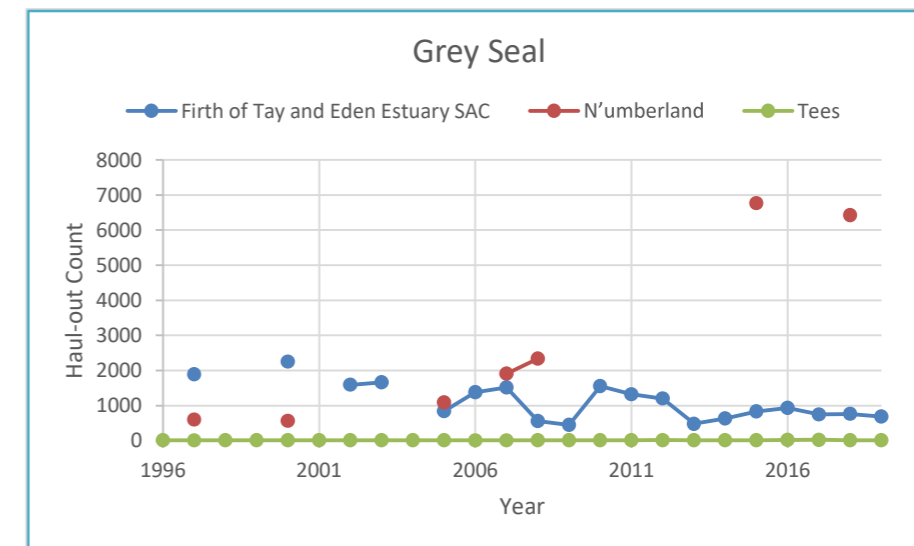


Figure 11: August Haul-out Counts of Grey Seals in the Firth of Tay and Eden Estuary SAC, Northumberland and the Tees

Table 6: August Counts of Grey Seals within the Firth of Tay and Eden Estuary SAC (East Scotland MU) and the North-east England MU between 1996 and 2019

Year	East Scotland MU						North-east England MU		
	Survey method	Upper Tay	Broughty Ferry	Buddon Ness	Abertay & Tentsmuir	Eden Estuary	N'um berland	Tees	Other
1996	n/s							11	
1997	1ti	61	0	0	1,820	10	603	10	
1998	n/s							11	
1999	n/s							12	
2000	1fw	64	0	101	2,088	0	568	11	
2001	n/s							11	
2002	1fw	78	0	0	1,490	25		12	
2003	1fw	50	16	33	1,560	4		11	
2004	1fw							13	
2005	2fw,1ti	42	0	11	763	27	1,092	12	
2006	1fw	22	8	25	1,267	57		8	
2007	1fw,1ti	27	1	85	1,375	31	1,907	8	
2008	2fw	26	8	7	483	33	2,338	12	
2009	1fw	55	0	0	395	0		12	
2010	1fw	98	0	12	1,406	39		14	
2011	1fw	16	2	22	1,265	17		14	
2012	1fw	39	3	13	1,111	36		18	
2013	1ti	127	0	18	323	14		16	
2014	1fw	62	2	0	531	39		16	
2015	1fw	115	0	2	687	32	6,767	16	
2016	1ti	132	0	0	738	66		22	60
2017	1fw	78	0	0	596	76		27	
2018	1fw	52	0	0	667	46	6,427	15	
2019	1fw	43	0	0	561	82		14	

fw, fixed-wing survey; ti, thermal imager helicopter survey

All east Scotland: Counts from SMRU aerial surveys using a fixed wing aircraft funded by NERC.

Northumberland: One complete survey in 2008 (funded by DECC). Helicopter surveys with thermal imager from Farne islands to Scottish Border in 1997, 2005, 2007, 2015, 2018. Fixed wing surveys of Holy Island only in 1994 & 2000.

The Tees: Ground counts by Industry Nature Conservation Agency (Bond, 2018). Single SMRU fixed-wing count in 1994.

Other: St Marys Island, Ravenscar, Filey Brigg (SMRU aerial surveys)

