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Data on Seal Haul-Out Sites and Distribution in Relation to the Marine Harvest Fish Feed Plant at Allt Anavig Quarry, Isle of Skye.

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1 Introduction

SMRU Consulting was contracted by Jacobs to provide baseline seal data in relation to the proposed jetty extension at Kyleakin as part of the development of the Marine Harvest Fish Feed Plant at Allt Anavig Quarry, Isle of Skye. The following data were requested:

- Harbour seal count data from August moult census surveys since 1996 to examine site specific abundance and trends in counts over time. This will cover all haul outs within a defined Study Area specified by the Client.

- Associated grey seal counts from these same August surveys (although note that during the summer months grey seal distribution is highly variable and these counts, while giving a snapshot of local summer distribution, are not a reliable census of population size).
- Provision of Regional, Management Unit and UK wide counts to provide context for the counts within the defined Study Area.
- Grey seal pup production estimates from all regularly surveyed breeding sites within the Study Area specified by the Client.
- Provision of satellite tracking data from all tagged harbour or grey seals from the SMRU telemetry database which tracks crossed the Study Area (regardless of where tagged).
- Special Area of Conservation (SAC) connectivity: display of seal satellite tracking data from tagged harbour and grey seals: either animals which were tagged at an SAC and whose tracks crossed the study area or animals whose tracks overlapped with both the study area and an SAC the SACs and visiting the Study Area, or visiting the specified area and also hauling out at the SACs).
- A basic quantification of the degree of connectivity between the Study Area specified by the Client and SACs.

1.1 Study Area

The study area was identified by Jacobs as a 50 km² boxed area around the existing jetty at Kyleakin, located on the eastern coast of the Isle of Skye. The Study Area is located within the West Scotland seal management unit (MU) (also known as the West Highlands), specifically the Central subdivision of the West Scotland MU (Figure 1).

