



Morven North Offshore Wind Array Project

Environmental Impact Assessment Report

**Volume 3, Annex 10.4: Marine Mammals Shared
Seal Telemetry and Haul-out Data Study Technical
Report**

MVCNS-J1201-RPS-10042
May 2026

B01



Document status

Version	Purpose of document	Authored by	Checker	Approved by	Date
FINAL	Application	SMRU	TTRPSEL	MvOWL	May 2026

The report has been prepared for the exclusive use and benefit of our client and solely for the purpose for which it is provided. Unless otherwise agreed in writing by Tetra Tech RPS Energy Ltd, any of its subsidiaries, or a related entity (collectively 'Tetra Tech RPS Energy') no part of this report should be reproduced, distributed or communicated to any third party. Tetra Tech RPS Energy does not accept any liability if this report is used for an alternative purpose from which it is intended, nor to any third party in respect of this report.

The report does not account for any changes relating to the subject matter of the report, or any legislative or regulatory changes that have occurred since the report was produced and that may affect the report. The report has been prepared using the information provided to Tetra Tech RPS Energy by its client, or others on behalf of its client.

To the fullest extent permitted by law, Tetra Tech RPS Energy shall not be liable for any loss or damage suffered by the client arising from fraud, misrepresentation, withholding of information material relevant to the report or required by Tetra Tech RPS Energy, or other default relating to such information, whether on the client's part or that of the other information sources, unless such fraud, misrepresentation, withholding or such other default is evident to Tetra Tech RPS Energy without further enquiry. It is expressly stated that no independent verification of any documents or information supplied by the client or others on behalf of the client has been made. The report shall be used for general information only.

Prepared by:

TTRPSEL

Prepared for:

Morven Offshore Wind Limited



SMRU Consulting

understand ♦ assess ♦ mitigate

Morven North and Morven South Offshore Wind Array Projects Seal Telemetry and Haul-out Data Study

Authors:	Stevens, A
Report Code:	SMRUC-RPS-2024-023
Date:	Tuesday, 28 April 2026

THIS REPORT IS TO BE CITED AS: STEVENS (2025). MORVEN NORTH AND MORVEN SOUTH ARRAY PROJECT SEAL TELEMETRY AND HAUL-OUT DATA STUDY. REPORT NUMBER SMRUC-RPS-2024-023. SUBMITTED TO RPS, MARCH 2025.

Document Control

Please consider this document as uncontrolled copy when printed

Rev.	Date.	Reason for Issue.	Prep.	Chk.	Apr.	Client
1	Dec 2024	First draft	AS	RRS	RRS	RPS
2	Mar 2025	Second draft	AS	RRS	RRS	RPS
3	Mar 2025	Final	TTRPSE	TTRPSE	TTRPSE	TTRPSE

Contents

Contents.....	2
Figures.....	3
Tables.....	4
1 Introduction	5
1.1 Study Area	5
2 Methods.....	7
2.1 Haul-out Surveys.....	7
2.1.1 Sea Mammal Research Unit Surveys.....	7
2.1.2 Summary of methods.....	9
2.2 Telemetry data.....	12
3 Protected sites	13
3.1 Special Areas of Conservation.....	13
3.2 Designated haul-out sites	15
4 August haul-out counts.....	17
4.1 Harbour seal.....	17
4.1.1 United Kingdom Population	17
4.1.2 Seal Monitoring Unit August counts	18
4.1.3 Distribution of August haul-outs.....	19
4.2 Grey seal.....	23
4.2.1 United Kingdom Population	23
4.2.2 Seal Monitoring Unit August Counts.....	24
4.2.3 Distribution of August haul-outs.....	25
4.2.4 Grey Seal Pup Counts	30
5 Telemetry Data	33
5.1 Grey seals	37
5.1.1 Adults and juveniles	37
5.1.2 Pups.....	38
6 Summary.....	43
6.1 Haul-out counts.....	43
6.2 Grey seal pup counts.....	44
6.3 Telemetry.....	44
7 Data Provided.....	44
8 Literature Cited	45

Figures

FIGURE 1.1 THE MORVEN NORTH AND MORVEN SOUTH BOUNDARIES, MORVEN OPTION LEASE AGREEMENT SITE MARINE MAMMAL STUDY AREA, AND EAST SCOTLAND AND NORTHEAST ENGLAND SMUS	6
FIGURE 2.1 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).	10
FIGURE 2.2 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).	11
FIGURE 2.3 AERIAL SURVEYS CARRIED OUT DURING THE HARBOUR SEAL MOULT IN AUGUST (2011-2021). MOST AREAS WERE LAST SURVEYED BETWEEN 2016 AND 2021 (SCOS 2023).	12
FIGURE 3.1 HARBOUR SEAL AND GREY SEAL SACs IN THE EAST SCOTLAND AND NORTHEAST ENGLAND SMUS.....	14
FIGURE 3.2 DESIGNATED HAUL-OUT SITES IN THE EAST SCOTLAND SMU.	16
FIGURE 4.1 AUGUST DISTRIBUTION OF HARBOUR SEALS AROUND THE BRITISH ISLES BY 10KM SQUARES BASED ON THE MOST RECENT AVAILABLE HAUL-OUT COUNT DATA COLLECTED UP UNTIL 2021. LIMITED DATA AVAILABLE FOR SMUS 10-13; NO DATA AVAILABLE FOR ST KILDA. FIGURE OBTAINED FROM SCOS (2023).	17
FIGURE 4.2 AUGUST HAUL-OUT COUNTS OF HARBOUR SEALS WITHIN EACH OF THE SMUS WITHIN THE EAST SCOTLAND AND NORTHEAST ENGLAND SMUS. DATA FROM SCOS (2023).....	19
FIGURE 4.3 ALL HISTORICAL AUGUST HARBOUR SEAL HAUL-OUT COUNTS IN THE EAST SCOTLAND AND NORTHEAST ENGLAND SMUS BETWEEN 1996 AND 2021 COMBINED. DATA PROVIDED BY SMRU.....	20
FIGURE 4.4 ANNUAL AUGUST HARBOUR SEAL HAUL-OUT COUNTS IN THE EAST SCOTLAND AND NORTHEAST ENGLAND SMUS IN 1997, 2005, 2007, 2013, 2016 AND 2021. DATA PROVIDED BY SMRU.....	21
FIGURE 4.5 AUGUST HARBOUR SEAL HAUL-OUT COUNTS IN THE EAST SCOTLAND AND NORTHEAST ENGLAND SMUS FOR 2021. DATA PROVIDED BY SMRU.	22
FIGURE 4.6 AUGUST DISTRIBUTION OF GREY SEALS AROUND THE BRITISH ISLES BY 10KM SQUARES BASED ON THE MOST RECENT AVAILABLE HAUL-OUT COUNT DATA COLLECTED UP UNTIL 2021. LIMITED DATA AVAILABLE FOR SMUS 10-13; NO DATA AVAILABLE FOR ST KILDA. FIGURE OBTAINED FROM SCOS (2023).....	23
FIGURE 4.7 AUGUST HAUL-OUT COUNTS OF GREY SEALS WITHIN EACH OF THE MUs WITHIN THE EAST SCOTLAND AND NORTHEAST ENGLAND SMUS. DATA FROM SCOS (2023).	24
FIGURE 4.8 ALL AUGUST GREY SEAL HAUL-OUT COUNTS IN THE EAST SCOTLAND AND NORTHEAST ENGLAND SMUS BETWEEN 1997 AND 2021 COMBINED. DATA PROVIDED BY SMRU.	26
FIGURE 4.9 ANNUAL AUGUST GREY SEAL HAUL-OUT COUNTS IN THE EAST SCOTLAND AND NORTHEAST ENGLAND SMUS IN 1997, 2005, 2007 AND 2008. DATA PROVIDED BY SMRU.	27
FIGURE 4.10 ANNUAL AUGUST GREY SEAL HAUL-OUT COUNTS IN THE EAST SCOTLAND AND NORTHEAST ENGLAND SMUS FOR 2013, 2015, 2016 AND 2018. DATA PROVIDED BY SMRU.....	28
FIGURE 4.11 AUGUST GREY SEAL HAUL-OUT COUNTS IN THE EAST SCOTLAND AND NORTHEAST ENGLAND SMUS FOR 2021. DATA PROVIDED BY SMRU.	29
FIGURE 4.12 DISTRIBUTION AND SIZE OF THE MAIN GREY SEAL BREEDING COLONIES IN THE UK. BLUE OVALS INDICATE GROUPS OF REGULARLY MONITORED COLONIES WITHIN EACH REGION AND BLUE CIRCLES REPRESENT NUMBER OF PUPS BORN (SCOS 2022). NOTE: THE NORTH SEA COLONIES ARE SUB-DIVIDED INTO THE FIRTH OF FORTH COLONIES, AND THE EAST ENGLAND COLONIES (DASHED BLUE OVALS).....	31

FIGURE 4.13 GREY SEAL COLONY PUP PRODUCTION ESTIMATES IN THE EAST SCOTLAND SMU FROM 1989 TO 2019. DATA PROVIDED BY SMRU.	32
FIGURE 4.14 GREY SEAL PUP PRODUCTION ESTIMATES IN THE NORTHEAST ENGLAND SMU FROM 1989 TO 2019. DATA PROVIDED BY SMRU.	32
FIGURE 5.1 TELEMETRY TRACKS FOR ALL 49 HARBOUR SEALS THAT ENTERED THE EAST SCOTLAND AND NORTHEAST ENGLAND SMUS (46 TAGGED IN THE EAST SCOTLAND SMU, TWO IN THE MORAY FIRTH SMU AND ONE IN THE SOUTHEAST ENGLAND SMU). DATA PROVIDED BY SMRU.	35
FIGURE 5.2 HARBOUR SEAL TELEMETRY TRACKS THAT ENTERED THE MORVEN OPTION LEASE AGREEMENT SITE MARINE MAMMAL STUDY AREA AND SHOWED CONNECTIVITY TO THE FIRTH OF TAY AND EDEN ESTUARY SAC (N=4, ALL TAGGED IN EAST SCOTLAND SMU). DATA PROVIDED BY SMRU.	36
FIGURE 5.3 TELEMETRY TRACKS FOR THE 68 ADULT GREY SEALS THAT ENTERED THE EAST SCOTLAND AND NORTHEAST ENGLAND SMUS (45 TAGGED IN THE EAST SCOTLAND SMU, 23 IN THE NORTHEAST ENGLAND SMU, 10 IN THE NORTH COAST AND ORKNEY SMU, 18 IN THE SOUTHEAST ENGLAND SMU AND FIVE IN THE MORAY FIRTH SMUS. DATA PROVIDED BY SMRU.	39
FIGURE 5.4 ADULT GREY SEAL TELEMETRY TRACKS RECORDED WITHIN THE MORVEN OPTION LEASE AGREEMENT SITE MARINE MAMMAL STUDY AREA WHICH SHOWED CONNECTIVITY TO THE SURROUNDING SACs (N=16). DATA PROVIDED BY SMRU.	40
FIGURE 5.5 TELEMETRY TRACKS FOR ALL 45 GREY SEAL PUPS THAT ENTERED THE EAST SCOTLAND AND NORTHEAST ENGLAND SMUS (29 TAGGED IN THE EAST SCOTLAND SMU, EIGHT IN THE NORTHEAST ENGLAND SMU AND EIGHT IN THE NORTH COAST AND ORKNEY SMU). DATA PROVIDED BY SMRU.	41
FIGURE 5.6 GREY SEAL PUP TELEMETRY TRACKS RECORDED WITHIN THE MORVEN OPTION LEASE AGREEMENT SITE MARINE MAMMAL STUDY AREA WHICH SHOWED CONNECTIVITY TO THE SURROUNDING SACs (N=13). DATA PROVIDED BY SMRU.	42

Tables

TABLE 3.1 SACs WITHIN THE EAST SCOTLAND AND NORTHEAST ENGLAND SMUS.	13
TABLE 3.2 DESIGNATED SEAL (BOTH SPECIES) AND SEASONAL GREY SEAL HAUL-OUT SITES IN THE EAST SCOTLAND SMU.	15
TABLE 4.1 HARBOUR SEAL AUGUST HAUL-OUT COUNTS AND POPULATION ESTIMATES FOR VARIOUS SURVEY PERIODS. DATA FROM SCOS (2023).	18
TABLE 4.2 GREY SEAL AUGUST HAUL-OUT COUNTS AND POPULATION ESTIMATES FOR VARIOUS SURVEY PERIODS. DATA FROM SCOS (2023).	24
TABLE 5.1 SUMMARY INFORMATION FOR THE 46 HARBOUR SEALS TAGGED IN THE EAST SCOTLAND SMU. DATA PROVIDED BY SMRU.	34
TABLE 5.2 SUMMARY INFORMATION FOR THE 117 GREY SEALS TAGGED IN THE EAST SCOTLAND SMU (N=74) AND THE NORTHEAST ENGLAND SMU (N=31). DATA PROVIDED BY SMRU.	37

1 Introduction

SMRU Consulting was contracted by RPS on behalf of Morven Offshore Wind Limited (hereafter, “the Applicant”) to provide seal haul-out count and telemetry data for the Morven Option Lease Agreement Site in relation to the Morven North Offshore Wind Array Project and Morven South Offshore Wind Array Project (hereafter, “Morven North” and “Morven South”).

The following data were requested:

- Harbour seal (*Phoca vitulina*) haul-out 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 study area specified by the Applicant (see Section 1.1).
- Associated grey seal (*Halichoerus grypus*) haul-out 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 Morven Option Lease Agreement Site Marine Mammal Study Area specified by the Applicant (see Section 1.1).
- Provision of seal satellite tracking data from tagged harbour and grey seals - either animals tagged or hauling out at the Special Areas of Conservation (SACs) and visiting the Morven Option Lease Agreement Site Marine Mammal Study Area.
- Provision of satellite tracking data from all harbour or grey seals which cross the Morven Option Lease Agreement Site Marine Mammal 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 Morven Option Lease Agreement Site Marine Mammal Study Area and protected haul-out sites.

1.1 Study Area

The Applicant specified that the primary area of interest to be used for this data request was the Morven Option Lease Agreement Site Marine Mammal Study Area, which encompasses the Morven North Boundary and the Morven South Boundary plus a 4km buffer. The regional study area of interest for the data request was defined by the Seal Monitoring Unit (SMU) which intersected the Morven Option Lease Agreement Site Marine Mammal Study Area. This comprised the East Scotland and Northeast England SMUs (Figure 1.1).

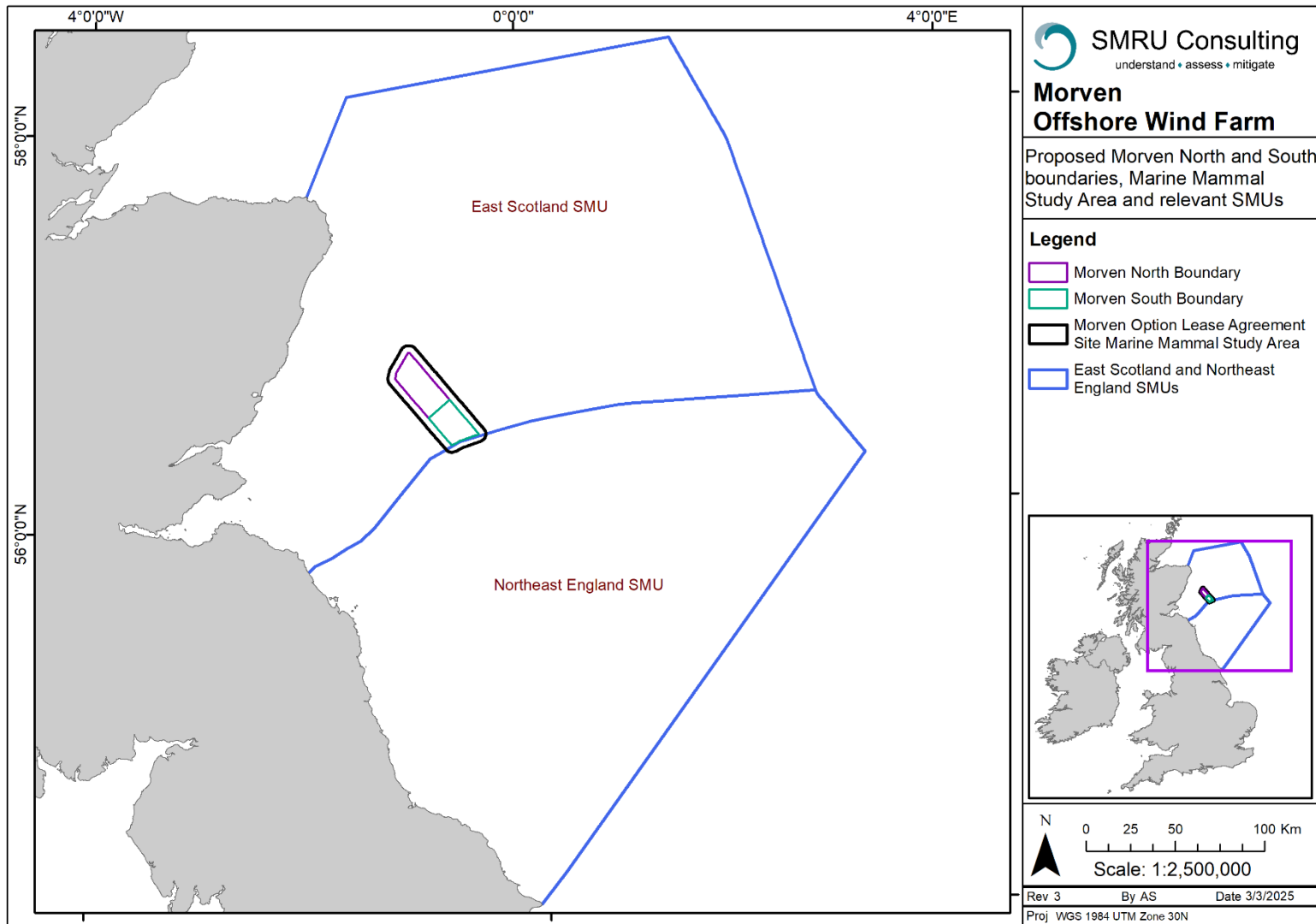


Figure 1.1 The Morven North and Morven South Boundaries, Morven Option Lease Agreement Site Marine Mammal Study Area, and East Scotland and Northeast England SMUs

2 Methods

2.1 Haul-out Surveys

2.1.1 Sea Mammal Research Unit Surveys

The Sea Mammal Research Unit (SMRU) carry 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 other organisations (including NatureScot, Natural England, Natural Resources Wales, National Trust and 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 (Northumberland, Lincolnshire and Norfolk) where seals are relatively abundant. 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 when moulting there is a relatively high and consistent proportion of population hauled out, 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 allow estimation of the number 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.