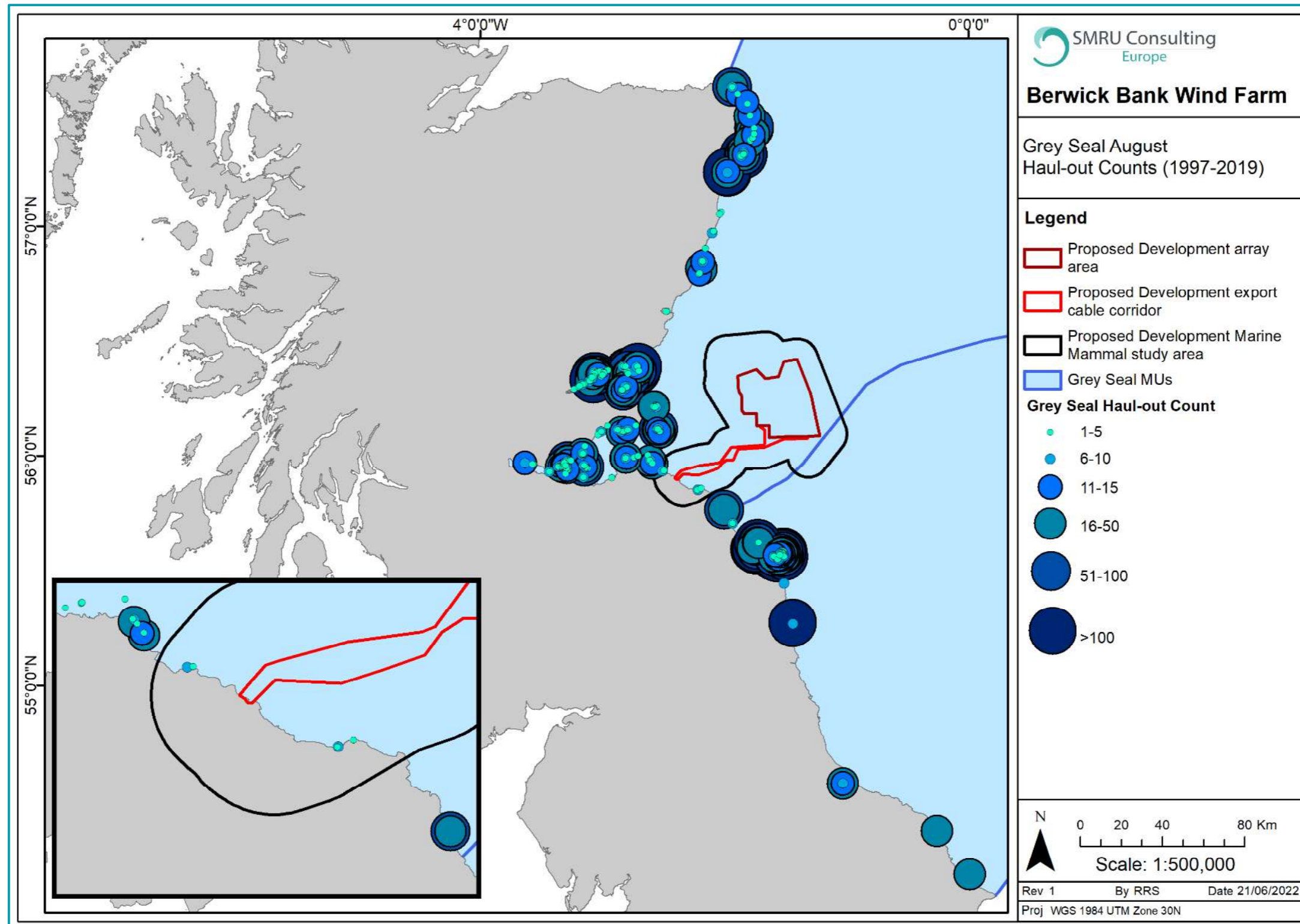


Figure 12: All Grey Seal August Haul-out Counts between 1997-2019, Inset: Haul-out Sites within the Proposed Development Marine Mammals Study Area and in Proximity to the Proposed Development Export Cable Corridor

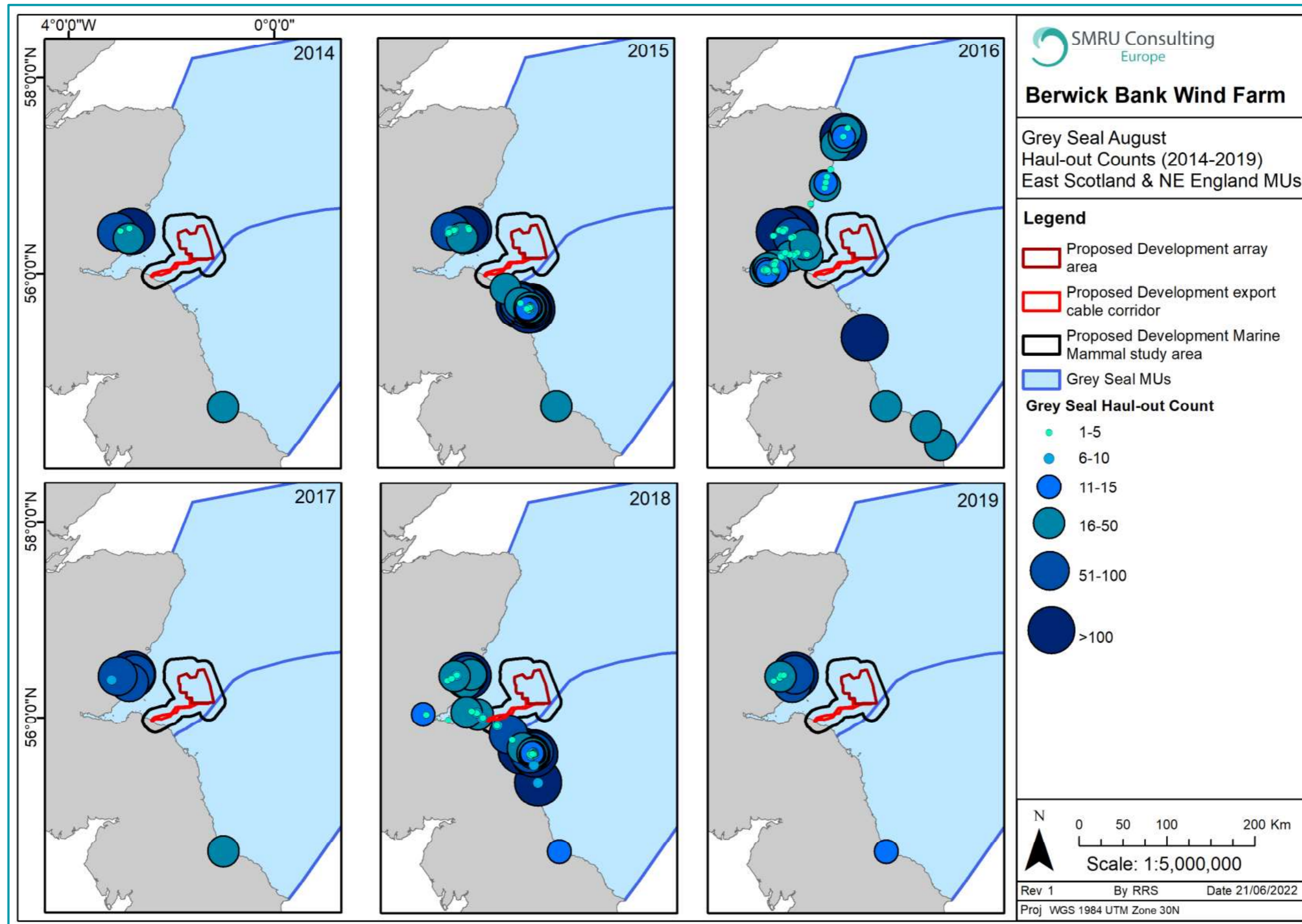


Figure 13: Grey Seal August Haul-out Counts between 2014 and 2019 in the East Scotland and NE England MUs