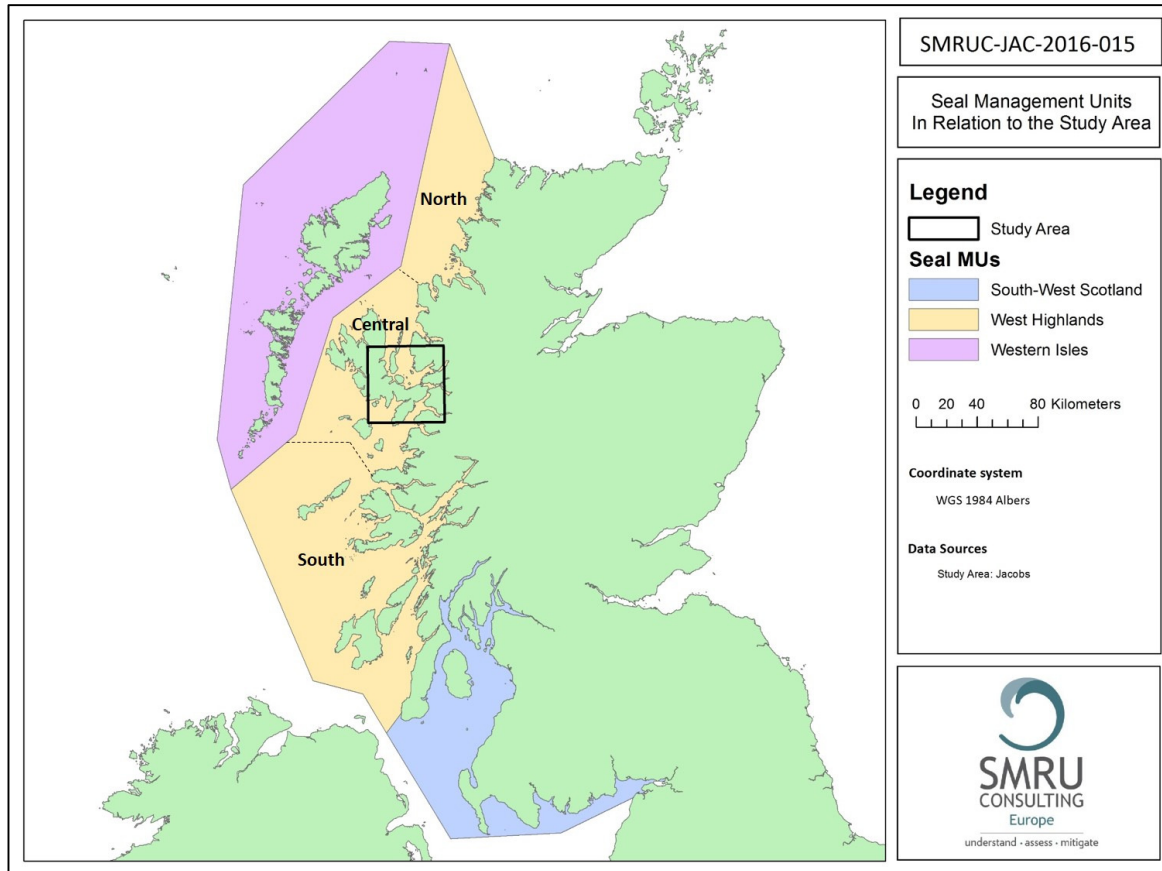


Figure 1 Seal Management Units in relation to the Study Area.

2 Methods

2.1 SMRU Seal Count 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 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 Scottish Natural Heritage, Natural England, Natural Resources Wales (formally 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 website (<http://www.smru.st-andrews.ac.uk/research-policy/scos/>).

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 grey seal surveys are designed to estimate the numbers of pups born at these colonies, between mid-September and the end of 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 (*Phoca vitulina*) are carried out during the summer months. Breeding seals are surveyed in June and July in a small number of areas. 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 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.