2.1.1.1 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.

2.1.1.1.1 Breeding counts

In recent years, harbour seal breeding surveys have been almost entirely restricted to The Wash, 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 Scotland. Given that there are no harbour seal breeding surveys conducted in the East Scotland or Northeast England SMUs, these are not considered further in this report.

2.1.1.1.2 August moult counts

The main population surveys are carried out when harbour seals are moulting, during the first three weeks of August (hereinafter referred to as August haul-out count surveys). The greatest and most consistent numbers of harbour seals are hauled-out ashore during their annual moult. To maximise the proportion of seals likely on shore and to reduce the effects of environmental variables, surveys are restricted to within two hours either side of low tides and are not conducted in the rain.

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

The frequency of surveys differs by area. In general, moult surveys that are conducted annually in Lincolnshire and Norfolk (England), the Moray Firth and the Firth of Tay and Eden SAC (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 using a helicopter equipped with a thermal imaging camera that can detect seals hauled out ashore at a distance of up to 3km. It is then possible to differentiate between the two species using the group structure on shore, a 'real' image from a camcorder, and from high resolution digital photographs. In some instances, however, species identity is still uncertain, and the seals are classified as 'species unknown'.

The moult counts represent the number of harbour seals that were on shore at the time of the survey and are a minimum estimate of the size of the population. 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 (such as the breeding period). The most recent count data presented in the SCOS 2022 report for the East Scotland and Northeast England SMUs are from 2021 (SCOS 2023).

It is estimated that 72 % (95 % CI: 54-88 %) of the total harbour seal population are hauled-out and available to count during August surveys (Lonergan et al. 2013). The harbour seal counts can be scaled by the proportion of seals hauled-out at the time of the counts, providing an estimated population size for an SMU.

2.1.1.2 Grey seals

2.1.1.2.1 August counts

Numbers of grey seals are also counted during the harbour seal August haul-out count surveys. Counts of greys seals during the summer months are highly variable, however they provide useful information on the summer and non-breeding season distribution of grey seals. The most recent data available presented in the SCOS 2022 report for the East Scotland and Northeast England SMUs are from 2021 (SCOS 2023).

It is estimated that 25.15 % (95 % CI: 21.45-29.07 %) of the total grey seal population are hauled-out and available to count during the August haul-out count surveys (Russel and Carter 2021) and, therefore, the total number of grey seals in the population for any given count period can be estimated by using the proportion of seals hauled-out.

Grey seals aggregate in the autumn (August – December) to breed at traditional colonies, and, therefore, their distribution during the breeding season is very different to their distribution at other times of the year (such as the annual moult – December-April, or other times of the year).

2.1.1.2.2 Pup production

Grey seals are surveyed during their breeding season, with most breeding colonies surveyed by SMRU using fixed wing aerial vertical photography (Hebrides, Orkney, North Scotland the Northeast Scotland, and most of the Firth of Forth) while others are surveyed by ground count by other organisations (Shetland and Inchcolm in the Firth of Forth). The grey seal pup production database (data provided by SMRU) contains data from 1996 to 2021 and includes 74 breeding colonies, 70 of which are in Scotland and one of which is in Northeast England (though not all colonies have been surveyed consistently 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 or triennial surveys instead due to reductions in funding combined with increased aerial survey cost and the extension of the survey programme into eastern England (SCOS 2015).

2.1.2 Summary of methods

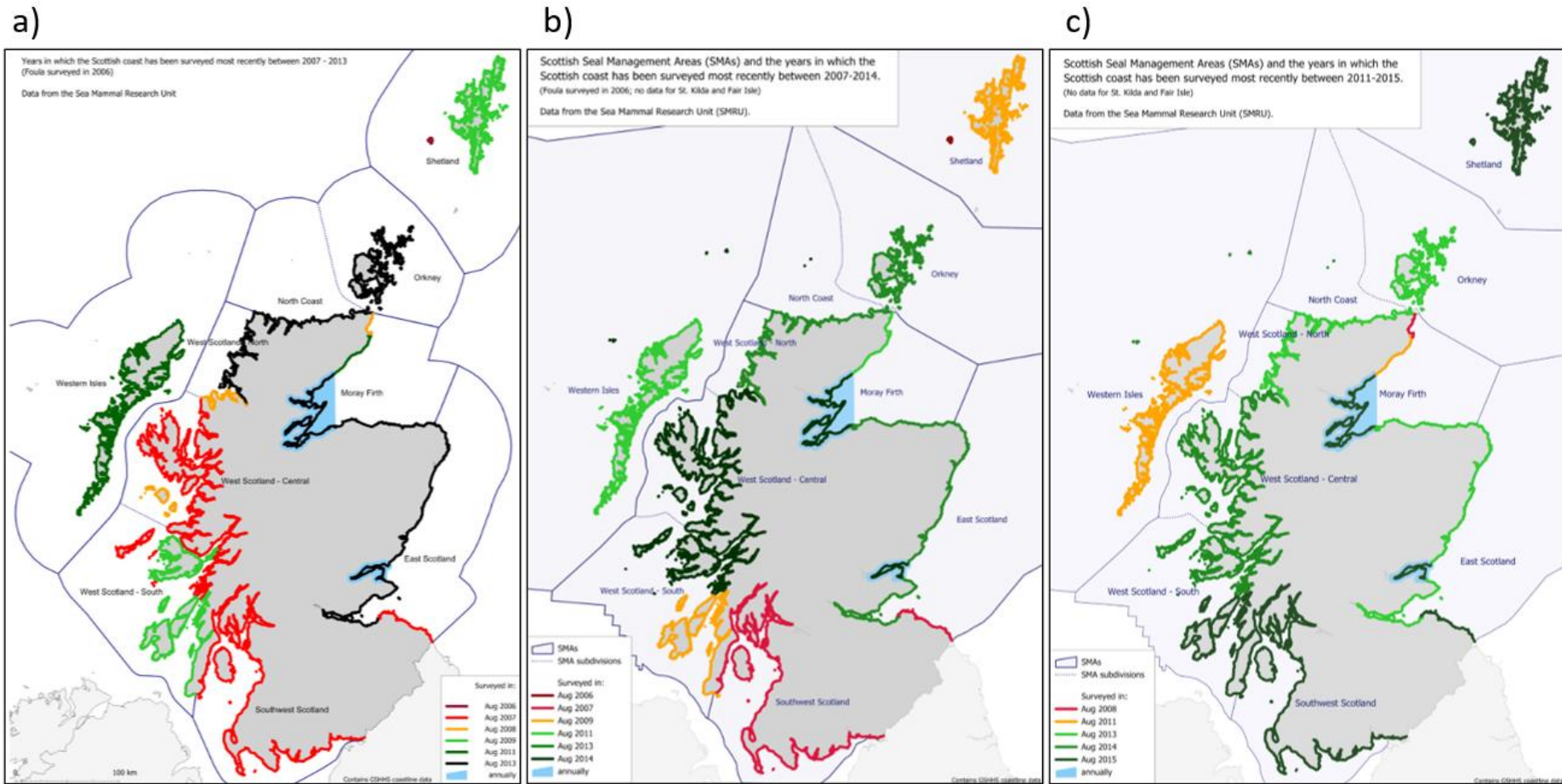
- Population surveys of harbour seals are carried out during their annual moult in August;
- Harbour seal August moult surveys provide a minimum estimate of the size of the population, not the total population size;
- In general, harbour seal population (August moult) surveys are carried out once every four to five years in most of Scotland but annually in Lincolnshire, Norfolk, the Moray Firth and the Firth of Tay. Surveys are conducted less frequently in Northern Ireland, and there are no systematic surveys conducted in Wales (<10 harbour seals);
- 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. These pup counts are used by SMRU to estimate the total grey seal UK population size;
- Grey seals are also counted during harbour seal August haul-out count surveys. Their numbers are highly variable in the summer months and provide information on the summer distribution and abundance of grey seals. These data also feed into the population model alongside pup data in order to estimate grey seal total population size;
- Population estimates of seals can be obtained by scaling the August haul-out count data by the proportion of the total population hauled-out and available for the count (harbour seal: 72 %, grey seal: 25.15 %);
- 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 website².

The haul-out count data from the annual SMRU surveys are not appropriate for assessing fine scale distribution of haul-out sites – these data are a snapshot usually from 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: 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 five years. Figures are provided in SCOS reports (and are duplicated here for information: Figure 2.1, Figure 2.2 and Figure 2.3) to highlight which part of the Scottish coastline has been surveyed each year³. In SCOS reporting, tables of the most recent haul-out counts are provided primarily by “survey period” (1996 to 1997, 2000 to 2006, 2007 to 2009, 2011 to 2015 and 2016 to 2019) as these represent periods within which the entire Scottish coastline was surveyed, as well as the most recent data from 2021 where only the East Scotland and Moray Firth SMUs were surveyed along the Scottish coast.

² <http://www.smru.st-andrews.ac.uk/research-policy/scos/>

³ Note: no equivalent map was provided in SCOS (2022).



a) Most areas were surveyed between 2007 and 2013. Foula, off Shetland, was last surveyed in 2006. The enclosed areas of the Firth of Tay and the Moray Firth (between Findhorn and Helmsdale) are surveyed every year, usually by fixed-wing aircraft.

b) Most areas were surveyed between 2007 and 2014. Foula, off Shetland, was last surveyed in 2006. The enclosed areas of the Firth of Tay and the Moray Firth (between Findhorn and Helmsdale) are surveyed every year, usually by fixed-wing aircraft.

c) Most areas were surveyed between 2011 and 2015. The enclosed areas of the Firth of Tay and the Moray Firth (between Findhorn and Helmsdale) are surveyed every year, usually by fixed-wing aircraft.

Figure 2.1 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).

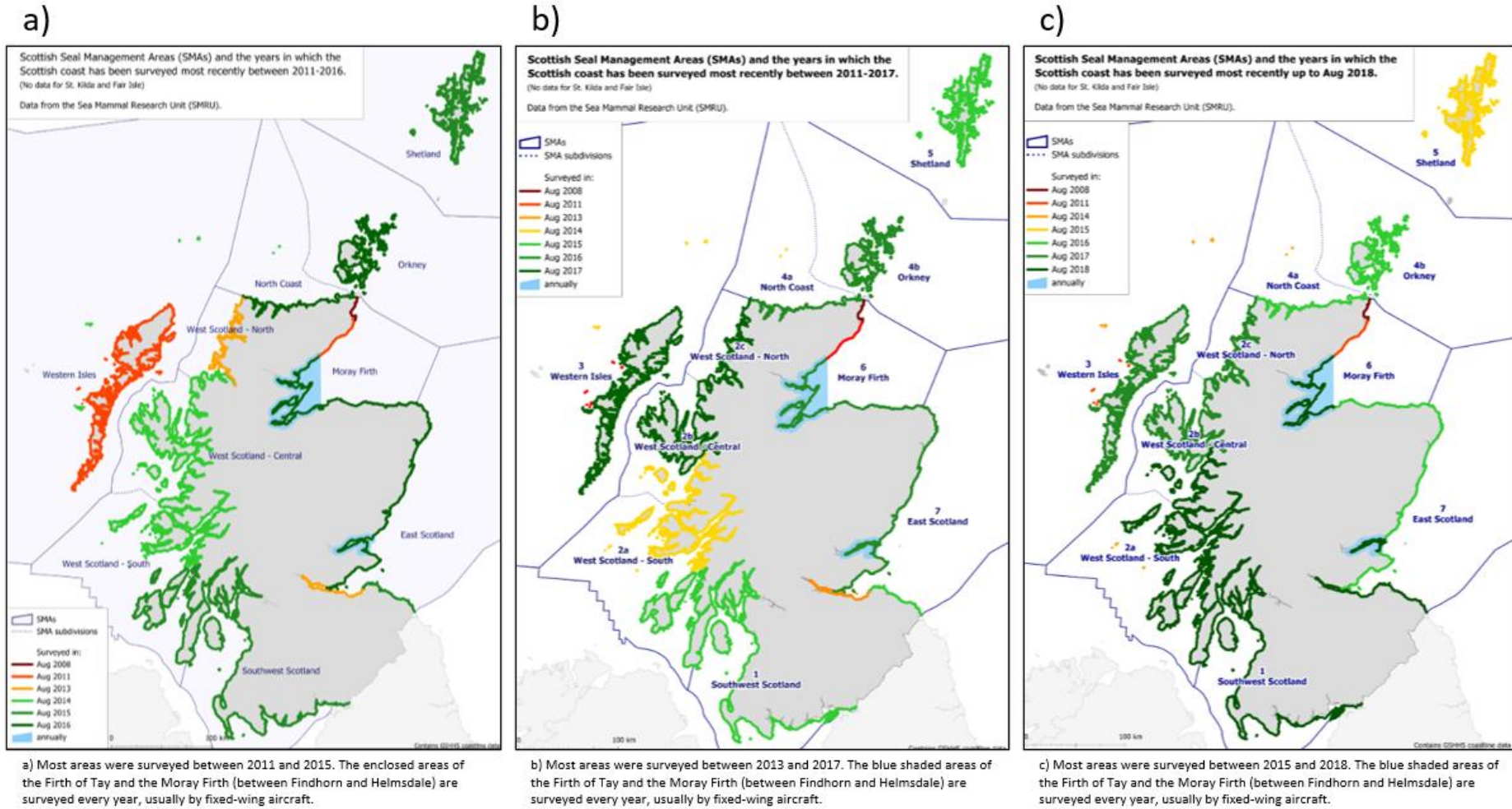
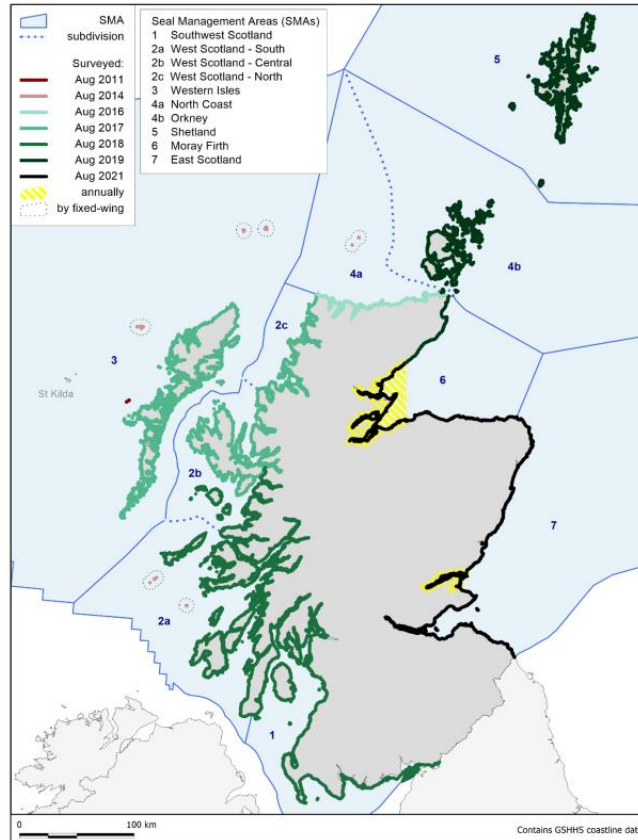


Figure 2.2 Years in which different parts of Scotland were surveyed by helicopter using a thermal imaging camera. a) 2011-2016 (SCOS 2018), b) 2011-2017 (SCOS 2019), c) 2011-2018 (SCOS 2020).



Most areas were last surveyed between 2016 and 2021. 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 has not been covered by aerial surveys.

Figure 2.3 Aerial surveys carried out during the harbour seal moult in August (2011-2021). Most areas were last surveyed between 2016 and 2021 (SCOS 2023).

2.2 Telemetry data

Relevant data were available for harbour and grey seals using the East Scotland and Northeast England SMUs 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 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. Argos location tags can have an error of >2.5km (Vincent et al. 2002) while GPS location tags have a better location accuracy, with a typical error of <50m (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 locational data every 5-20 minutes (depending on the parametrisation at set-up). Data are stored on board the tags and then relayed by a satellite (via Argos tags) or, more commonly, by quad-band GSM mobile phone module 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). Telemetry data obtained using Ultra High Frequency (UHF) tags are not included in the data presented as these tags would

introduce bias as these tags typically provide fewer locations over a shorter period of time are reliant on base stations which results in potential bias.

3 Protected sites

3.1 Special Areas of Conservation

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 species⁴. This network of SACs is designed to ensure that the species listed in Annex II of the EU Habitats Directive (1992), are maintained in a favourable conservation status in their natural range (Article 3(1)). This includes both grey and harbour seals (also Annex V species) and, therefore, SACs must be established for their protection. Information on the SACs which have been designated for harbour seals can be found on the JNCC website⁵. Information on the SACs which have been designated for grey seals can be found on the JNCC website⁶.

Within the East Scotland SMU, there is one SAC designated for harbour seals (Firth of Tay and Eden Estuary SAC) and there are two SACs designated for grey seals: the Isle of May SAC and the Berwickshire and North Northumberland Coast SAC (Table 3.1). The Berwickshire and North Northumberland Coast SAC also spans the Northeast England SMU. There are no SACs located within **the Morven Option** Lease Agreement Site Marine Mammal Study Area (Figure 3.1).

Table 3.1 SACs within the East Scotland and Northeast England SMUs.

SMU	SAC	Marine mammal species
East Scotland SMU	Berwickshire and North Northumberland Coast SAC	Grey seal
	Firth of Tay and Eden Estuary SAC	Harbour seal
	Isle of May SAC	Grey seal
Northeast England SMU	Berwickshire and North Northumberland Coast SAC	Grey seal

⁴ The UK retained the fundamental requirements of the Habitats Directive in domestic law after leaving the EU in January 2021.