4 Grey Seal Pup Counts

All grey seal pup count data (collected in the autumn breeding season) for the East Scotland and North-east England MUs can be found in the Excel Workbook: **Pup Counts East Scot and NE Eng MUs.xls** found on <https://smrumarine.box.com/s/bwft0c8j9ag8k5vmq60iimwvi2l07pls>.

Figure 14 shows the distribution of the main grey seal breeding colonies within the UK. The main Scottish breeding surveys were last flown in 2016/2018, though some sites have been surveyed in years since then. The total number of pups estimated to have been born in 2018 in the UK was 68,050 (95% CI: 60,500 – 75,100 pups) (SCOS 2021). This pup production estimate is then used to estimate the total adult population size and projected forwards to the start of the 2018 breeding season (Russell *et al.*, 2019; Thomas *et al.*, 2019) (SCOS 2021). Based on the 2016/18 pup count, the adult population size at the start of the 2019 breeding season was estimated to be 149,700 (95% CI: 120,000 – 174,900) (SCOS 2021). The 2016/18 pup production estimate for Scotland was 55,200 which accounts for 81% of the grey seal pups born in the UK.

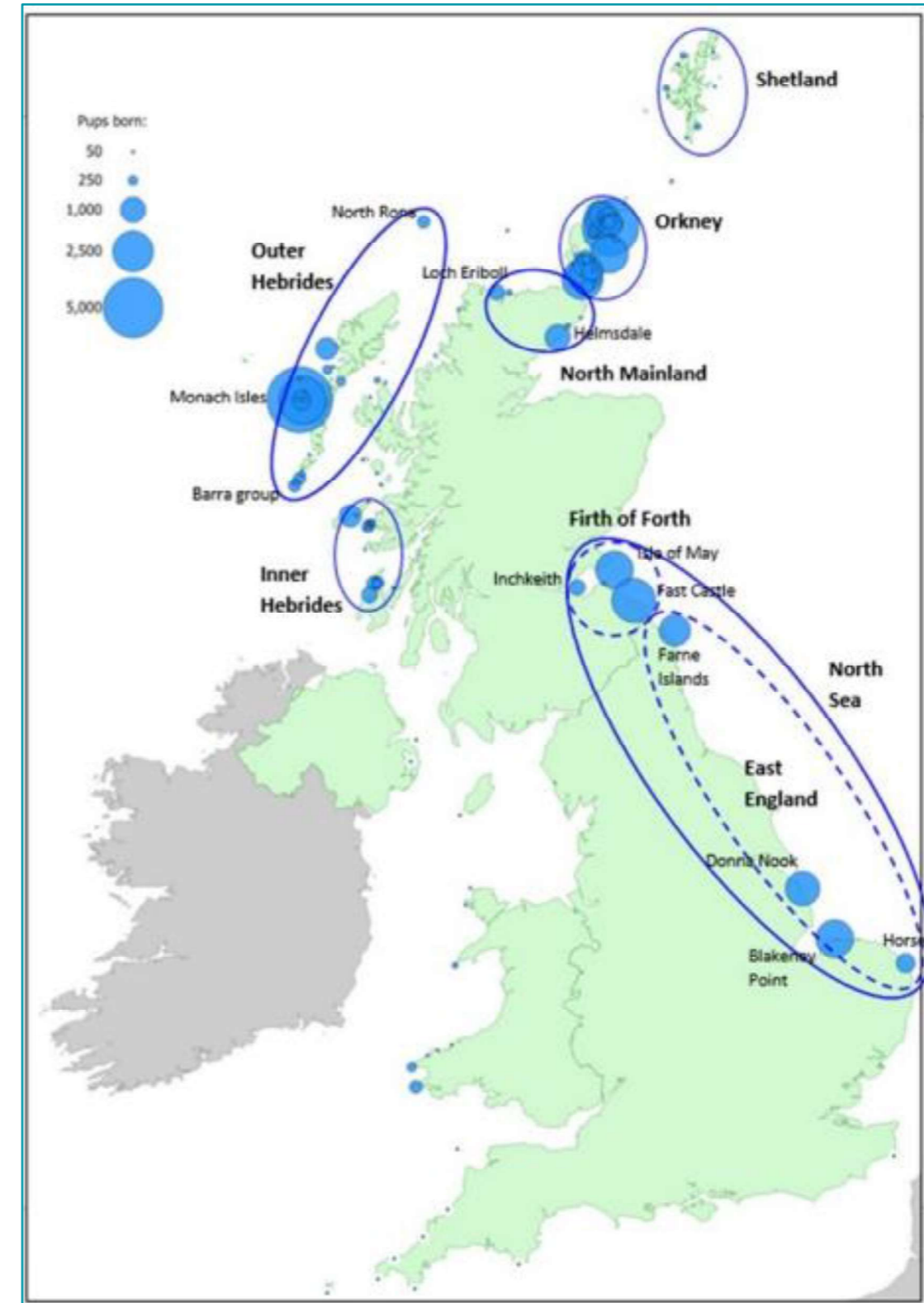


Figure 14: Distribution and Size of the Main Grey Seal Breeding Colonies (SCOS, 2021)

Blue ovals indicate groups of regularly monitored colonies within each region.