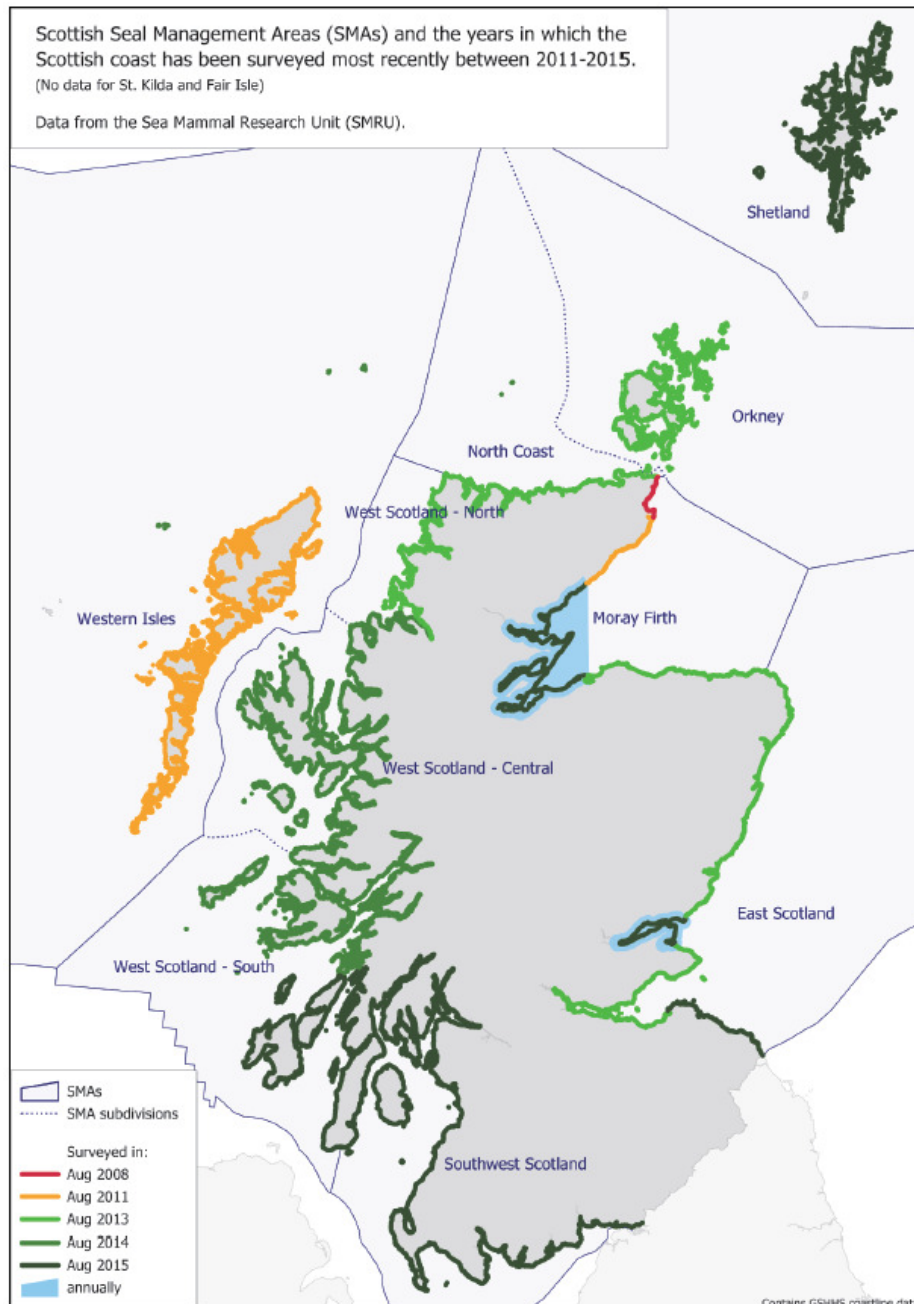


Figure 2 The years in which different parts of Scotland were most recently surveyed for harbour seals (Duck & Morris, 2016).

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 Scottish Natural Heritage in areas designated as Special Areas of Conservation (SACs) for

harbour seals.

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 3 km. Numbers of grey seals are also counted during these August 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, 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 (the Firth of Tay and part of the Moray Firth) are usually surveyed from a fixed wing light aircraft using conventional, oblique photography.

The 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. However, these counts are often scaled up to provide an estimate of the population size by scaling the counts by the estimated proportion hauled out to account for the proportion of animals at sea during these surveys. 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.

The most recent data for the Study Area are from 2015.

2.1.2 Grey Seals

Grey seals (*Halichoerus grypus*) 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.

SMRU's main surveys of grey seals are designed to estimate the numbers of pups born at the main breeding colonies around Scotland. Breeding grey seals are surveyed annually between mid-September and late November using large-format vertical photography from a fixed-wing aircraft. Over 60 colonies are surveyed annually between three and seven times, at 10 to 12 day intervals, through the breeding season. Total pup production for each colony is derived from the series of counts obtained. Approximately 40 additional colonies are surveyed less regularly. The main grey

seal breeding colonies in Shetland, England, Wales and Northern Ireland are counted by other, local, organisations. SNH staff count pups in Shetland in a manner compatible with counts from aerially surveyed colonies.

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

SMRU survey grey seals annually during their breeding season, between early October and late November, using fixed-wing aerial photography. Breeding colonies are surveyed between four and six times each year, and total pup production is estimated from the series of counts of pups at each colony. The grey seal pup production counts are conducted by SMRU during the autumn breeding season. These were previously conducted every year, but since 2010 this has changed to biennial counts. The most recent grey seal pup production survey was conducted in 2015.