⁵ <https://sac.jncc.gov.uk/species/S1365/>

⁶ <https://sac.jncc.gov.uk/species/S1364/>

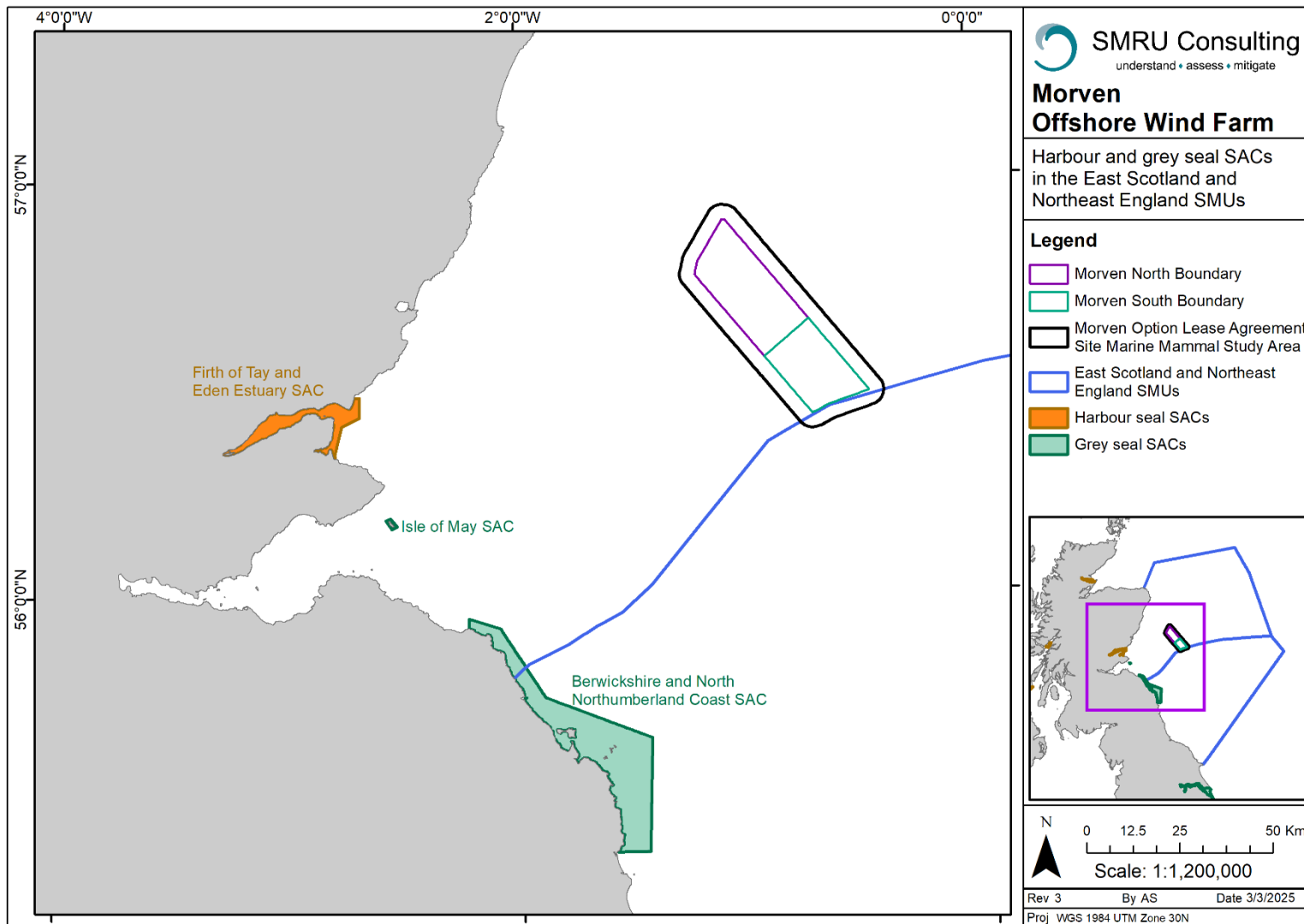


Figure 3.1 Harbour seal and grey seal SACs in the East Scotland and Northeast England SMUs.

3.2 Designated haul-out sites

Seal haul-out sites are designated under section 117 of the Marine (Scotland) Act 2010 in the Protection of Seals (Designation of Seal Haul-out Sites) (Scotland) Order 2014. These sites are areas where seals are known to use for resting, moulting and/or breeding activities and have been selected by the Scottish Ministers in consultation with SMRU (on behalf of the Natural Environment Research Council). There are currently 195 designated haul-out sites within Scotland and intentionally or recklessly harassing seals hauled-out at these sites is considered an offence.

In the East Scotland SMU, there are three designated haul-out sites for both species (Ythan River Mouth, Kinghorn Rocks, and Inchmickery and Cow and Calves) and three seasonal grey seal haul-out sites (Table 3.2 and Figure 3.2). However, the closest designated haul-out site (Ythan River Mouth) is located over 65km away, with all other sites being over 100km swimming distance away from the Morven Option Lease Agreement Site Marine Mammal Study Area. Designated haul-out sites are restricted to Scotland and, therefore, there are none located in the Northeast England SMU.

Table 3.2 Designated seal (both species) and seasonal grey seal haul-out sites in the East Scotland SMU.

Site ID	Site Name	Location	Distance from the Morven Option Lease Agreement Site Marine Mammal Study Area by sea
Designated harbour and grey haul-out sites (based on August survey counts)			
EC-001	Kinghorn Rocks	Firth of Forth North	137km
Intertidal mudbanks and rocky coastline between Long Craig and Linton Court and associated rocky outcrops.			
EC-002	Inchmickery and Cow and Calves	Firth of Forth	148km
Rocky coastline around Inchmickery and entire islands of Cow, Calves and Oxcars.			
EC-003	Ythan River Mouth	Ythan Estuary	65.5km
Areas of land above mean low water spring tide that fall within the areas of water and land adjacent to the mouth of the River Ythan			
Seasonal grey seal haul-out sites (based on grey seal breeding counts)			
BC-043	Fast Castle	between Dunbar and Eyemouth	101km
Rocky coastline at the foot of the cliffs between Coldingham Loch and Cove Harbour.			
BC-044	Inchkeith	halfway between Kinghorn and Leith	140km
Entire coast of Inchkeith.			
BC-045	Craigeith	off North Berwick	117km
Southern half of Craigeith.			

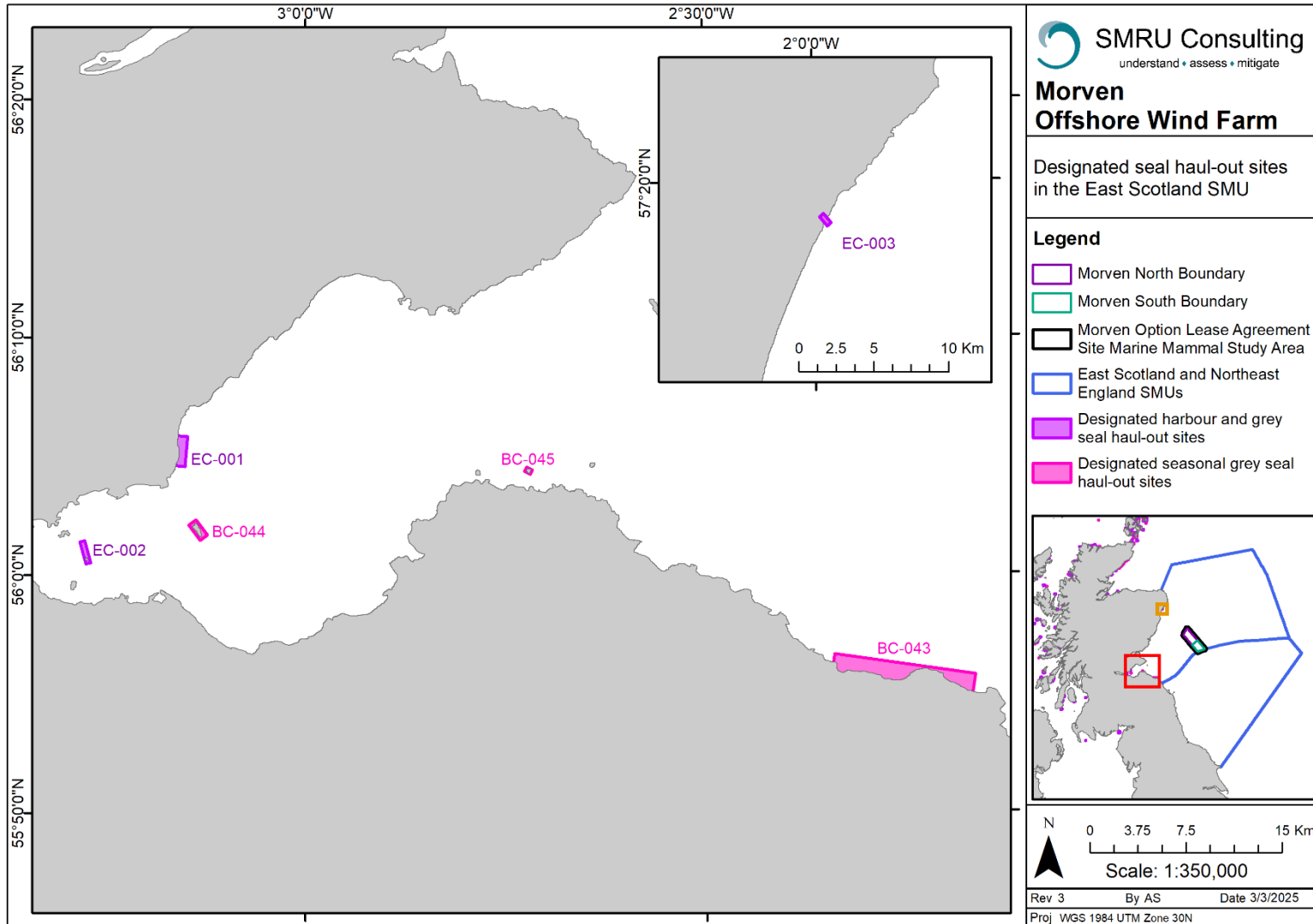


Figure 3.2 Designated haul-out sites in the East Scotland SMU.

4 August haul-out counts

4.1 Harbour seal

4.1.1 United Kingdom Population

The most recent August haul-out count for the whole of Scotland is for the count period 2016 to 2019 and 2021, where a total of 26,378 harbour seals were counted (includes data from the 2016 to 2019 count period for SMUs 1-5 and from 2021 for SMUs 6 and 7). For England and Wales, in 2021 a further 3,659 harbour seals were counted and in Northern Ireland 818 were counted. This results in a total count of 30,855 harbour seals in the UK during the period 2016 to 2021 (34,862 including the Republic of Ireland) (Figure 4.1) (SCOS 2023). 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, there is an estimated population of ~42,900 harbour seals⁷ in the UK (~48,400 including the Republic of Ireland).

Around the UK, high concentrations of harbour seal haul-outs are located around the Scottish coastline, particularly around West Scotland, the Western Isles, Northern Isles, and the Moray Firth. In England, haul-out counts are greatest around The Wash (SMU 9; Figure 4.1).

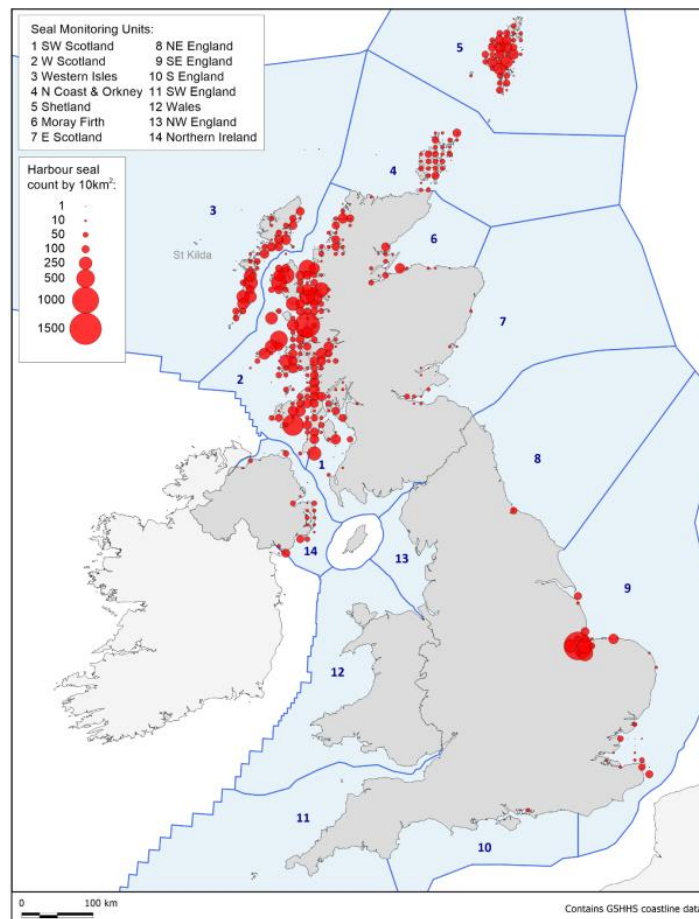


Figure 4.1 August distribution of harbour seals around the British Isles by 10km squares based on the most recent available haul-out count data collected up until 2021. Limited data available for SMUs 10-13; no data available for St Kilda. Figure obtained from SCOS (2023).

⁷ Calculated as: $(30,855/72)*100$

4.1.2 Seal Monitoring Unit August counts

Not all sites within the East Scotland SMU are surveyed annually; however annual counts have been conducted in the Firth of Tay and Eden Estuary SAC on an almost annual basis since 2005. In the East Scotland SMU, the population has been in decline since the 1996 to 1997 survey period where the highest counts of 764 individuals were recorded. In the 2016 to 2019 survey block, the haul-out counts within the East Scotland SMU had increased for the first time since the decline, to 343 (compared to 224 in 2011-2015) but have since declined again in the most recent 2021 surveys to 262. The current scaled population estimate for the East Scotland SMU is 364 harbour seals (Table 4.1).

A sudden change in the East Scotland SMU population trend was observed in 2002, but the decline is not thought to be related to Phocine Distemper Virus (PDV), and the nature of this change remains unknown. Within this SMU, the majority of the population was located within the Firth of Tay and Eden Estuary SAC, representing approximately 85 % of the SMU count from 1990 to 2002 (SCOS 2022). The population within the SAC then declined rapidly and monotonically from 2002 to 2021 to a count of 41 individuals, representing an approximate 95 % decline and now the SAC accounts for approximately 16 % of the haul-out counts in the SMU. Such rapid population decline appears to be restricted to the SAC, and there is now evidence that this decline may be slowing (SCOS 2022). There has also been a redistribution of harbour seals within the East Scotland SMU since the decline within the Firth of Tay and Eden Estuary SAC. Additional groups of harbour seals in the East Scotland SMU are located in the Firth of Forth, Montrose Basin and around the Aberdeenshire coast (SCOS 2022).

Within the Northeast England SMU, all sites in the Tees Estuary have been surveyed annually between 1996 and 2021 by the Industry Nature Conservation Agency (INCA), and, additionally, SMRU have carried out surveys in the wider SMU (e.g. Northumberland in 1997, 2005, 2007, 2008, 2015, 2016, 2018 and 2020). In the Northeast England SMU, harbour seal haul-out counts are low, with a maximum count of 91 harbour seals in the 2011-2015 count period (Table 4.1 and Figure 4.2). The most recent haul-out count of 89 harbour seals for the 2021 count period can be scaled by the proportion of seals hauled-out at the time of the count to result in a total Northeast England SMU population size estimate of 124 harbour seals. There were sudden declines in the population noted in 1988 and 2002 and PDV is considered to be the cause of these declines (SCOS 2022). Since the 2011-2015 count period the counts have increased and the most recent counts for the Tees Estuary (containing the majority of the Northeast England population) indicates that abundance is now stable (SCOS 2023).

Table 4.1 Harbour seal August haul-out counts and population estimates⁸ for various survey periods. Data from SCOS (2023).

HARBOUR SEAL		1996-1997	2000-2006	2007-2009	2011-2015	2016-2019	2021
East Scotland	Count	764	667	283	224	343	262
	Population estimate	1061	926	393	311	476	364
Northeast England	Count	54	62	58	91	79	89
	Population estimate	75	86	81	126	110	124

⁸ Population estimates calculated as: (Count/72)*100

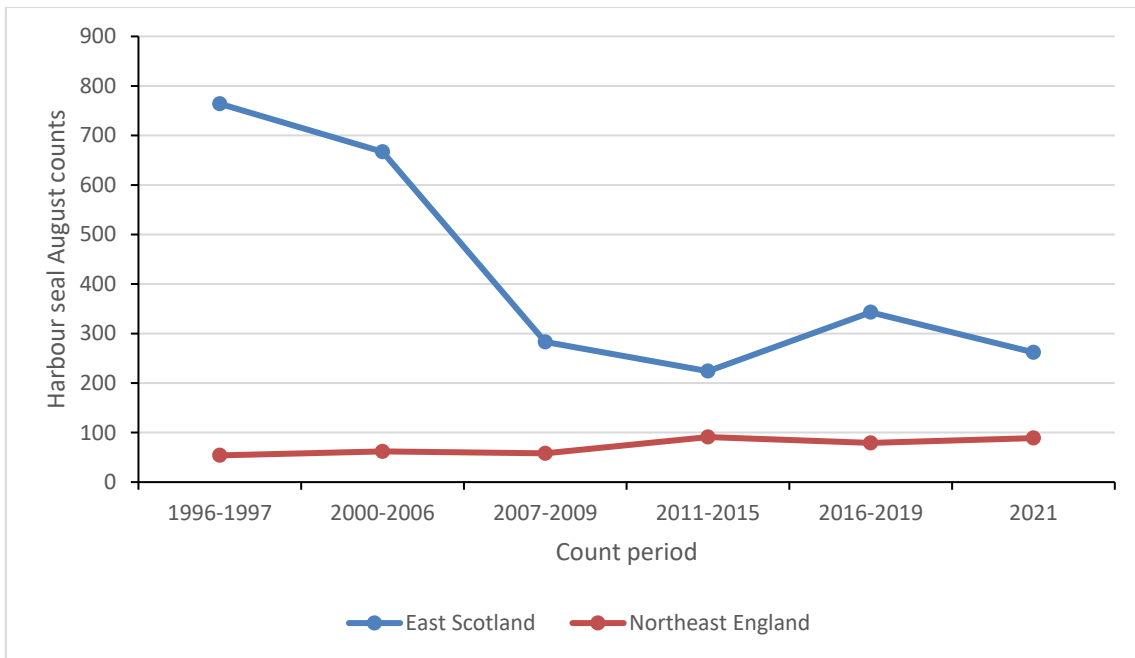


Figure 4.2 August haul-out counts of harbour seals within each of the SMUs within the East Scotland and Northeast England SMUs. Data from SCOS (2023).