The grey seal population in the North Sea has grown almost constantly since the mid-1990s (Figure 15), and approximately 80% of the pups in this region are born within SACs: Isle of May SAC, Berwickshire & North Northumberland coast SAC (which is made up of Fast Castle and the Farne Islands), and the Humber Estuary SAC (includes Donna Nook) (Russell *et al.*, 2019).

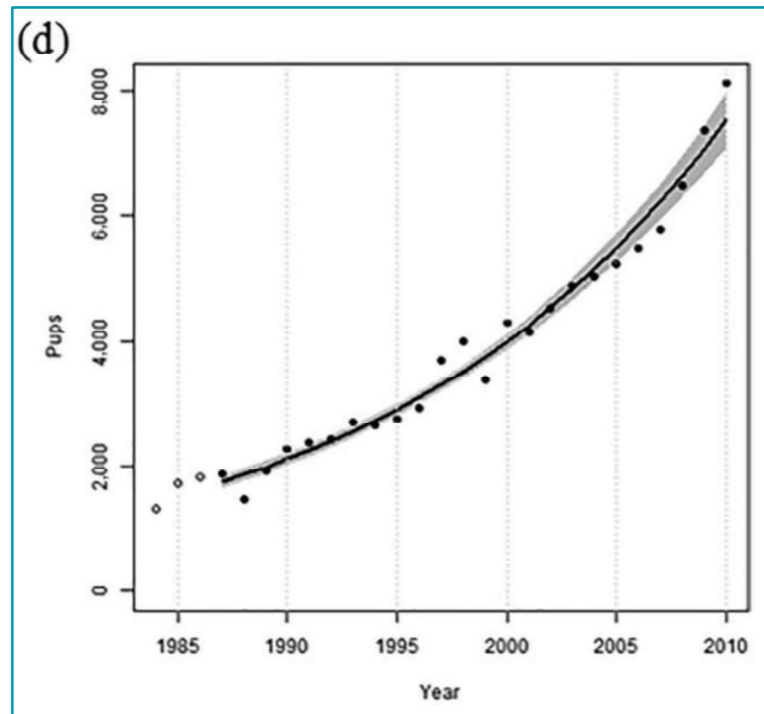


Figure 15: Estimated Pup Production of Regularly Monitored Colonies in the North Sea (Russell *et al.*, 2019)

Trends are fitted using estimates (filled dots) up to 2010. Mean predictions are shown from the best-fitting model (generalized linear model: solid line; generalized additive model: dashed line). The shaded areas indicate the 95% confidence intervals around the trends. Estimates using different methodology than described in the paper are shown as open dots.

There are five grey seal breeding sites in the East Scotland MU, all located within the Firth of Forth region (Craigleith, Fast Castle, Inchcolm, Inchkeith and the Isle of May). Additionally, there is one grey seal breeding site in the North-east England MU (the Farne Islands). The pup production counts in this area used to be dominated by the Isle of May and the Farne Islands: however, in recent years the pup counts at Fast Castle have considerably increased such that it now has the largest pup production count in the area (Figure 16).

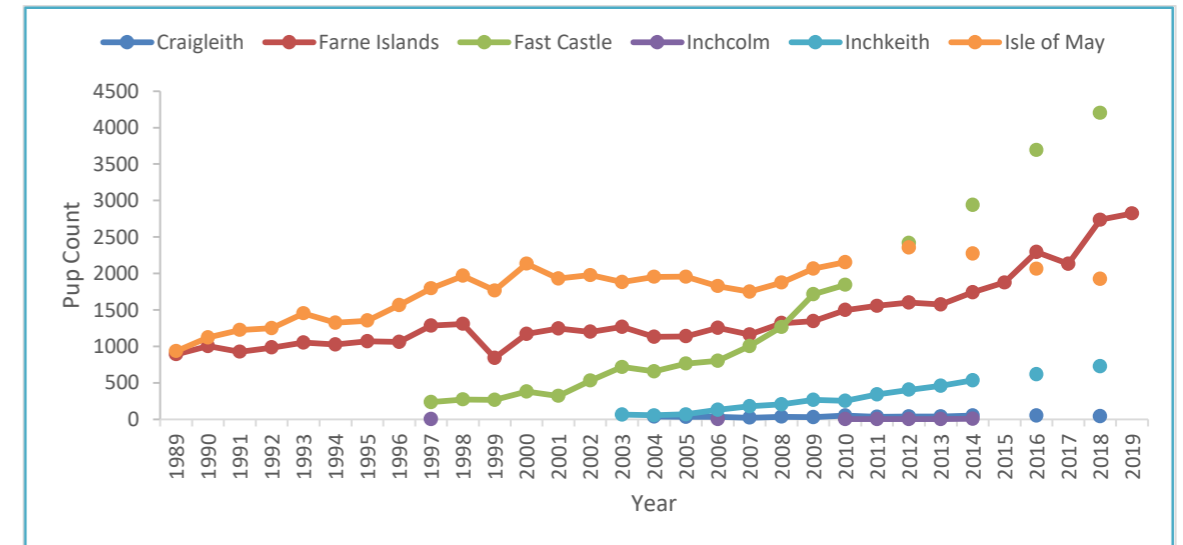


Figure 16: Grey Seal Pup Production Counts in the East Scotland and North-east England MUs

5 Telemetry Data

Shapefiles of all individual seals with telemetry data within the Proposed Development marine mammals study area are provided in:

Harbour_seal_telem_within_study_area.shp

Grey_seal_telem_within_study_area_-_adults.shp

Grey_seal_telem_within_study_area_pup_juv.shp

A list of the data for each individual seal tagged in East Scotland and the North-east England MUs is provided in: **Telemetry Bios.xls**.

All files are found on <https://smrumarine.box.com/s/bwft0c8j9ag8k5vmq60iimwvi2l07pls>.