2.1.3 Summary of seal survey methods

1. Population surveys of harbour seals are carried out during their annual moult in August.
2. Harbour seal moult surveys provide an estimate of the minimum size of the population, not the total population size.
3. Harbour seal breeding season surveys are carried out annually in east England and the Moray Firth, and infrequently elsewhere.
4. In general, harbour seal population (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.
5. Grey seals are also counted during harbour seal 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 population size.
6. The main grey seal surveys estimate the number of pups born at the main breeding colonies around Scotland.
7. Other organisations monitor the number of grey seal pups born in England, Wales, Northern Ireland and Shetland.
8. 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 website (<http://www.smru.st-andrews.ac.uk/research-policy/scos/>).

The haul out count data from the annual SMRU surveys are not appropriate for assessing the very fine scale distribution of haul out sites – the data we have are a snap shot 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.

2.2 SMRU Telemetry Data

The Sea Mammal Research Unit (SMRU) has deployed telemetry tags on grey seals (*Halichoerus grypus*) and harbour seals (*Phoca vitulina*) in the UK since 1988. These tags transmit data on seal locations with the tag duration (number of days) varying between individual deployments. There are two types of telemetry tag which differ by their data transmission methods. Data transmission can be through the Argos satellite system (Argos tags) or mobile phone network (phone tags). Both types of transmission result in location fixes, but data from phone tags comprise better quality and more frequent locations. All telemetry data used in this report have been cleaned according to SMRU protocol (Russell *et al.*, 2011).

The telemetry database was queried to determine whether any seals had any degree of overlap with the Isle of Skye Study Area provided by Jacobs (Figure 3). The selected tracks and locations that crossed into the Study Area were then divided using the database into those that were tagged at seal SACs, those that visited SACs and those that did not visit any SACs throughout the tagging duration.

For all tagged animals which had locations within the Study Area, the percentage of locations within the area was calculated as a proportion of the total number of locations from each track. Although there is likely to be a good relationship between the time an animal spends in an area and the number of location fixes, it is important to note that there are a number of other factors which can affect the rate at which location fixes are obtained and these are not controlled for here, these include such things as satellite availability and the duration animals spend at the surface between dives. As such there may be unquantifiable biases in these metrics.

3 Legislation protecting seals in the area of interest

3.1 Marine (Scotland) Act 2010

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. The Natural Environment Research Council (NERC), through the Special Committee on Seals (SCOS) and the NERC sponsored Sea Mammal Research Unit (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 significant 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, 2014b).

Within the Central sub-division of the West Scotland Management Unit there are 10 designated haul out sites for harbour seals based on August survey counts and one additional designated haul out site for a grey seal breeding colony (Table 1, Table 2 & Figure 3).

Table 1 Description of all designated haul out sites for harbour seals in the Central sub-division of the West Scotland MU based on August survey counts.

Site ID	Site Name	Location	Distance from Construction Site by sea	Description
WSC-001	Arisaig	Arisaig	~40.5 km	Entire islands of Luinga Bheag, Luinga Mhor, Am Fraoch-eilean, Sgeir an Fheoir, Sgeir Ghainmheach between the northern and southern channels into Loch nan Ceall plus Sgeir Philip and Sgeirean Buidhe and associated intertidal sandbanks and rocky outcrops along the immediately opposite coastline of the mainland.
WSC-002	Pabay & Ardnish Peninsula	South East Skye	~4.5 km	Intertidal sandbanks and rocky outcrops surrounding Pabay, the entire islands of Sgeir Gobhlach and Sgeir Dubh and intertidal sandbanks and rocky outcrops along the coastline of Ardnish between Rubh Achadha' Chuirn and Broadford airstrip.
WSC-003	Loch a' Bhraige	North Rona, Sound of Raasay	~36 km	Intertidal sandbanks and rocky outcrops on the north end of the Island of Rona between Ob nam Feusgan and Tidal Pond and associated rocky outcrops.