4.1.3 Distribution of August haul-outs

The August haul-out counts showing the historical distribution of harbour seals across the East Scotland and Northeast England SMUs from 1996 – 2021 are presented in Figure 4.3. When looking at all years combined, historically the main harbour seal haul-outs were located in the Firth of Forth and the Tay and Eden estuaries. The largest haul-out count of 192 harbour seals was made at Outhead on the Eden Estuary in 2002. However, as mentioned in Section 4.1.2, the harbour seal population in the Firth of Tay and Eden Estuary SAC has been in decline (SCOS 2022). It should, therefore, be noted that the historical combined haul-out count map is not representative of the current trends in harbour seal haul-out size and distribution. Within the Northeast England SMU, harbour seal haul-outs were primarily recorded at Lindisfarne in north Northumberland and within the Tees Estuary (near Middlesbrough).

Haul-out counts were highly variable between years. Haul-out counts are presented below for the years in which haul-out surveys were undertaken over the wider SMUs (rather than years in which only the SAC was surveyed; Figure 4.4). The most recent haul-out counts from 2021 are presented in Figure 4.5 as these represent the current trends in harbour seal haul-out size and distribution. In 2021, the largest haul-out site in the East Scotland SMU was at Chapel Garden Rocks in West Wemyss where 24 harbour seals were counted. It is again noted that the haul-out count within the Firth of Tay and Eden Estuary SAC in 2021 continues to be low with 41 individuals counted (Figure 4.5) but have not declined further since the 2019 counts (also 41; SCOS 2022). Note, the Northumberland coast was not surveyed in 2021. Within the Northeast England SMU, haul-out counts in 2021 were highest for the Tees Estuary, where 91 individuals were counted (Figure 4.5).

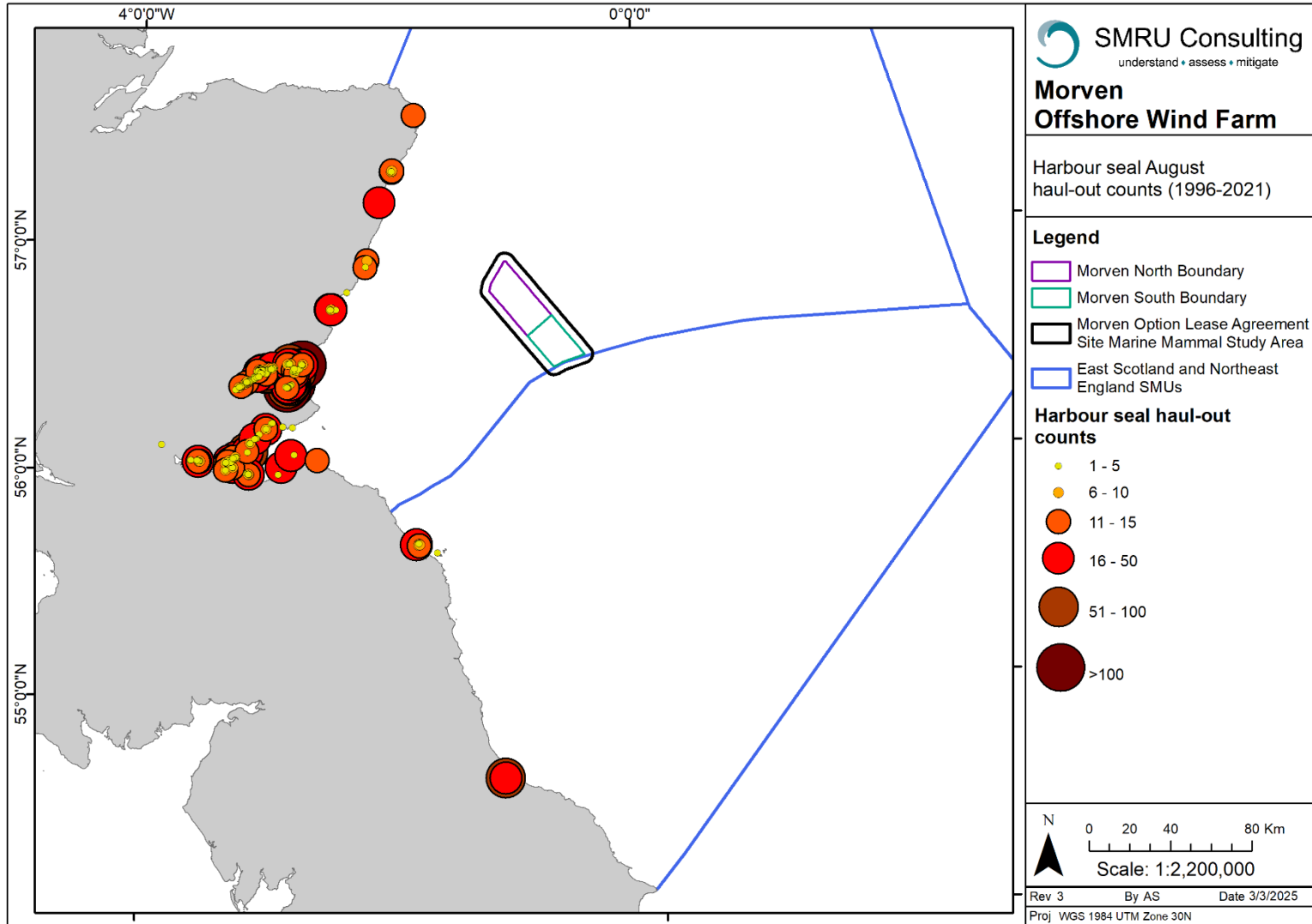


Figure 4.3 All historical August harbour seal haul-out counts in the East Scotland and Northeast England SMUs between 1996 and 2021 combined. Data provided by SMRU.

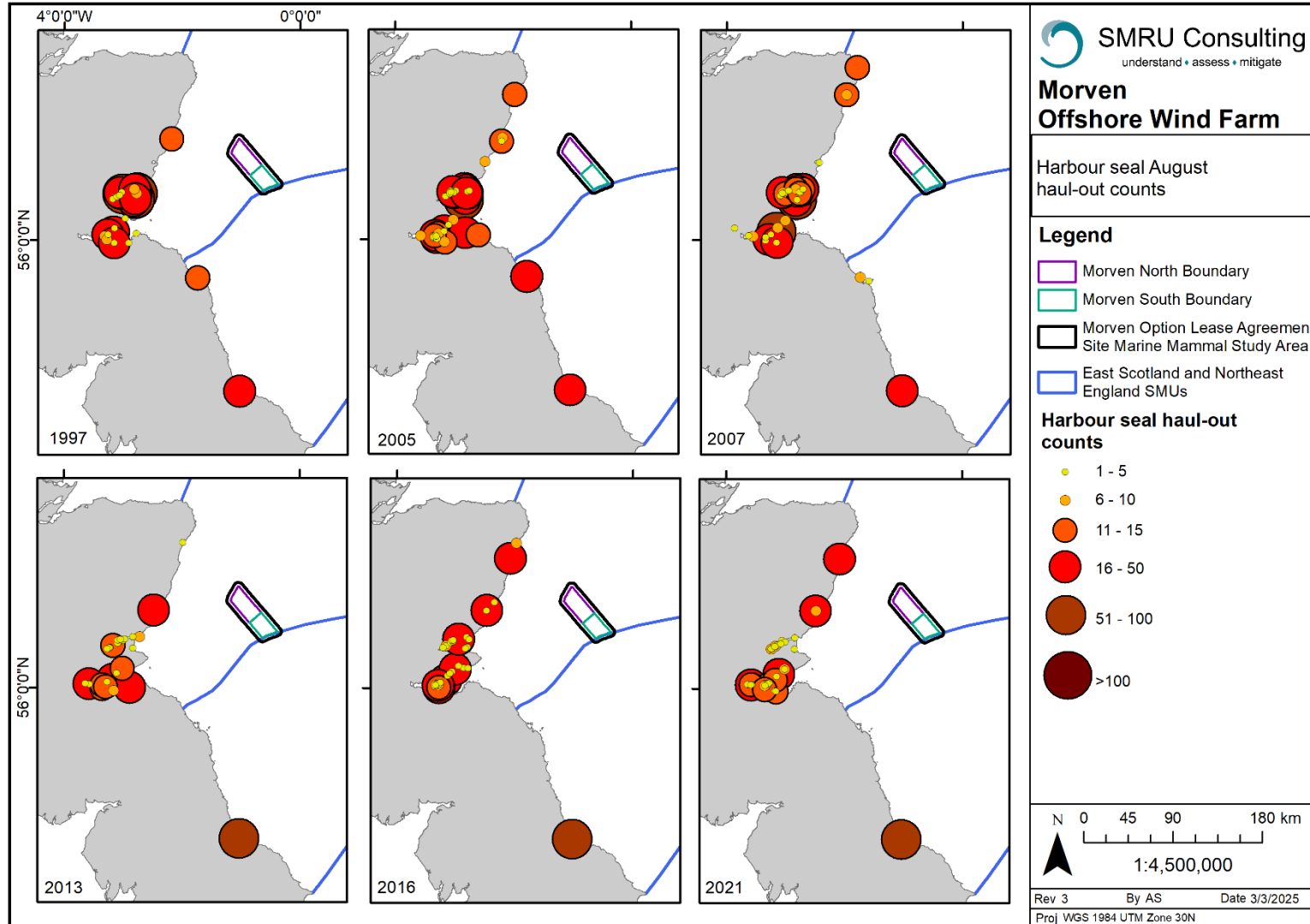


Figure 4.4 Annual August harbour seal haul-out counts in the East Scotland and Northeast England SMUs in 1997, 2005, 2007, 2013, 2016 and 2021. Data provided by SMRU.

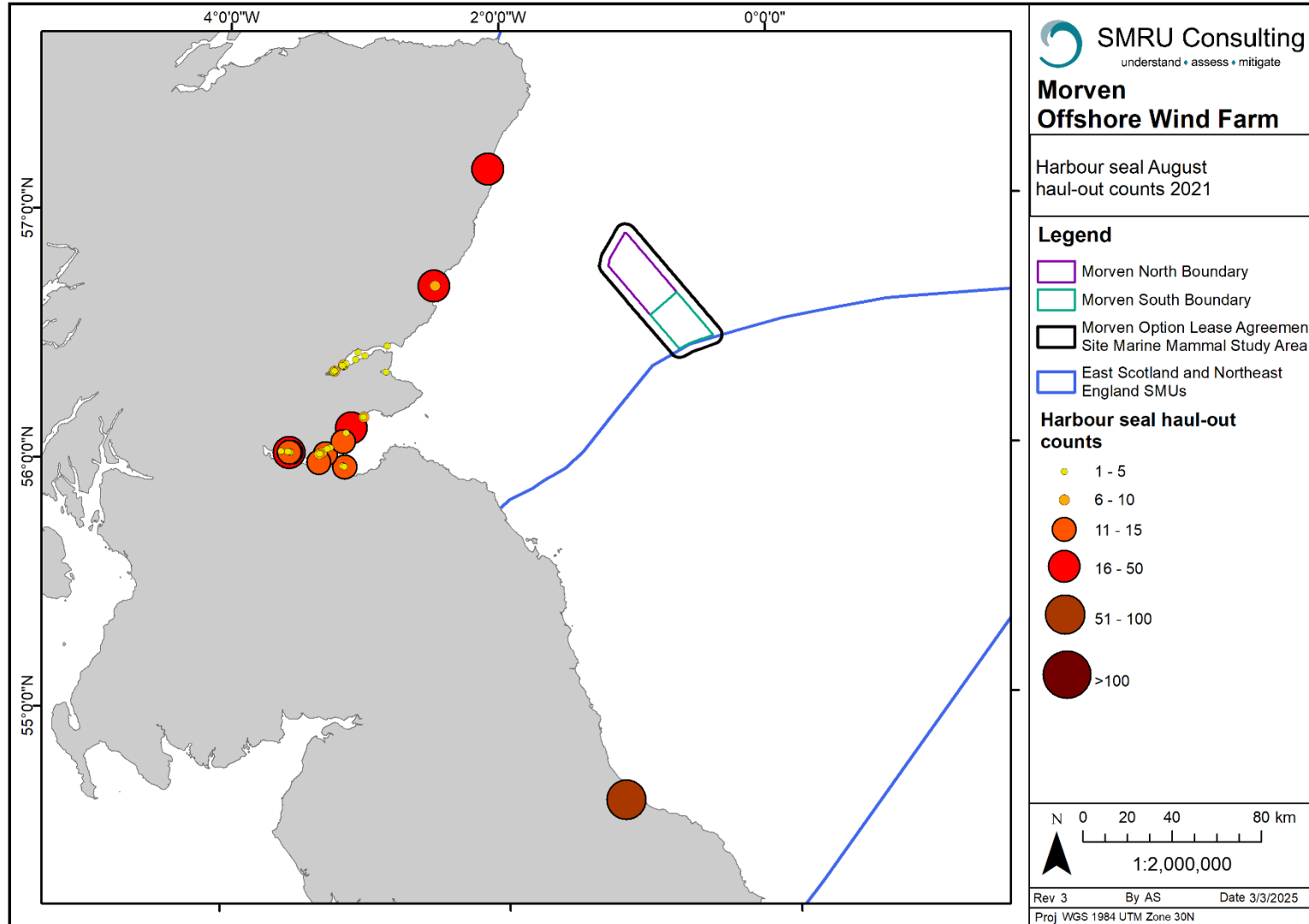


Figure 4.5 August harbour seal haul-out counts in the East Scotland and Northeast England SMUs for 2021. Data provided by SMRU.

4.2 Grey seal

4.2.1 United Kingdom Population

The UK wide grey seal population is estimated using a population model that combines regional pup production estimates and August haul-out counts scaled to population estimates. The UK total grey seal population size at the start of the 2022 breeding season was estimated to be 162,000 grey seals (95 % CI: 146,700-178,500) of which 129,100 were in Scotland (SCOS 2023). Grey seals are widely distributed around the UK in August, with highest SMU August haul-out counts in Scotland occurring in the North Coast and Orkney SMU (8,599 in 2019) and in England in the Southeast England SMUs (7,694 in 2021) (SCOS 2023) (Figure 4.6).

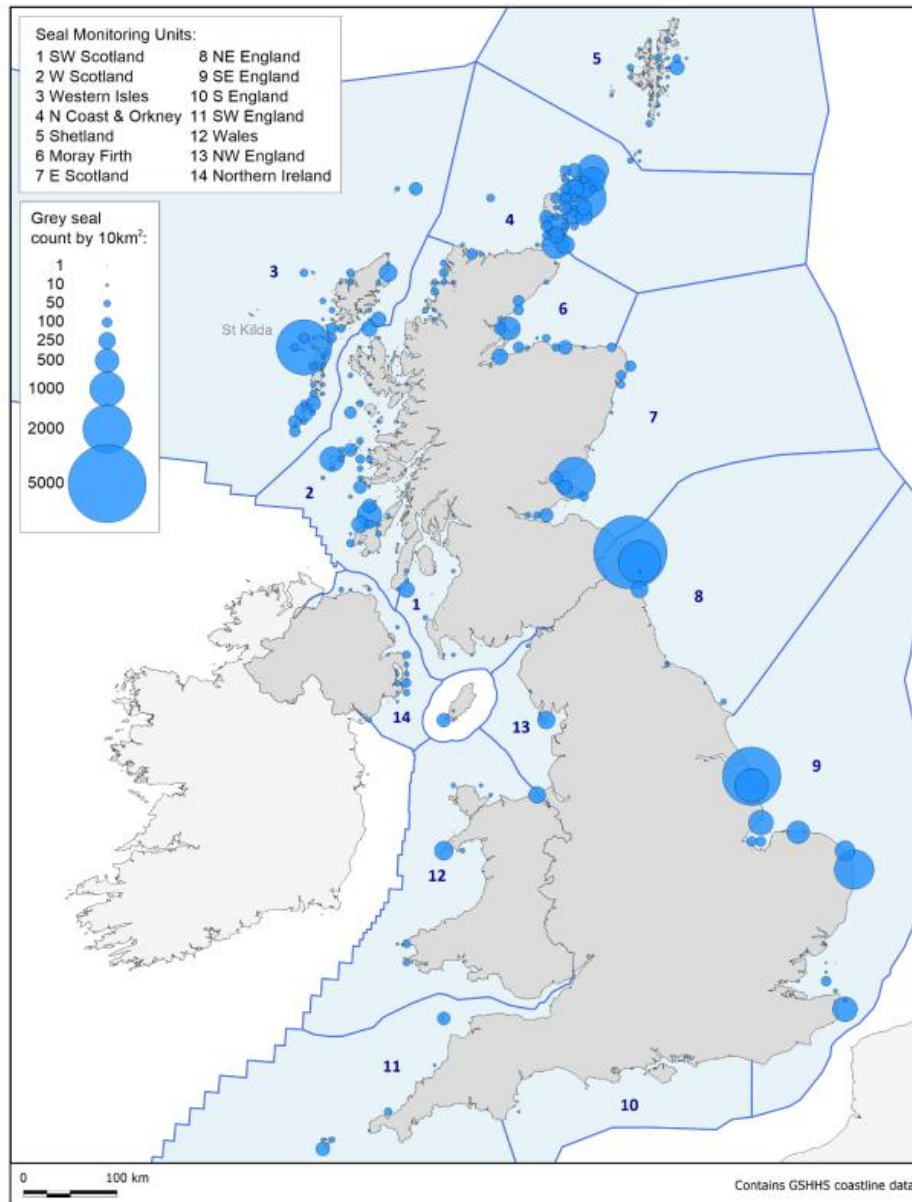


Figure 4.6 August distribution of grey seals around the British Isles by 10km squares based on the most recent available haul-out count data collected up until 2021. Limited data available for SMUs 10-13; no data available for St Kilda. Figure obtained from SCOS (2023).

4.2.2 Seal Monitoring Unit August Counts

Grey seal August counts are estimated to be stable in the East Scotland SMU. The most recent August grey seal count (2021) in the East Scotland SMU was 2,712 individuals (SCOS 2023), equating to a scaled August population estimate of 10,783 grey seals. The population estimate represents a decrease since the previous August count period (2016 to 2019; Table 4.2 and Figure 4.7), though it should be noted that grey seal haul-outs in August are highly variable.