5.1 Harbour seals

Harbour seals typically forage within 40 - 50 km from their haul-out sites (compared to >100 km for grey seals) (SCOS 2020). In total, 46 adult harbour seals have been tagged in the East Scotland MU between 2001 and 2017 (Table 7). Of the 46 adult harbour seals tagged in east Scotland, 25 had telemetry track data recorded within the Proposed Development marine mammals study area (Figure 17). The telemetry tracks were concentrated in the north-west of the Proposed Development marine mammals study area, with considerably lower numbers of tracks within the south-east of the Proposed Development array area or the Proposed Development export cable corridor. All 25 of these harbour seals also showed connectivity with the Firth of Tay and Eden Estuary SAC.

Only two of the 25 harbour seals tagged in the East Scotland MU recorded telemetry data out with the East Scotland MU, with both seals recording telemetry tracks within the North-east England MU. No harbour seals have been tagged in the North-east England MU.

Table 7: Summary Information for All 50 Harbour Seals Tagged in the East Scotland MU

Date	Total	Location	Sex	Tag Type	Funders
Nov 2001	4	3x Abertay 1x Eden	4x M	4x Argos SRDL	DECC and NERC
Jan 2002	6	6x Eden	5x F1x M	6x Argos SRDL	DECC and NERC
Oct 2002	5	1x Abertay 4x Eden	1x F 4x M	5x Argos SRDL	DECC and NERC
Jan 2003	2	2x Eden	2x M	2x Argos SRDL	SMRU and NERC
Mar 2003	8	8x Eden	6x F2x M	8x Argos SRDL	SMRU and NERC
May 2008	6	6x Eden	3x F3x M	6x GPM GSM	SNH and Marine Scotland
Feb 2011	5	5x Eden	1x F4x M	5x GPM GSM	SNH and Marine Scotland
May 2012	3	3x Eden	3x M	3x GPS/ARGOS GPS_SRDL	NERC, SNH & Marine Scotland
July 2012	3	3x Eden	3x M	3x GPS/ARGOS GPS_SRDL	NERC, SNH & Marine Scotland
Mar 2013	1	1x Kirkaldy	1x M	1x GPS GSM	SNH
May 2013	3	3x Kirkaldy	1x F2x M	3x GPS GSM	SNH

Note: this does not include the 4 harbour seals tagged at the River Don in 2017 as they were tagged specifically for river studies and were tagged with UHF tags which would bias by not including long trips.

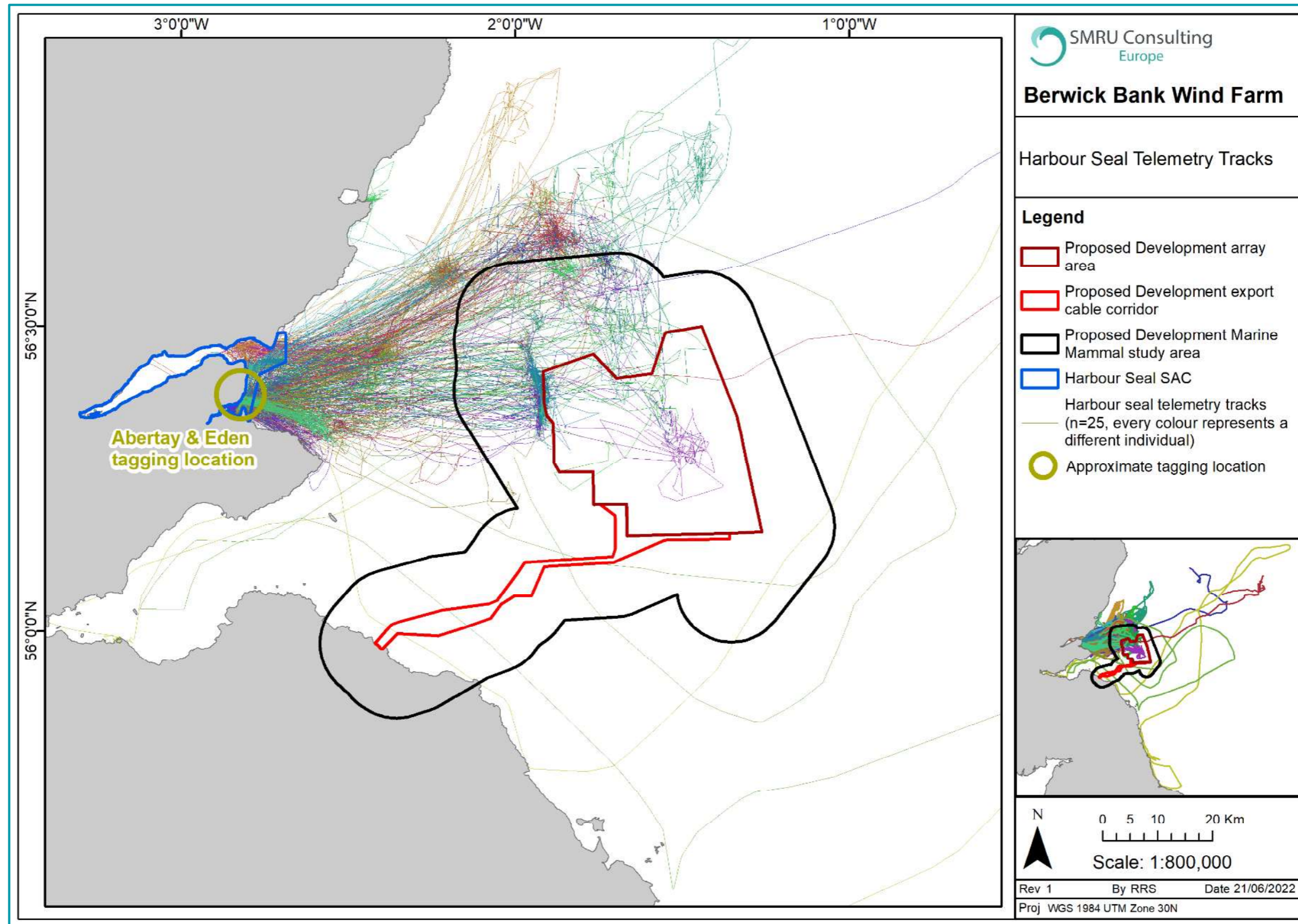


Figure 17: Telemetry Tracks for All 25 Harbour Seals that Entered into the Proposed Development Marine Mammals Study Area (all tagged in the East Scotland MU)