WSC-004	Kishorn Island & Strome Islands	Loch Carron	~10.5 km	Entire islands of Kishorn Island, An Garbh-eilean, Sgeir an Fheoir, Sgeir Buidhe, Eilean na Creige Duibhe, Ulluva, Eilean an-t-Stratha, Strome Islands and associated rocky outcrops, including those between Sgeir Bhuidhe and Eilean a Chairt, those between Eilean a Chairt and Eilean an-t-Stratha and those between An Garbh-eilean and the mainland.
WSC-005	Hyskeir	South West of Canna	~86 km	Entire islands of Oigh-sgeir and Garbh Sgeir and associated rocky outcrops.
WSC-006	West Canna	West Canna	~76 km	Rocky coastline between a point on the north coast of West Canna directly north of Ceann Creag-airighe following the coast to the west and then back east to the fort at Tota Tarra on the south coast of West Canna.
WSC-007	Sgeir a' Phuirt	outside Canna Harbour, East Canna	~71 km	Entire island of Sgeir a' Phuirt.
WSC-008	Fladda-chuain	off North Skye	~68.5 km	Entire island of Fladda-chuain and associated rocky outcrops.
WSC-009	South West Rum	South West Rum	~63 km	Rocky coastline between Rubha Sgorr an t-Snidhe and Rubha nam Meirleach and associated rocky outcrops.
WSC-010	Sgeir nam Maol	East of Fladda-chuain, off North Skye	~68 km	Entire island of Sgeir nam Maol and associated rocky outcrops.

Table 2 Description of all designated haul out sites for grey seals in the Central sub-division of the West Scotland MU based on grey seal breeding colonies.

Site ID	Site Name	Location	Distance from Construction Site by sea	Description
BC-005	Trodday	off North tip of Skye	~61.5 km	Rocky coastline and neighbouring grassy areas of Eilean Trodday.