The grey seal population in the Northeast England SMU is considered to be increasing. The latest August count (2021) for the Northeast England SMU (Table 4.2 and Figure 4.7) is 6,517 individuals (similar to the estimate of to 6,501 in the 2016 to 2019 count period) (SCOS 2023). The latest August count for the SMU results in a scaled population estimate of 25,913 grey seals.

Table 4.2 Grey seal August haul-out counts and population estimates⁹ for various survey periods. Data from SCOS (2023).

GREY SEAL		1996-1997	2000-2006	2007-2009	2011-2015	2016-2019	2021
East Scotland	Count	2,328	1,898	1,238	2,296	3,683	2,712
	Population estimate	9,256	7,547	4,922	9,129	14,644	10,783
Northeast England	Count	613	1,100	2,350	6,942	6,501	6,517
	Population estimate	2,437	4,374	9,344	27,602	25,849	25,913

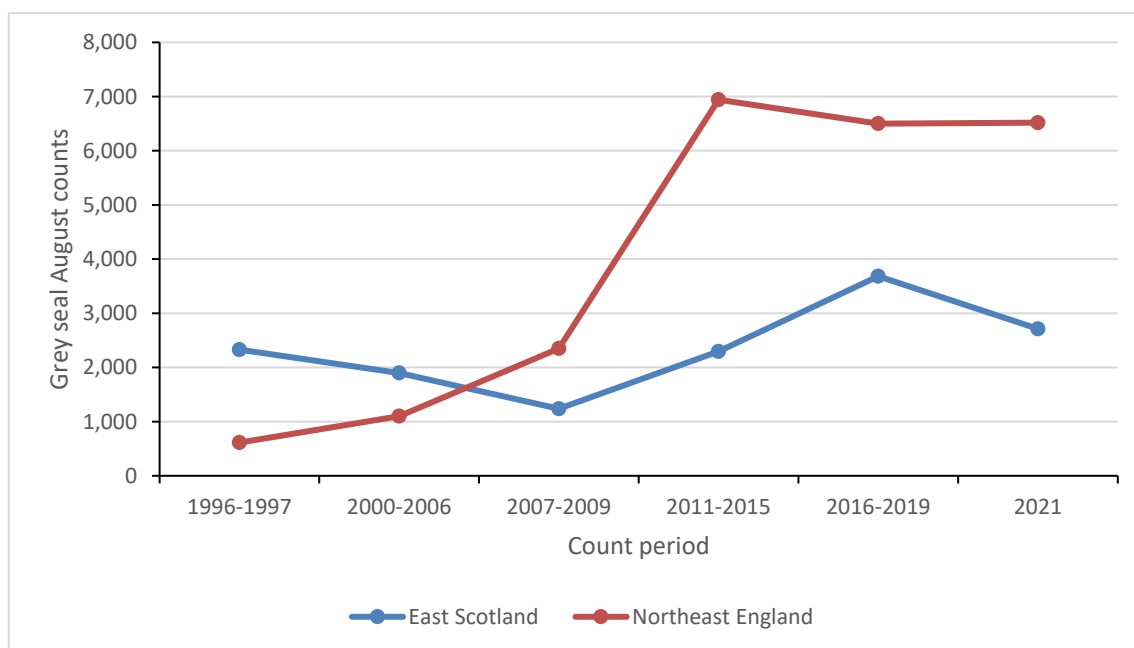


Figure 4.7 August haul-out counts of grey seals within each of the MUs within the East Scotland and Northeast England SMUs. Data from SCOS (2023).

⁹ Population estimates calculated as: $(\text{Count}/25.15) \times 100$

4.2.3 Distribution of August haul-outs

The August haul-out counts showing the historical distribution of grey seals across the East Scotland and Northeast England SMUs from 1997 to 2021 are presented in Figure 4.8, with the annual break down of their distribution presented in Figure 4.9, Figure 4.10 and Figure 4.11. In the East Scotland SMU, haul-out sites are concentrated around sites in the Firth of Forth and the Tay and Eden estuaries as well as further north around Peterhead and Fraserburgh. The largest haul-out count of 1,924 grey seals was made at the mouth of the River Ythan in 2016. Within the Northeast England SMU, the largest concentrations of haul-outs were found in 2018 along the north Northumberland coast and within the Tees Estuary, with the largest haul-out count of 2,413 grey seals being observed around Holy Island.

Haul-out counts were highly variable between years. Haul-out counts are presented below for the years in which haul-out surveys were undertaken over the wider SMUs, not just focussed on the SAC areas (Figure 4.9

and Figure 4.10). The most recent 2021 haul-out counts are presented in Figure 4.11. In 2021, the largest haul-out site in the East Scotland SMU was at Abertay Sands where 1,360 grey seals were counted (Figure 4.11). A further 98 grey seals were counted within the Isle of May SAC. In the Northeast England SMU, 2021 haul-out counts were made in the Tees Estuary, where 30 grey seals were counted. Note, the Berwickshire and North Northumberland Coast SAC was not surveyed in 2021 (Figure 4.11).

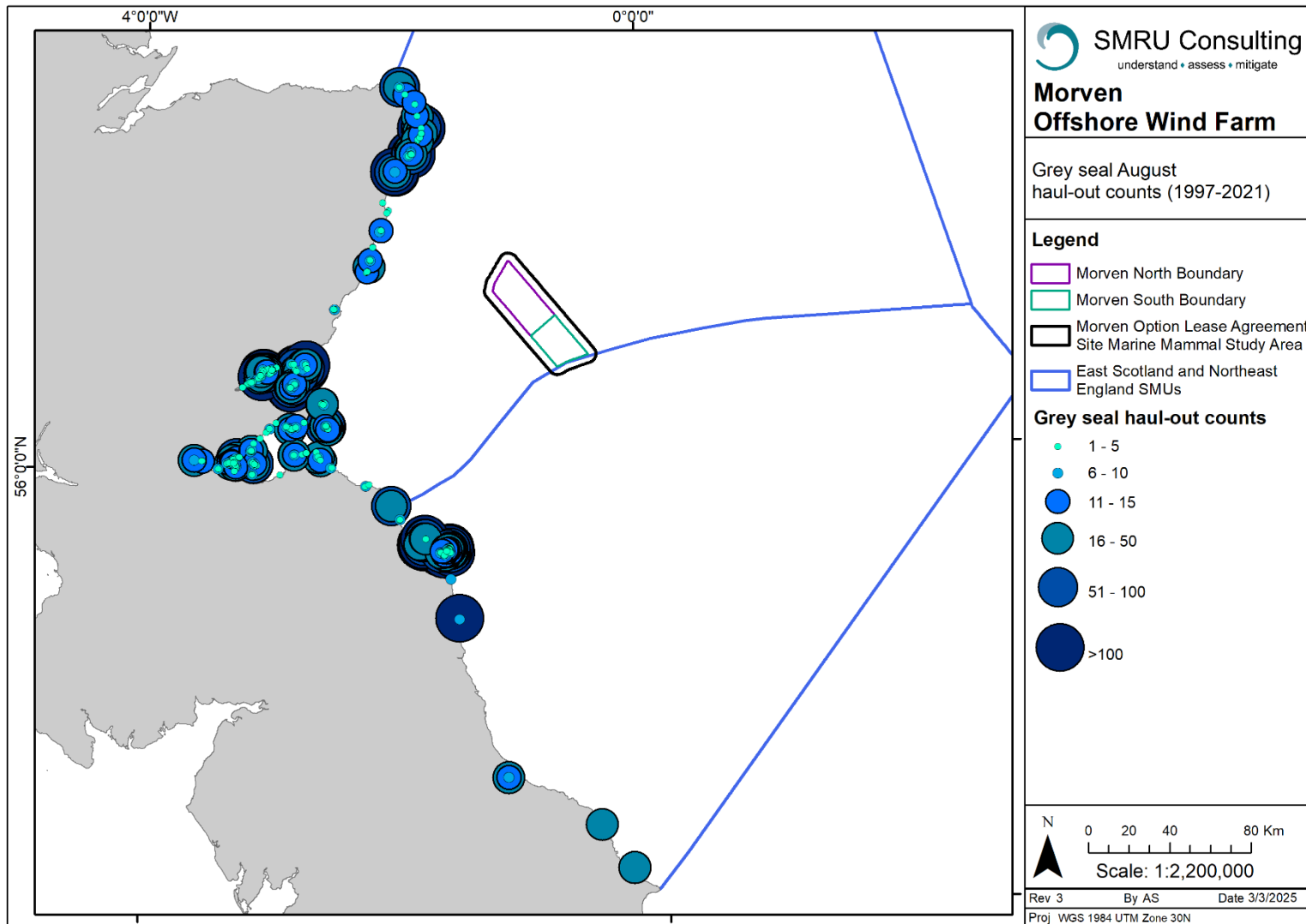


Figure 4.8 All August grey seal haul-out counts in the East Scotland and Northeast England SMUs between 1997 and 2021 combined. Data provided by SMRU.

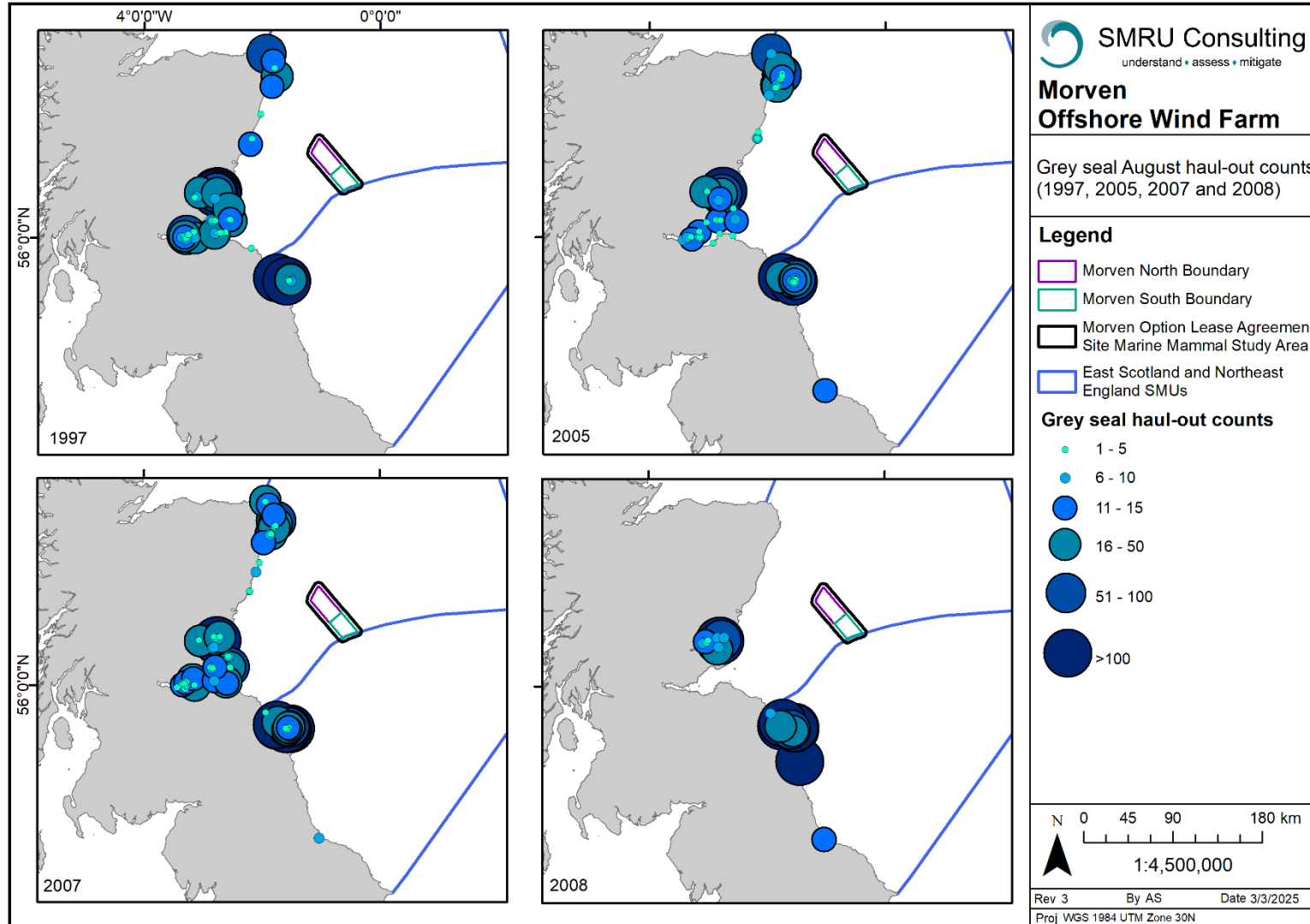


Figure 4.9 Annual August grey seal haul-out counts in the East Scotland and Northeast England SMUs in 1997, 2005, 2007 and 2008. Data provided by SMRU.

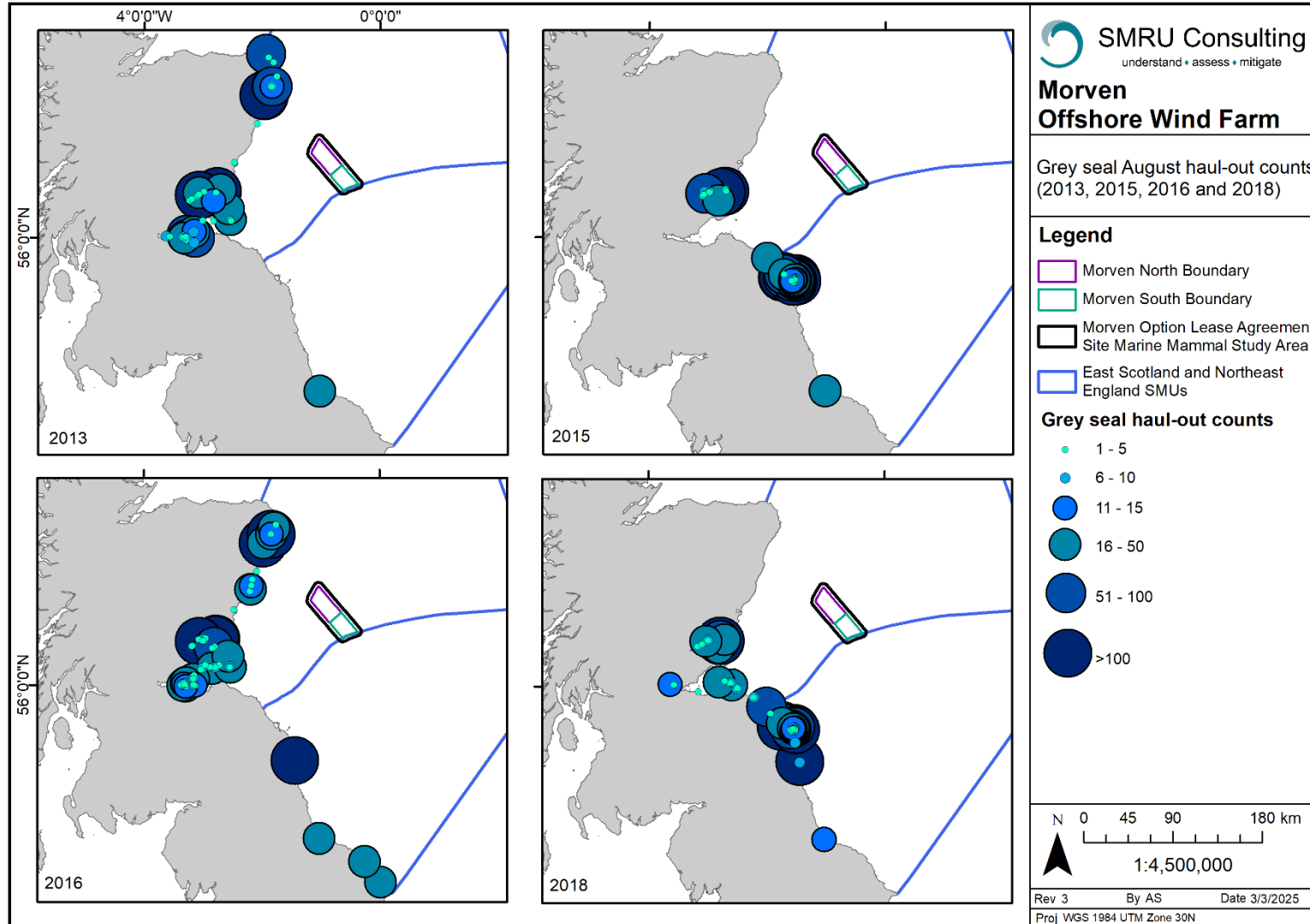


Figure 4.10 Annual August grey seal haul-out counts in the East Scotland and Northeast England SMUs for 2013, 2015, 2016 and 2018. Data provided by SMRU.