5.2 Grey seals

Note: the telemetry data provided does not include a) individuals released from the SMRU pool facility or b) the individual known as "Hannibal" as they are not considered to be representative.

5.2.1 Adults

Telemetry data have shown that grey seals travel further to forage and between haul-out sites than harbour seals. Grey seals typically forage within 100 km of a haul-out site and foraging trips can last for 30 days, however individual tracks have shown that some grey seals can make trips several hundred kilometres offshore (SCOS 2020).

In total, 46 adult grey seals have been tagged in the East Scotland MU between 1990 and 2013, and a further 23 have been tagged in the North-east England MU between 1991 and 2008 (Table 8).

Whilst the focus of this report was on the East Scotland MU and North-east England MU, all tagged grey seals recorded within the Proposed Development marine mammals study area were investigated to determine their origin. Of the 59 adult grey seals that were tracked within the Proposed Development marine mammals study area (Figure 18):

- 38 were tagged in the East Scotland MU;
- 18 were tagged in the North-east England MU; and
- three were tagged in the North Coast and Orkney MU.

Grey seals tracks have been recorded throughout the Proposed Development marine mammals study area, with a higher density of tracks in the north-west and south-east parts of the Proposed Development array area and a lower density of tracks within the eastern parts of the Proposed Development array area and the Proposed Development export cable corridor. The data showed wide ranging behaviour, with individual grey seals tagged in the East Scotland MU and recording telemetry data within the Proposed Development marine mammals study area, also recording telemetry tracks as far as the Outer Hebrides and Denmark (green lines Figure 18).

These 59 adult grey seals with telemetry track data within the Proposed Development marine mammals study area also showed connectivity with several UK grey seal SACs:

- 43 had telemetry tracks within the Berwickshire and North Northumberland Coast SAC (73%);
- 24 had telemetry data within the Isle of May SAC (41%);
- two had telemetry tracks within the Faray and Holm of Faray SAC (3%);
- one had telemetry tracks within the Humber Estuary SAC (2%);
- one had telemetry tracks within the North Rona SAC (2%); and
- one had telemetry tracks within the Monach Islands SAC (2%).

Therefore, it can be concluded that there is a high level of connectivity between the Proposed Development marine mammals study area and the Berwickshire and North Northumberland Coast SAC and the Isle of May SAC (the two closest grey seal SACs) and lower levels of expected connectivity with grey seal SACs at further distances.

5.2.2 Pups and juveniles

The movement data obtained from telemetry tags on pups and juveniles may not be representative of the typical movement patterns of adult grey seals, since recently weaned pups are known to

disperse widely to haul-out locations far from their birth colony location (Brasseur *et al.*, 2015; Carter *et al.*, 2017; Peschko *et al.*, 2020). Therefore, their telemetry data has been shown separately here.

In total, 3 grey seal juveniles, 28 pups and 1 unknown age class grey seals have been tagged in the East Scotland MU between 2001 and 2014, and a further 8 grey seal pups have been tagged in the North-east England MU (Table 8).

As for adult seals, any tagged grey seal juvenile/pups within the Proposed Development marine mammals study area were investigated to determine their origin (tagging location). Of a total 38 pup/juvenile grey seals recorded within the Proposed Development marine mammals study area (Figure 19):

- 31 were tagged in the East Scotland MU; and
- seven were tagged in the North-east England MU.

These 38 pup/juvenile grey seals with telemetry track data within the Proposed Development marine mammals study area showed wide ranging behaviour, with telemetry tracks extending into Norwegian and Dutch waters. They also showed connectivity with several UK grey seal SACs:

- 27 had telemetry tracks within the Berwickshire and North Northumberland Coast SAC (71%);
- 19 had telemetry tracks within the Isle of May SAC (50%); and
- two had telemetry tracks within the Humber Estuary SAC (5%).

Table 8: Summary Information for the 109 Grey Seals tagged in the East Scotland or North-east England MUs

MU	Year	#	Tagging Location	Sex	Tag Type
Adults					
East Scotland	Nov 1990	3	Isle of May	3x F	ARGOS SRDL
	Jul 1993	2	Abertay	1x F, 1x M	ARGOS SRDL
	Nov 1996	7	Isle of May	7x F	ARGOS SRDL
	Jun 1997	7	6x Abertay 1x Isle of May	4x F, 3xM	ARGOS SRDL
	May 1998	10	Abertay	3x F, 7x M	ARGOS SRDL
	Jun 2001	1	Abertay	1x F	ARGOS SRDL
	Sep 2004	1	St Andrews	1x F	ARGOS SRDL
	May 2005	2	Tentsmuir	1x F, 1x M	GPS/ARGOS, GPS_SRDL
	Apr 2008	9	Abertay	5x F, 4x M	GPS GSM
Aug 2013	4	Abertay	2x F, 2x M	1x GPS/ARGOS, GPS_SRDL 8x GPS GSM	
North-east England	Aug 1991	4	Farnes	4x M	ARGOS SRDL
	Nov 1991	1	Farnes	1x F	ARGOS SRDL
	Mar 1992	3	Farnes	3x M	ARGOS SRDL
	Jul 1992	4	Farnes	1x F, 3xM	ARGOS SRDL
	Jul 1997	1	Farnes	1x M	ARGOS SRDL
	Apr 2008	10	Farnes	5x F, 5x M	ARGOS SRDL
Pups/Juveniles/Unknown					
East Scotland	Nov/Dec 2001	11	Isle of May	5x F, 5x M	ARGOS SRDL
	Nov 2002	2 (juv)	St Andrews	2x F	
	Nov/Dec 2002	10 (pup)	Isle of May	5x F, 5x M	ARGOS SRDL
	Mar 2005	1 (unk.)	Tentsmuir	unknown	GPS/ARGOS, GPS_SRDL
	Mar 2005	1 (juv)	St Andrews	1x F	ARGOS SRDL
	Nov/Dec 2014	7 (pup)	Isle of May	4x F, 3x M	GPS GSM
North-east England	Dec 1993	4 (pup)	Farnes	2x F, 2x M	ARGOS SRDL
	Dec 1994	4 (pup)	Farnes	2x F, 2x M	ARGOS SRDL

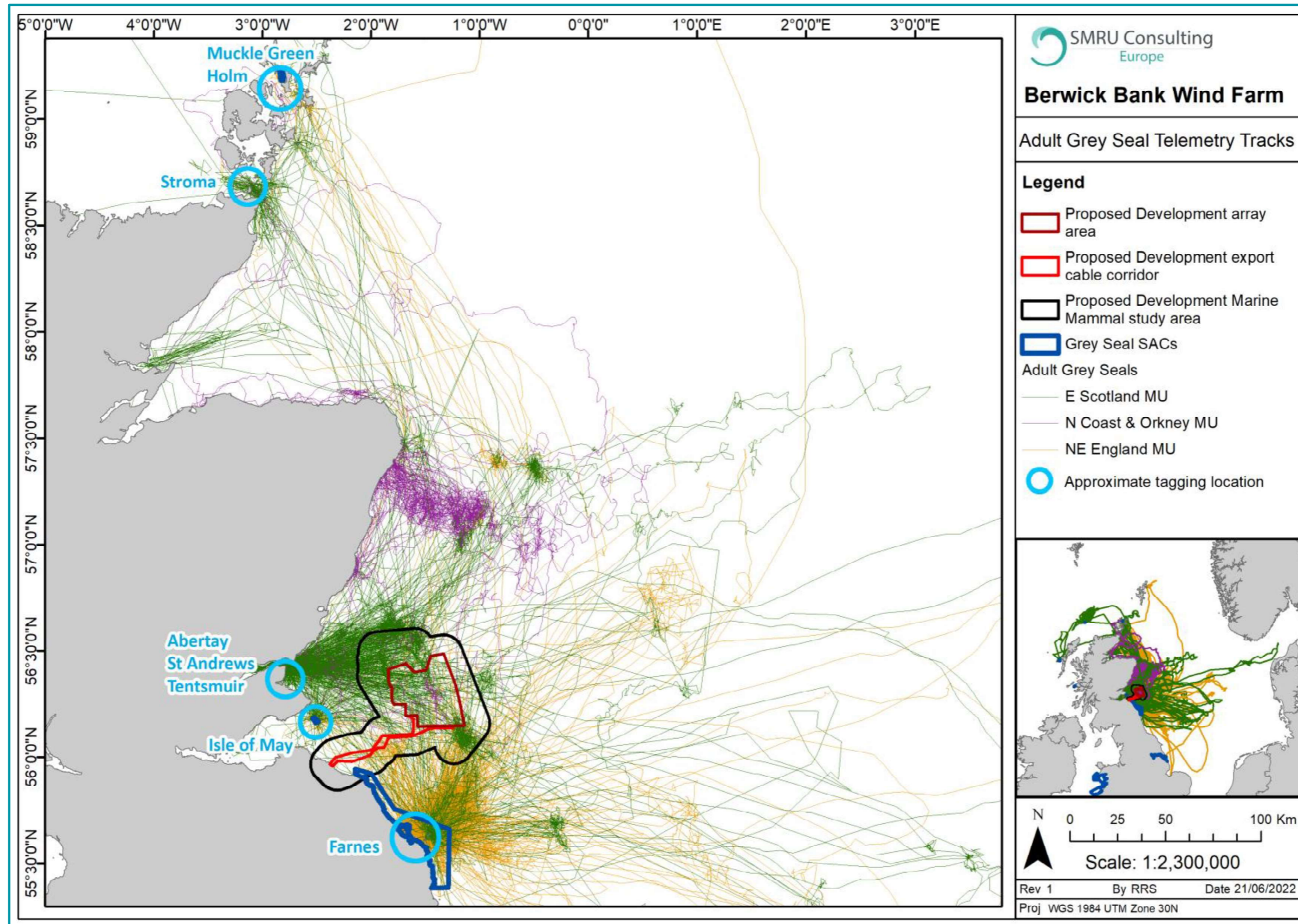


Figure 18: Telemetry Tracks for All 59 Adult Grey Seals that Entered into the Proposed Development Marine Mammals Study Area (Coloured by the MU They Were Tagged in)