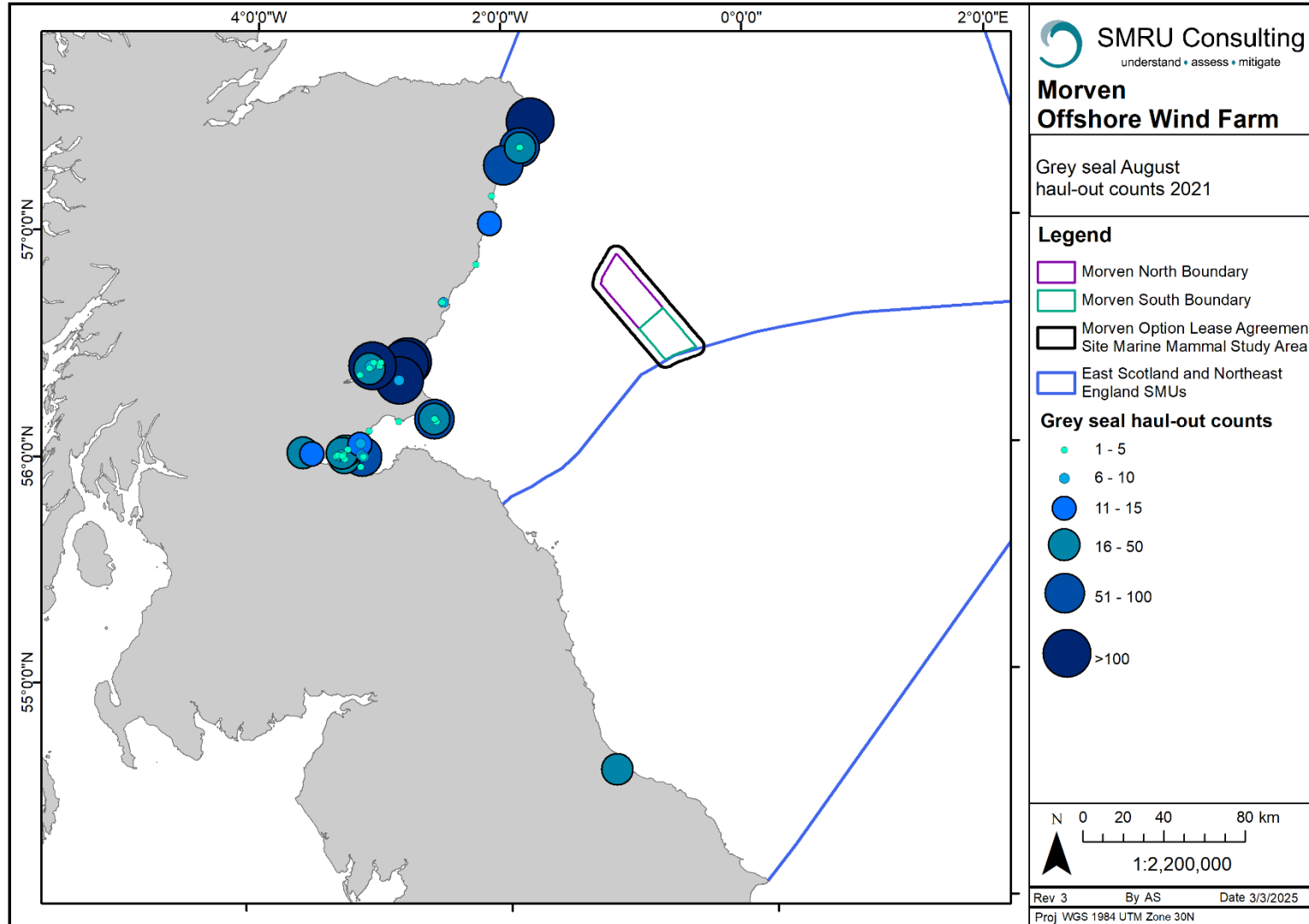


Figure 4.11 August grey seal haul-out counts in the East Scotland and Northeast England SMUs for 2021. Data provided by SMRU.

4.2.4 Grey Seal Pup Counts

Grey seals typically express a preference for remote breeding sites (SCOS 2023) which can make pup abundance difficult to estimate. In 2019, total UK pup production was estimated at 67,850 (95 % CI: ~60,500–75,100) (Figure 4.12). Pup production in Scotland in 2019 was estimated at 54,050 individuals (SCOS 2022). It should be noted that pup production survey methodology changed in 2010, with new digital camera technology and reduced survey height improving the efficacy of counting and classification of moult stages in pups. These advancements coincide with the apparent step change in the observed numbers of pups (SCOS 2023).

In the East Scotland SMU, the overall trend in pup production has been increasing in recent years, with an increase of approximately 28 % observed between 2014 and 2019. The total estimated pup count across all grey seal colonies in the SMU is 7,268 pups (from SMRU pup database). However, the distribution of pup production within the SMU appears to be changing. Prior to the 1990s, the Isle of May SAC was the dominant location for pup production, but pup production at this location is now considered to be stable or potentially declining (SCOS 2022) (Figure 4.13). Since 2012, pup production estimates at the Isle of May have been overtaken by the Fast Castle colony that is showing a rapidly increasing pup population: the most recent 2019 pup count for Fast Castle was 4,499 individuals (from SMRU pup database).

In the Northeast England SMU, pup production comes entirely from the Farne Islands, where the pup production has been showing a rapid increasing trend. The latest pup count for the Farne Islands is for 2019, with 2,823 pups counted (from SMRU pup database) (Figure 4.14). From 2014 to 2019, the mean estimated increase in pup production was 53 % (SCOS 2022).

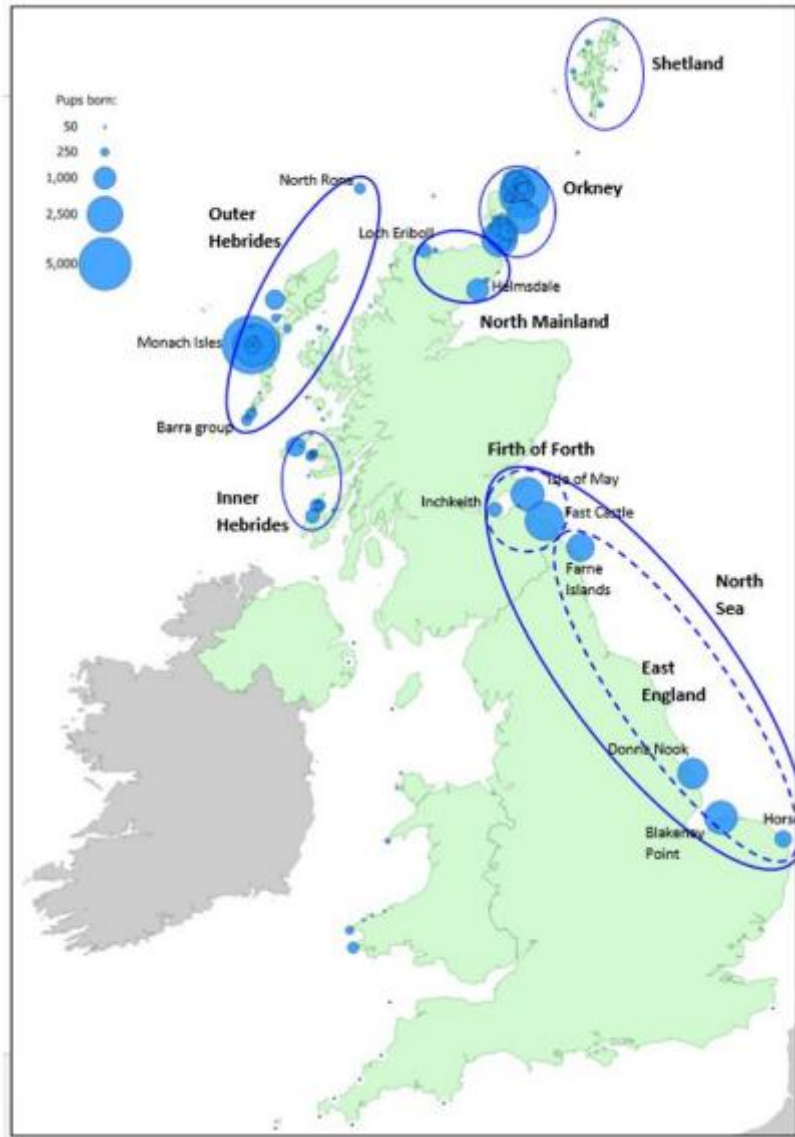


Figure 4.12 Distribution and size of the main grey seal breeding colonies in the UK. Blue ovals indicate groups of regularly monitored colonies within each region and blue circles represent number of pups born (SCOS 2022). Note: the North Sea colonies are sub-divided into the Firth of Forth colonies, and the East England colonies (dashed blue ovals).

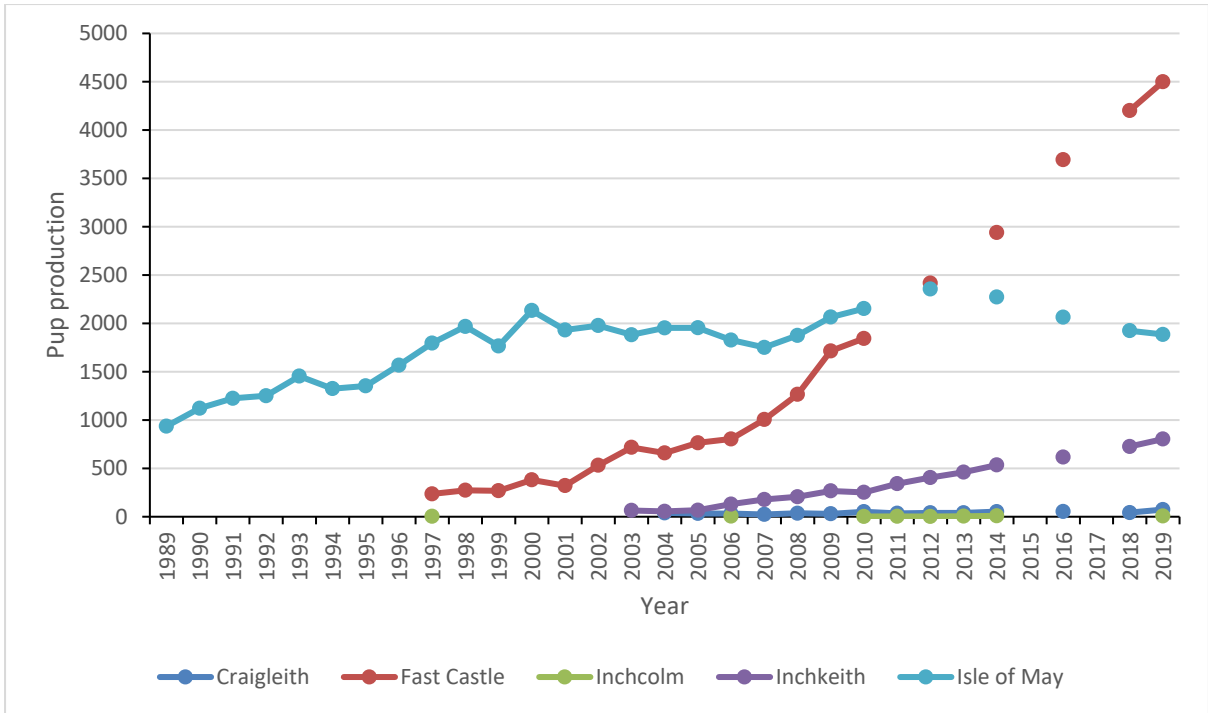


Figure 4.13 Grey seal colony pup production estimates in the East Scotland SMU from 1989 to 2019. Data provided by SMRU.

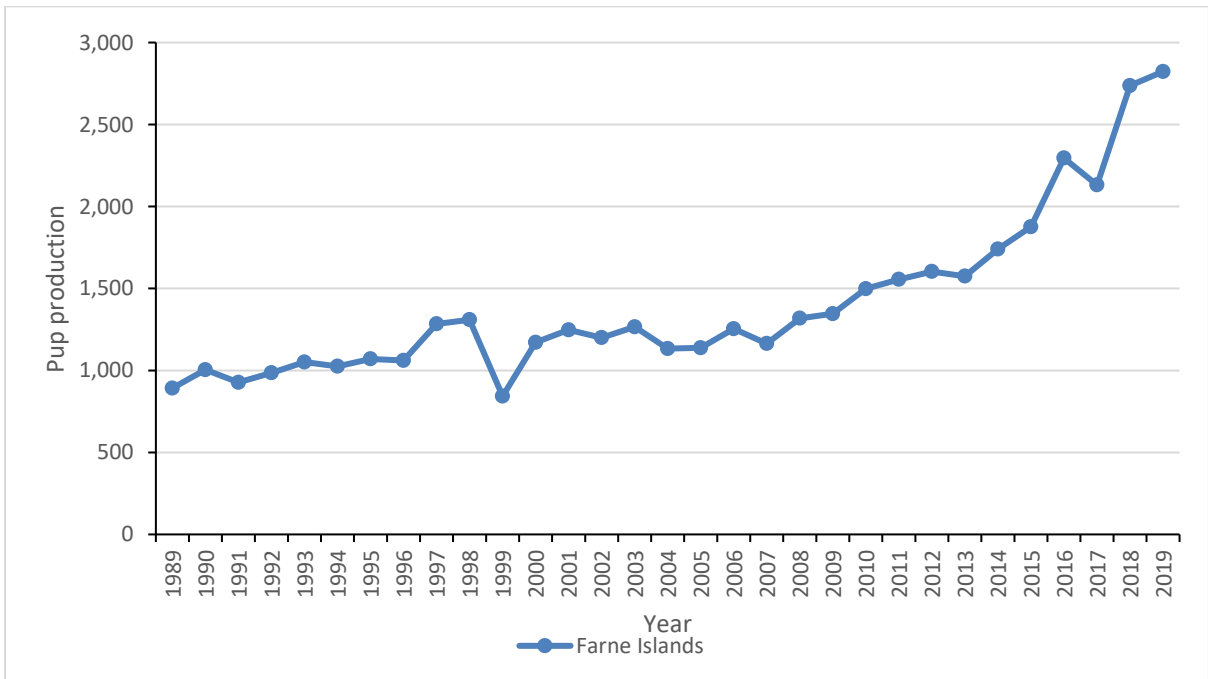


Figure 4.14 Grey seal pup production estimates in the Northeast England SMU from 1989 to 2019. Data provided by SMRU.

5 Telemetry Data

Harbour seals

Harbour seals typically forage within 40 - 50km from their haul-out sites (SCOS 2020) but have maximum foraging ranges of >250km recorded (Carter et al. 2022). Between 2001 and 2013, 46 harbour seals¹⁰ were tagged in the East Scotland SMU (Figure 5.1 and Table 5.1). All harbour seals tagged within the East Scotland SMU were adults, (> 1 year old), 29 of which were male and the remaining 17 of which were female. The majority of harbour seals were tagged at the Eden location (38), as well as Abertay (4) and Kirkcaldy (4). No harbour seals were tagged in the Northeast England SMU.

In addition to these telemetry tracks, a further two harbour seals tagged in the Moray Firth SMU, were tracked within the East Scotland SMU, and one tagged in the Southeast England SMU was tracked within the Northeast England SMU. However, it should be noted that all three of these tracks only just came into the SMUs and so their use of the area should be seen as limited. This resulted in a total of 49 harbour seal telemetry tracks within the SMUs of interest: 45 within the East Scotland SMU only, one within the Northeast England, and three within both SMUs, all of which were adult seals. Harbour seal telemetry tracks were recorded throughout the SMUs, but with a higher concentration around the Fife and Aberdeenshire coast, particularly in the south of the East Scotland SMU around the Tay and Eden estuaries (where most of the seals were tagged) (Figure 5.1).

Of the 49 tagged harbour seals that entered the SMUs of interest, four had telemetry track data recorded within the Morven Option Lease Agreement Site Marine Mammal Study Area (Figure 5.2). All four of these were tagged within the Firth of Tay and Eden Estuary SAC, thus showing connectivity between the SAC and the Morven Option Lease Agreement Site Marine Mammal Study Area. None of these four individuals showed connectivity with SACs outside of the East Scotland and Northeast England SMUs.

¹⁰ Note: this does not include the four harbour seals tagged at the River Don in 2017 as they were tagged specifically for river studies and three were also tagged with Ultra High Frequency tags which would introduce bias by not including long trips.

Table 5.1 Summary information for the 46 harbour seals tagged in the East Scotland SMU. Data provided by SMRU.

Date	Total	Location	Sex	Tag Type
November 2001	3	Abertay	3 x M	SRDL
	1	Eden	1 x M	SRDL
January 2002	6	Eden	5 x F 1 x M	SRDL
October 2002	1	Abertay	1 x M	SRDL
	4	Eden	1 x F 3 x M	SRDL
January 2003	2	Eden	2 x M	SRDL
March 2003	8	Eden	6 x F 2 x M	SRDL
May 2008	6	Eden	3 x F 3 x M	GSM
February 2011	5	Eden	1 x F 4 x M	GSM
May 2012	3	Eden	3 x M	GPS SRDL
July 2012	3	Eden	3 x M	GPS SRDL
March 2013	1	Kirkcaldy	1 x M	GSM
May 2013	3	Kirkcaldy	1 x F 2 x M	GSM

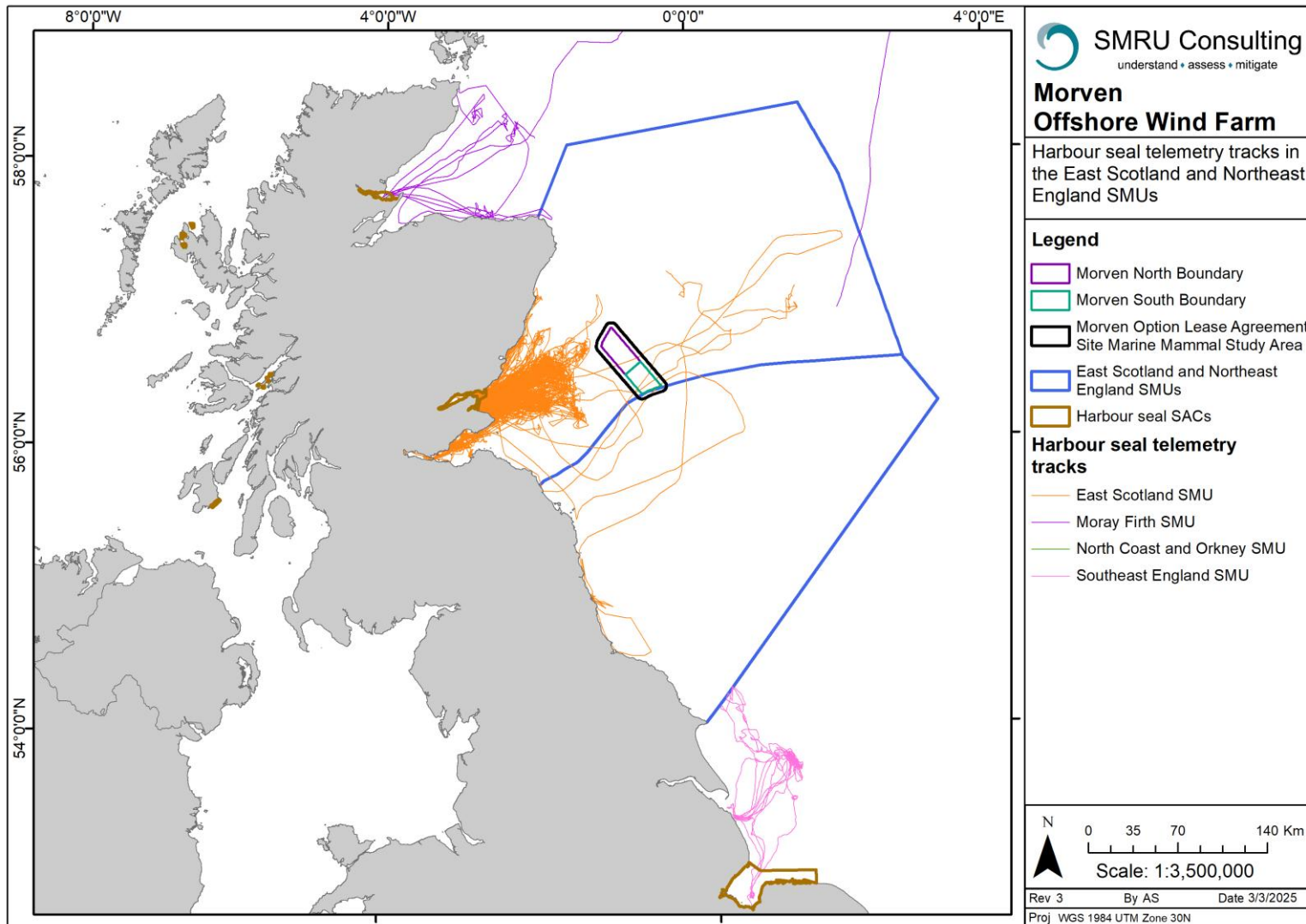


Figure 5.1 Telemetry tracks for all 49 harbour seals that entered the East Scotland and Northeast England SMUs (46 tagged in the East Scotland SMU, two in the Moray Firth SMU and one in the Southeast England SMU). Data provided by SMRU.

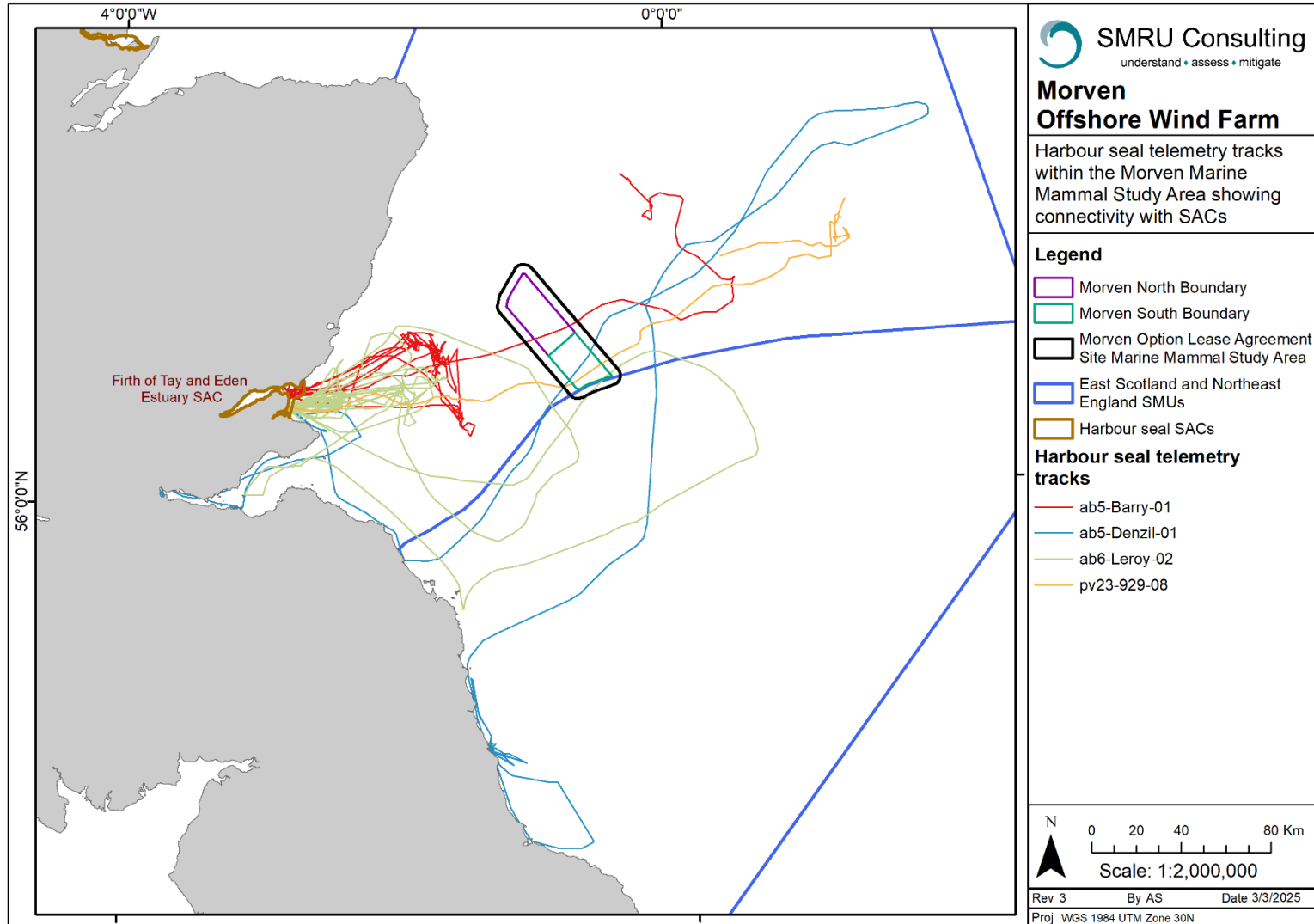


Figure 5.2 Harbour seal telemetry tracks that entered the Morven Option Lease Agreement Site Marine Mammal Study Area and showed connectivity to the Firth of Tay and Eden Estuary SAC (n=4, all tagged in East Scotland SMU). Data provided by SMRU.

5.1 Grey seals

A total of 105 grey seals were tagged in the SMUs of interest between 1990 and 2014¹¹: 74 in the East Scotland SMU and 31 in the Northeast England SMU (Table 5.2). Of these tagged individuals, 67 were adults (>1 year old), one was of unknown age (also >1 year old; Figure 5.3) and 37 were pups (Table 5.2).

A further 41 grey seals were tagged outside the East Scotland and Northeast England SMUs but were tracked within them: 18 were tagged in the North Coast and Orkney SMU, 18 in the Southeast England SMU, and five in the Moray Firth SMU (. This resulted in a total of 146 grey seal telemetry tracks within the SMUs: 44 that were tracked within the East Scotland SMU only, 15 within the Northeast England, and 87 within both SMUs (Figure 5.3 and Figure 5.5).

Table 5.2 Summary information for the 117 grey seals tagged in the East Scotland SMU (n=74) and the Northeast England SMU (n=31). Data provided by SMRU.

SMU	Year	#	Tagging Location	Sex	Tag Type
Adults (n=67) and unknown (n=1)					
East Scotland	November 1990	3	Isle of May	3 x F	SRDL
	July 1993	2	Abertay	1 x F, 1 x F	SRDL
	November 1996	7	Isle of May	7 x F	SRDL
	June 1997	6	Abertay	3 x F, 3 x M	SRDL
	July 1997	1	Isle of May	1 x F	SRDL
	May 1998	10	Abertay	3 x F, 7 x M	SRDL
	March 2005	1	Tentsmuir	1 x unknown	GPS SRDL
	May 2005	2	Tentsmuir	1 x F, 1 x M	GPS SRDL
	April 2008	9	Abertay	5 x F, 4 x M	GSM
	August 2013	4	Abertay	2 x F, 2 X M	3 x GSM 1 x GPS SRDL
Northeast England	August 1991	4	Farnes	4 x M	SRDL
	November 1991	1	Farnes	1 x F	SRDL
	March 1992	3	Farnes	3 x M	SRDL
	July 1992	4	Farnes	1 x F, 3 x M	SRDL
	July 1997	1	Farnes	1 x M	SRDL
	April 2008	10	Farnes	5 x F, 5 x M	SRDL
Pups (n=37)					
East Scotland	November 2001	1	Isle of May	1 x M	SRDL
	December 2001	10	Isle of May	5 x F, 5 x F	SRDL
	November 2002	3	Isle of May	2 x F, 1 x M	SRDL
	December 2002	7	Isle of May	3 x F, 4 x M	SRDL
	November 2014	5	Isle of May	2 x F, 3 x M	GSM
	December 2014	3	Isle of May	2 x F, 1 x M	GSM
Northeast England	December 1993	4	Farnes	3 x F, 1 x M	SRDL
	December 1994	4	Farnes	2 x F, 2 x M	SRDL

5.1.1 Adults and juveniles

Telemetry data has shown that grey seals travel further to forage and between haul-out sites than harbour seals. Grey seals typically forage within 100km 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).

¹¹ Grey seals that were tagged and released following captive studies were removed from telemetry analysis as their movements are unlikely to be representative of animals that were tagged in the wild.

Of the 68 adult grey seals tagged within the SMUs of interest, 45 were in the East Scotland SMU (44 adults and one of unknown age) and 23 were in the Northeast England SMU (all adults; Table 5.2 and Figure 5.3). In the East Scotland SMU, adult and juvenile grey seals were tagged in Abertay (31), Isle of May (11) and Tentsmuir (3), and in the Northeast England SMU seals were tagged around the Farne Islands (23) (Table 5.2). Several telemetry tracks covered large ranges: individuals that were tagged in the East Scotland SMU were tracked to the Shetland Isles and Western Isles as well as into the Danish North Sea (over 700km from the UK coast), and individuals tagged in the Northeast England SMU were tracked as far as the Greater Thames Estuary, Shetland and Orkney (Figure 5.3).

In addition, there were 33 adult grey seals that were tagged elsewhere and that entered the SMUs of interest (Figure 5.3): 10 were tagged in the North Coast and Orkney SMU predominantly around Stroma and Sanday, 18 were tagged in the Southeast England SMU (four adults and 14 of unknown age) predominantly around Donna Nook and Blakeney, and five were tagged in the Moray Firth SMU predominantly around Dornoch Firth.

In total, there were 101 adult grey seals (i.e. the 68 tagged within the SMUs plus the 33 tagged elsewhere). These included 33 that were tracked within the East Scotland SMU only, 14 within the Northeast England, and 54 within both SMUs. Adult and juvenile grey seal tracks have been recorded throughout the East Scotland and Northeast England SMUs (Figure 5.3).

Of these 101 adult grey seals, 20 were tracked within the Morven Option Lease Agreement Site Marine Mammal Study Area. Sixteen of these individuals (six female and 10 male) that showed use of the Morven Option Lease Agreement Site Marine Mammal Study Area also showed connectivity with at least one grey seal SAC (Figure 5.4). Connectivity with only the Isle of May SAC was observed in two grey seals, with only the Berwickshire and North Northumberland Coast SAC in nine grey seals, and with both SACs in five grey seals. Connectivity was also noted between the Berwickshire and North Northumberland Coast SAC and the Faray and Holm of Faray SAC (one adult male tagged in the Northeast England SMU) and the Monach Islands SAC (one adult male tagged in the East Scotland SMU).

5.1.2 Pups

The movement data obtained from telemetry tags on pups 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 (Figure 5.5).

Of the 37 grey seal pups (19 females and 18 male) tagged between 1993 and 2014 within the SMUs of interest, 29 were in the East Scotland SMU and eight were in the Northeast England (Table 5.2 and Figure 5.5). Within the East Scotland SMU, all grey seal pups were tagged at the Isle of May, and in the Northeast England SMU they were tagged around Farne Islands (Table 5.2).

A further eight grey seal pups were tagged that were tagged in the North Coast and Orkney SMU, predominantly around Stroma and Muckle Green Holm, also entered the SMUs of interest (Figure 5.5).

In a total, 45 grey seal pups were tracked within the SMUs (i.e. 37 tagged within the SMUs plus eight tagged elsewhere). There were 11 tracked within the East Scotland SMU only, one within the Northeast England, and 33 within both SMUs (Figure 5.5).

Of these 45 grey seal pups, 13 were tracked within the Morven Option Lease Agreement Site Marine Mammal Study Area. Thirteen of these individuals that showed use of the Morven Option Lease Agreement Site Marine Mammal Study Area also showed connectivity with at least one grey seal SAC (Figure 5.6). Connectivity with only the Isle of May SAC was observed in four grey seal pups, with only the Berwickshire and North Northumberland Coast SAC in five grey seals, and with both SACs in four grey seals. No connectivity was observed between these grey seal pups and any SACs outside the East Scotland and Northeast England SMUs.

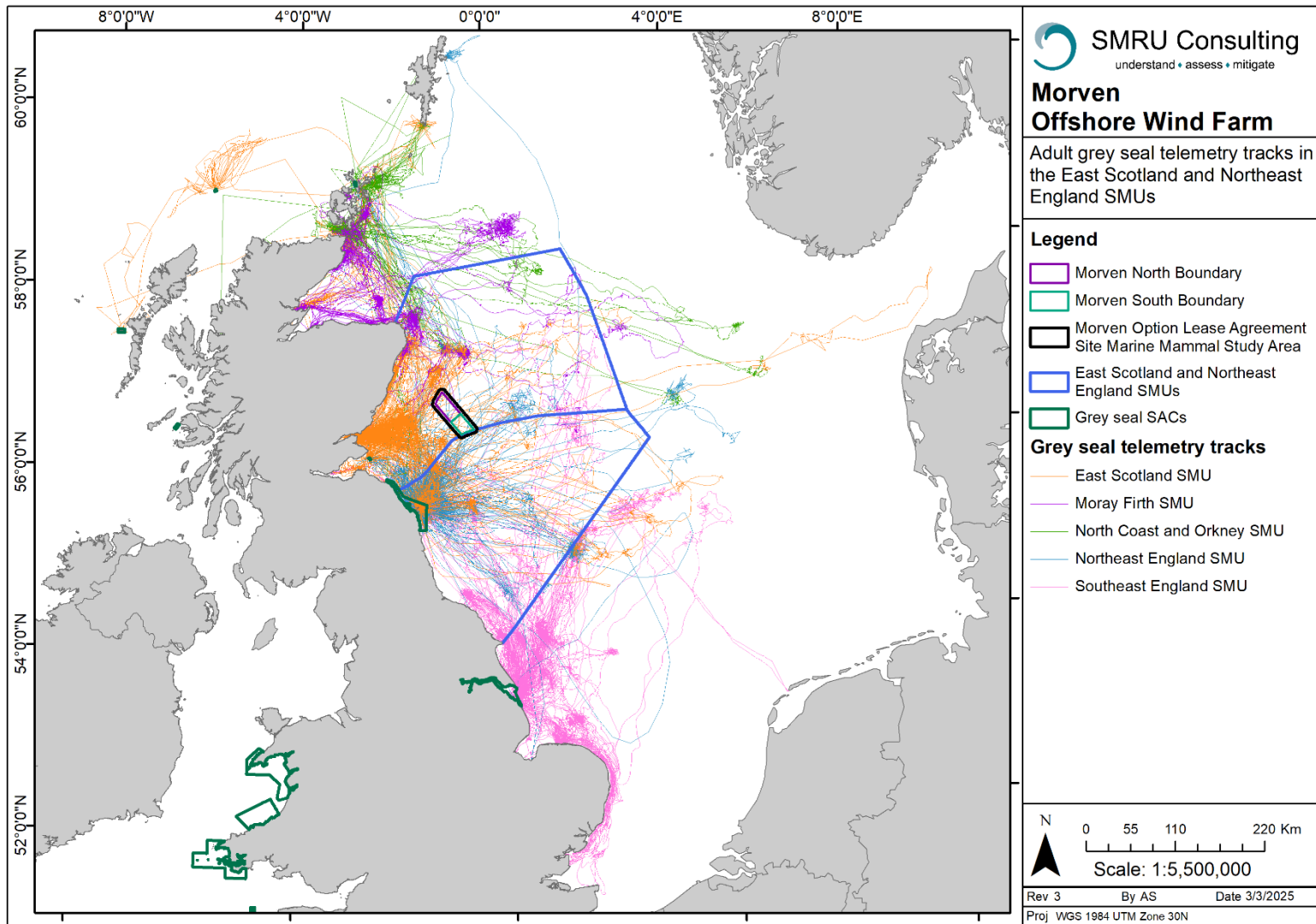


Figure 5.3 Telemetry tracks for the 68 adult grey seals that entered the East Scotland and Northeast England SMUs (45 tagged in the East Scotland SMU, 23 in the Northeast England SMU, 10 in the North Coast and Orkney SMU, 18 in the Southeast England SMU and five in the Moray Firth SMUs. Data provided by SMRU.

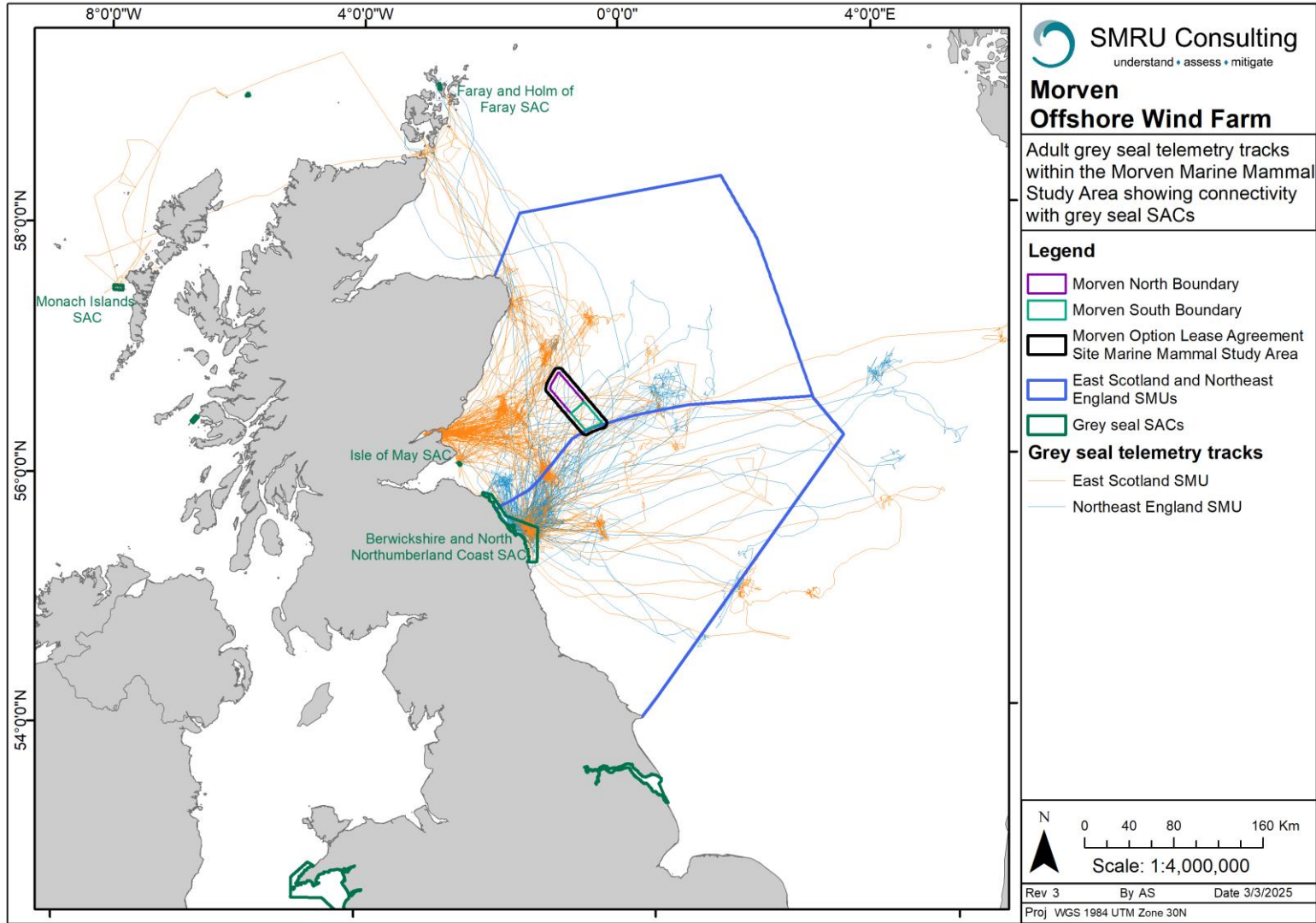


Figure 5.4 Adult grey seal telemetry tracks recorded within the Morven Option Lease Agreement Site Marine Mammal Study Area which showed connectivity to the surrounding SACs (n=16). Data provided by SMRU.