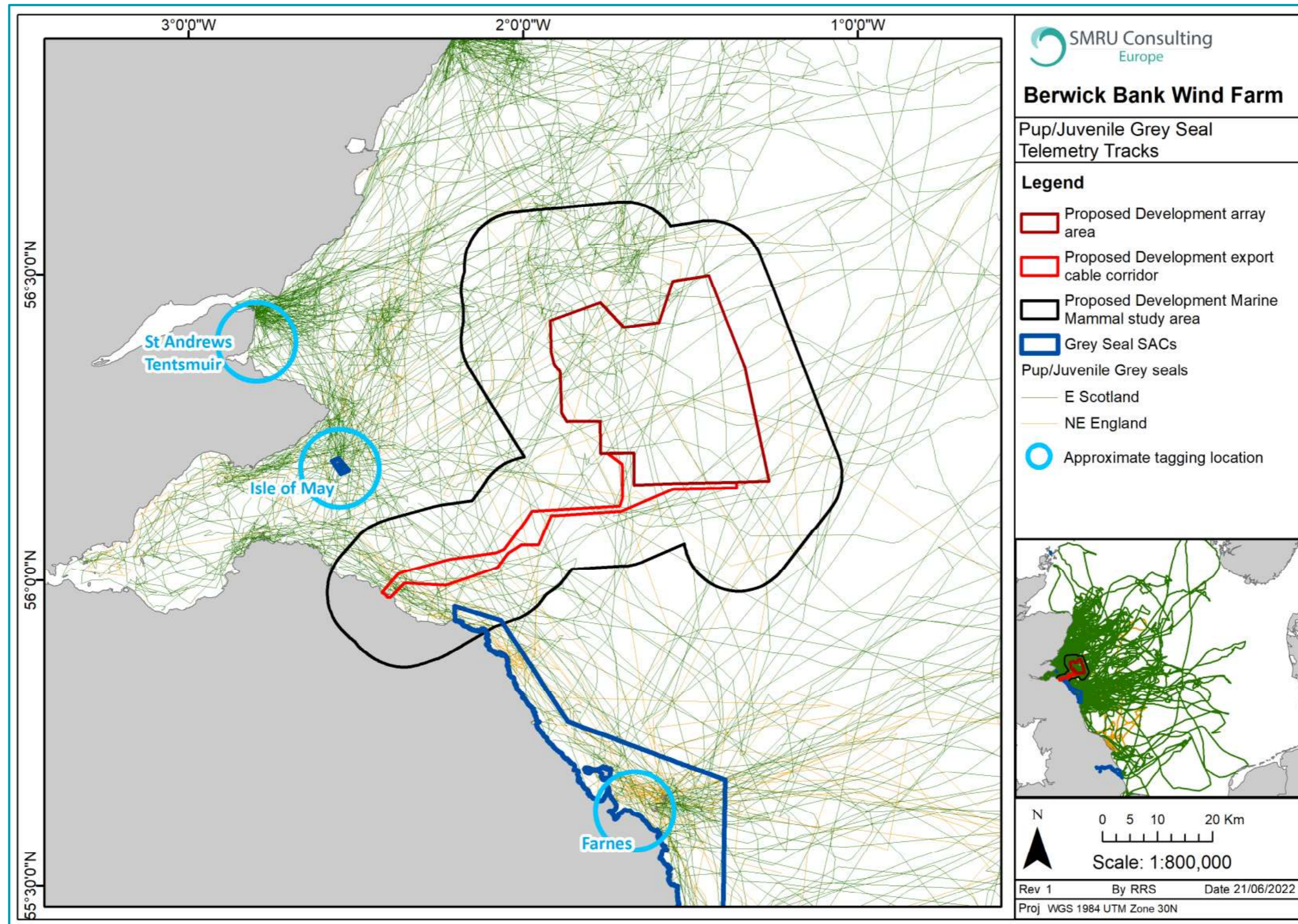


Figure 19: Telemetry Tracks for All 38 Pup/Juvenile Grey Seals that Entered into the Proposed Development Marine Mammals Study Area (Coloured by the MU They Were Tagged in)

6 Summary

6.1 Haul-out counts

- Not all sites within the East Scotland MU are surveyed annually.
- Harbour seal:
 - Counts for the East Scotland MU have declined since the 1996-1997 count period.
 - East Scotland MU: The most recent haul-out count of 343 can be scaled by the proportion of seals hauled-out to result in a total East Scotland MU population size estimate of 476 harbour seals.
 - North-east England MU: The most recent haul-out count of 79 can be scaled by the proportion of seals hauled-out to result in a total North-east England MU population size estimate of ~110 harbour seals.
 - There were no harbour seal haul-outs recorded within the Proposed Development marine mammals study area (Figure 9).
- Grey seal:
 - East Scotland MU: An August haul-out count of 3,683 can be scaled to account for the proportion of the population at seal at the time of the survey to result in a population estimate within the East Scotland MU of ~15,400 grey seals.
 - North-east England MU: The August haul-out count of 6,501 can be scaled to account for the proportion of the population at seal at the time of the survey to result in a population estimate within the North-east England MU of ~27,200 grey seals.
 - There were four haul-out sites within the Proposed Development marine mammals study area where grey seals have been counted (Figure 12).

6.2 Pup counts

- The grey seal population in the North Sea has grown almost constantly since the mid-1990s (Figure 15).
- There are five grey seal breeding sites in the East Scotland MU, all located within the Firth of Forth region (Craigleith, Fast Castle, Inchcolm, Inchkeith and the Isle of May).

6.3 Telemetry

- Harbour seal:
 - Telemetry tracks were concentrated in the north-west of the Proposed Development marine mammals study area.
 - There was a high level of connectivity between the Proposed Development marine mammals study area and the Firth of Tay and Eden Estuary SAC.
- Grey seal:
 - Telemetry tracks were recorded throughout the Proposed Development marine mammals study area, with a higher density of tracks in both the north-west and south-east of the Proposed Development array area.

- There was a high level of connectivity between the Proposed Development marine mammals study area and both the Berwickshire and North Northumberland Coast SAC and the Isle of May SAC.
- There were lower levels of expected connectivity between the Proposed Development marine mammals study area and grey seal SACs at further distances (e.g. Faray and Holm of Faray SAC, Humber Estuary SAC, North Rona SAC, and Monach Islands SAC).

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