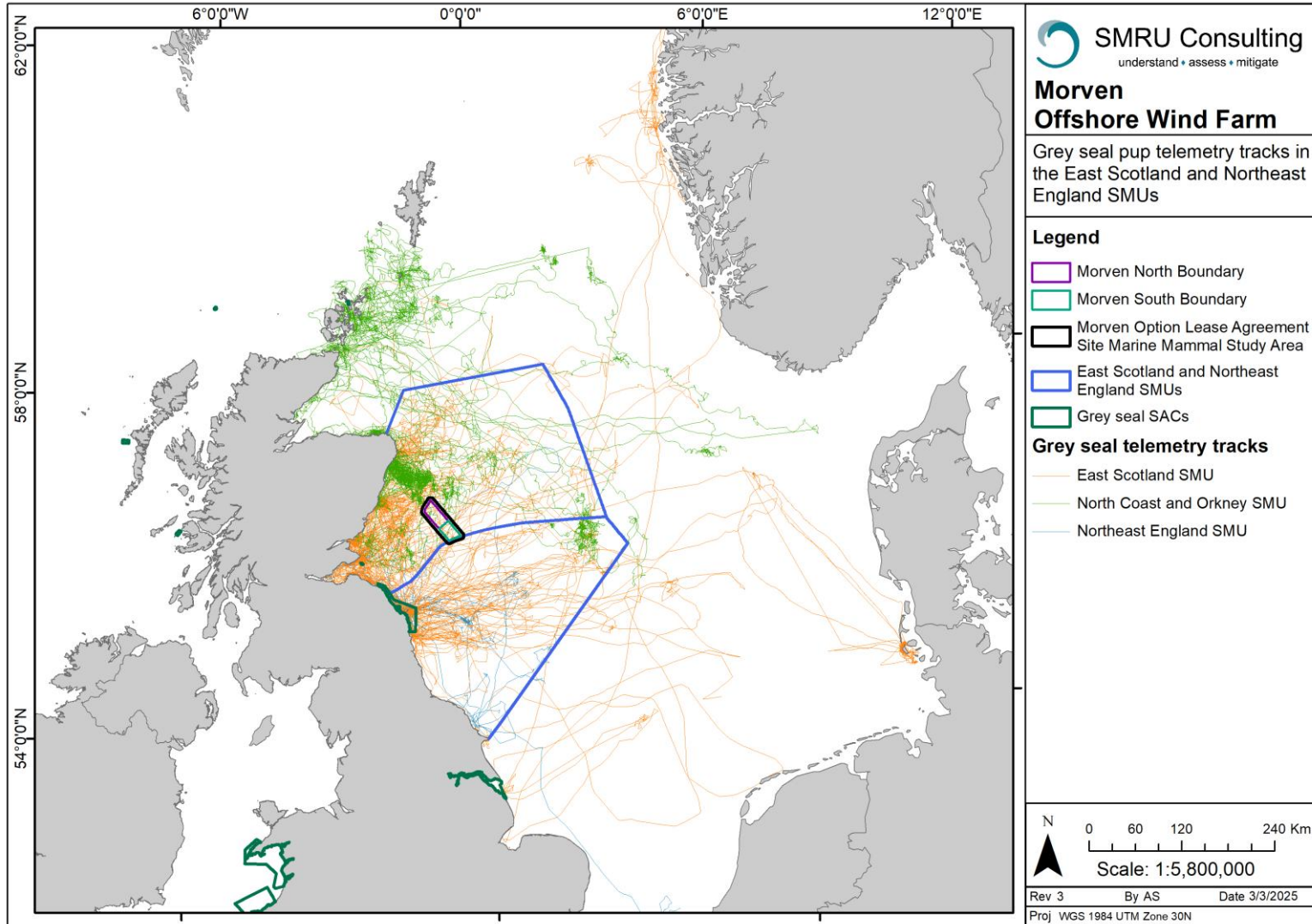


Figure 5.5 Telemetry tracks for all 45 grey seal pups that entered the East Scotland and Northeast England SMUs (29 tagged in the East Scotland SMU, eight in the Northeast England SMU and eight in the North Coast and Orkney SMU). Data provided by SMRU.

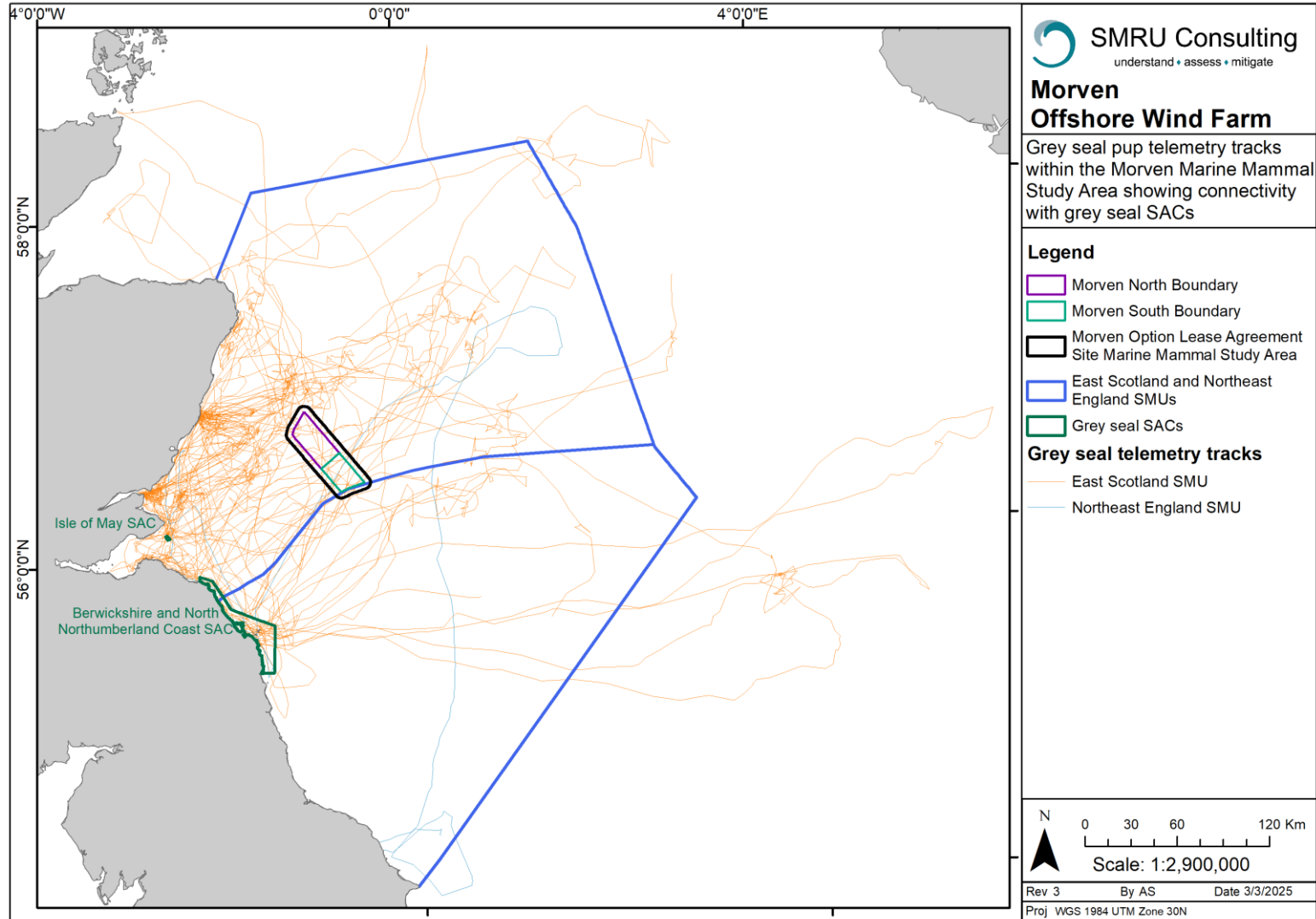


Figure 5.6 Grey seal pup telemetry tracks recorded within the Morven Option Lease Agreement Site Marine Mammal Study Area which showed connectivity to the surrounding SACs (n=13). Data provided by SMRU.

6 Summary

6.1 Haul-out counts

- Not all sites within the East Scotland SMU are surveyed annually; however annual counts have been conducted in the Firth of Tay and Eden Estuary SAC on an annual basis since 2005;
- Within the Northeast England SMU, all sites in the Tees Estuary have been surveyed annually between 1996 and 2019 by INCA, and, additionally, SMRU have carried out surveys in the wider SMU in 1997, 2005, 2007, 2008, 2015, 2016 and 2018;
- Harbour seal
 - East Scotland SMU:
 - The 2021 August haul-out count of 262 can be scaled to account for the proportion of the population at sea at the time of the survey to result in a total population estimate of 364 (hailed-out and at-sea at the time of the survey);
 - The East Scotland SMU population has been in decline, with a sudden change in the population trend was observed in 2002, but the decline is not thought to be related to PDV, and the nature of this change remains unknown.
 - Northeast England SMU:
 - The 2021 August haul-out count of 89 can be scaled to account for the proportion of the population at sea at the time of the survey to result in a total population estimate of 124 (hailed-out and at-sea at the time of the survey);
 - There were sudden declines in the population noted in 1988 and 2002 and PDV is considered to be the cause of these declines. Haul-out counts have remained low, but the trend is now stabilising/increasing.
- Grey seal
 - East Scotland SMU:
 - The 2021 August haul-out count of 2,712 can be scaled to account for the proportion of the population at sea at the time of the survey to result in a total population estimate of 10,783 (hailed-out and at-sea at the time of the survey);
 - The grey seal population is estimated to be stable in the East Scotland SMU. The most recent haul-out counts also indicated that the population may be increasing.
 - Northeast England SMU:
 - The 2021 August haul-out count of 6,517 can be scaled to account for the proportion of the population at sea at the time of the survey to result in a total population estimate of 25,913 (hailed-out and at-sea at the time of the survey);
 - The grey seal population in the Northeast England SMU is considered to be increasing.

6.2 Grey seal pup counts

- East Scotland SMU:
 - Pup production is estimated at 7,268 pups from five grey seal colonies. Prior to the 1990s, the Isle of May SAC was the dominant location for pup production, but pup production at this location is now considered to be stable or potentially declining. Since 2012, pup production estimates have been overtaken by the Fast Castle colony located in the Berwickshire and North Northumberland Coast SAC, that is showing a rapidly increasing pup population: the most recent 2019 pup count for Fast Castle was 4,499 individuals (Figure 4 14).
- Northeast England SMU:
 - Pup production comes entirely from the Farne Islands, located within the Berwickshire and North Northumberland Coast SAC. The most recent 2019 pup count was 2,823 pups.

6.3 Telemetry

- Harbour seal:
 - A total of 49 harbour seal telemetry tracks were recorded within the East Scotland and Northeast England SMU. Telemetry tracks were recorded throughout the East Scotland and Northeast England SMUs but were more densely concentrated around the Fife and Aberdeenshire coast, particularly in the south of the East Scotland SMU around the Tay Estuary. The majority of harbour seals were tagged in the East Scotland SMU (46), as well as the Moray Firth (two) and Southeast England SMU (one). No harbour seals were tagged in the Northeast England SMU;
 - Connectivity between the Morven Option Lease Agreement Site Marine Mammal Study Area and the Firth of Tay and Eden Estuary SAC was observed in four adult male harbour seals.
- Grey seal:
 - There have been 146 grey seal tracks recorded throughout the East Scotland and Northeast England SMUs. This comprised 101 adult grey seals and 45 grey seal pups;
 - Connectivity between the Morven Option Lease Agreement Site Marine Mammal Study Area and a grey seal SAC was observed in 29 grey seals, (16 adults and 13 pups). There were six grey seals showing connectivity with only the Isle of May SAC, 14 with only the Berwickshire and North Northumberland coast SACs and nine which showed connectivity with both SACs;
 - Connectivity was also observed between the Morven Option Lease Agreement Site Marine Mammal Study Area and two grey seal SACs outside the SMUs of interest: the Faray and Holm of Faray and Monach Island SACs.

7 Data Provided

All count data for the East Scotland and Northeast England SMUs can be found in the attached Excel Workbook:

- August Haulout Counts East Scotland and Northeast England SMUs.xls
- Grey seal pup production East Scotland and Northeast England SMUs.xls

Shapefiles of the August haul-out count data are provided in:

- Harbour_seal_haulout_counts_seal_management_units_1996to2021.shp
- Grey_seal_haulout_counts_seal_management_units_1997to2021.shp

Shapefiles of all individual seals with telemetry data within the East Scotland and Northeast England SMUs and Morven Option Lease Agreement Site Marine Mammal Study Area are provided in:

- Harbour_seal_telem_within_seal_management_units.shp
- Harbour_seal_telem_within_Array_marine_mammal_study_area_connectivity_SACs.shp
- Grey_seal_telem_within_seal_management_units_adults.shp
- Grey_seal_telem_within_Array_marine_mammal_study_area_connectivity_SACs_adults.shp
- Grey_seal_telem_within_seal_management_units_pups.shp
- Grey_seal_telem_within_Array_marine_mammal_study_area_connectivity_SACs_pups.shp

A list of the data for each individual seal tagged in the East Scotland and Northeast England SMUs:

- Telemetry Bios.xls

8 Literature Cited

- Brasseur, S. M., T. D. Polanen Petel, T. Gerrodette, E. H. Meesters, P. J. Reijnders, and G. Aarts. 2015. Rapid recovery of Dutch gray seal colonies fueled by immigration. *Marine Mammal Science* **31**:405-426.
- Carter, M. I., D. J. Russell, C. Embling, C. Blight, D. Thompson, P. J. Hosegood, and K. A. Bennett. 2017. Intrinsic and extrinsic factors drive ontogeny of early-life at-sea behaviour in a marine top predator. *Scientific Reports* **7**:15505.
- Carter, M. I. D., L. Boehme, M. A. Cronin, C. D. Duck, W. J. Grecian, G. D. Hastie, M. Jessopp, J. Matthiopoulos, B. J. McConnell, D. L. Miller, C. D. Morris, S. E. W. Moss, D. Thompson, P. M. Thompson, and D. J. F. Russell. 2022. Sympatric Seals, Satellite Tracking and Protected Areas: Habitat-Based Distribution Estimates for Conservation and Management. *Frontiers in Marine Science* **9**:875869.
- Lonergan, M., C. Duck, S. Moss, C. Morris, and D. Thompson. 2013. Rescaling of aerial survey data with information from small numbers of telemetry tags to estimate the size of a declining harbour seal population. *Aquatic Conservation: Marine and Freshwater Ecosystems* **23**:135-144.
- Patterson, T. A., B. J. McConnell, M. A. Fedak, M. V. Bravington, and M. A. Hindell. 2010. Using GPS data to evaluate the accuracy of state-space methods for correction of Argos satellite telemetry error. *Ecology* **91**:273-285.
- Peschko, V., S. Müller, P. Schwemmer, M. Mercker, P. Lienau, T. Rosenberger, J. Sundermeyer, and S. Garthe. 2020. Wide dispersal of recently weaned grey seal pups in the Southern North Sea. *ICES Journal of Marine Science* **77**:1762-1771.
- Russel, D. J. F., and M. Carter. 2021. Grey seal independent estimate scalar: converting counts to population. SCOS Briefing paper 21/02. Sea Mammal Research Unit, University of St Andrews.
- Russell, D., J. Matthiopoulos, and B. McConnell. 2011. SMRU seal telemetry quality control process. SCOS Briefing paper (11/17).
- Russell, D. J. F., B. McConnell, D. Thompson, C. Duck, C. Morris, J. Harwood, and J. Matthiopoulos. 2013. Uncovering the links between foraging and breeding regions in a highly mobile mammal. *Journal of Applied Ecology* **50**:499-509.
- SCOS. 2015. Scientific Advice on Matters Related to the Management of Seal Populations: 2014.

SCOS. 2016. Scientific Advice on Matters Related to the Management of Seal Populations: 2015.

SCOS. 2017. Scientific Advice on Matters Related to the Management of Seal Populations: 2016.

SCOS. 2018. Scientific Advice on Matters Related to the Management of Seal Populations: 2017.

SCOS. 2019. Scientific Advice on Matters Related to the Management of Seal Populations: 2018.

SCOS. 2020. Scientific Advice on Matters Related to the Management of Seal Populations: 2019.

SCOS. 2022. Scientific Advice on Matters Related to the Management of Seal Populations: 2021.

SCOS. 2023. Scientific Advice on Matters Related to the Management of Seal Populations: 2022.

Vincent, C., B. J. McConnell, V. Ridoux, and M. A. Fedak. 2002. Assessment of Argos location accuracy from satellite tags deployed on captive gray seals. *Marine Mammal Science* **18**:156-166.