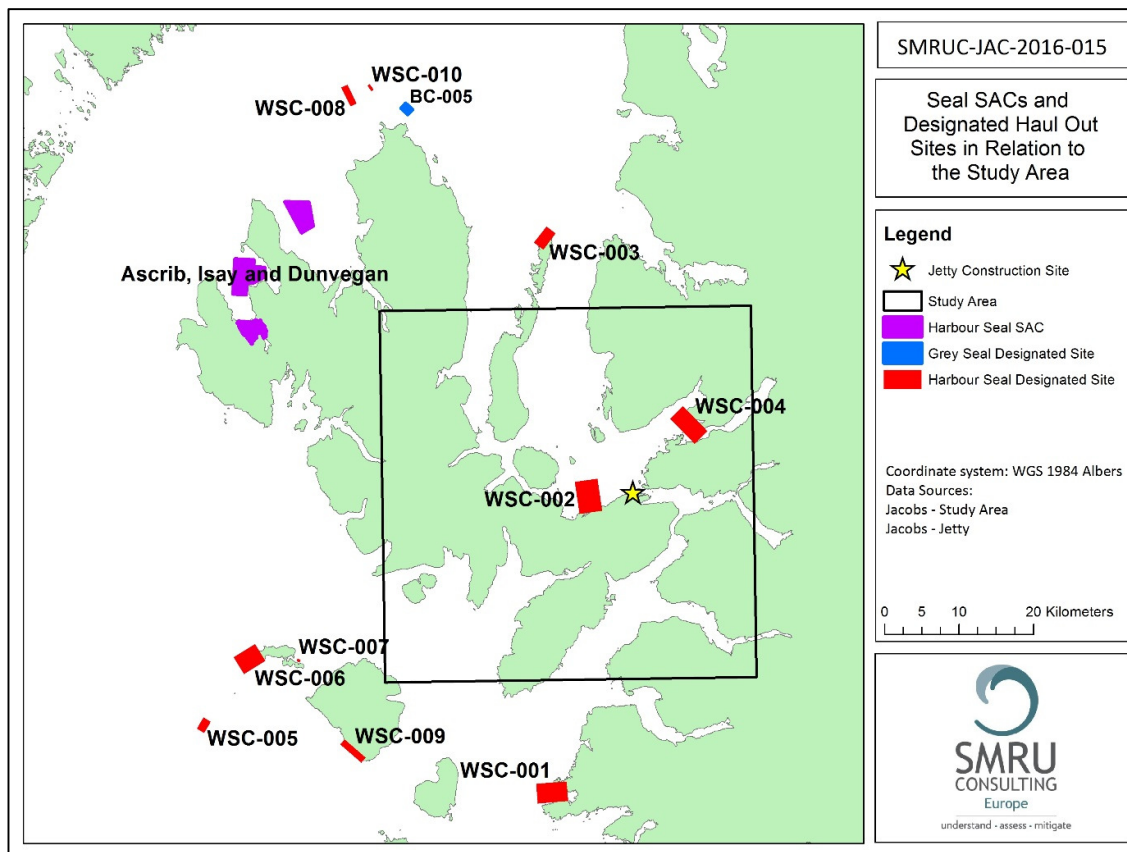


Figure 3 SACs and Designated seal haul out sites located within the Central subdivision of the West Scotland Seal Management Unit.

3.2 Habitats Directive

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 at

<http://www.jncc.gov.uk/protectedsites/sacselection/species.asp?FeatureIntCode=S1365>.

Information on the SACs which have been designated for grey seals can be found at <http://www.jncc.gov.uk/protectedsites/sacselection/species.asp?FeatureIntCode=S1364>.

The Habitats Directive is transposed into law in Scotland under the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended in Scotland). The Habitats Directive requires the creation of a Europe-wide network of Special Areas of Conservation (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 Special Areas of Conservation (SACs) be established for their protection. There are four seal SACs in the West Scotland and the Western Isles Management Units that are referred to in this report in relation to the Study Site: the Ascrib, Isay and Dunvegan, and the Eileanan agus Sgeiran Lios mor SACs for harbour seals and the Treshnish Isles and the Monarch Islands SACs for grey seals.

The Ascrib, Isay and Dunvegan SAC, for which harbour seals are the primary species for selection of the site, is located in the Central sub-division of the West Scotland Management Unit, approximately 79 km from the construction site (Figure 4). This SAC is described as: *the complex of skerries, islets, undisturbed mainland shores and offshore islands in north-west Skye (that) consistently support a breeding colony of the Harbour seal (Phoca vitulina). The site represents one of the larger discrete colonies of common seals in the UK, holding around 2% of the UK population¹.* The Eileanan agus Sgeiran Lios mor SAC, for which harbour seals are the primary species for selection of the site, is located in the South sub-division of the West Scotland Management Unit, approximately 124 km from the construction site (Figure 4). This SAC is described as: *the most sheltered and enclosed site for the Harbour seal. Lismore is a composite site comprising five groups of small offshore islands and skerries which are extensively used as haul-out sites by the colony. Seal numbers represent just over 1% of the UK population².*

The Treshnish Isles SAC, for which grey seals are the primary species for selection of the site, is located in the South sub-division of the West Scotland Management Unit, approximately 101 km from the construction site (Figure 4). This SAC is described as: *a remote chain of uninhabited islands and skerries situated in south-west Scotland. The islands, numerous skerries, islets and reefs support a breeding colony of grey seals, contributing just under 3% of annual UK pup production³.* The Monarch Islands SAC, for which grey seals are the primary species for selection of the site, is located in the South sub-division of the West Scotland Management Unit, approximately 145 km from the construction site (Figure 4). This SAC is described as: *a wide area of largely undisturbed habitat for breeding grey seal, and there is easy access to the grassy swards and dune systems of the islands.*

¹ <http://jncc.defra.gov.uk/protectedsites/sacselection/sac.asp?EUcode=UK0030230>

² <http://jncc.defra.gov.uk/protectedsites/sacselection/sac.asp?EUcode=UK0030182>

³ <http://jncc.defra.gov.uk/protectedsites/sacselection/sac.asp?EUcode=UK0030289>

These islands hold the largest breeding colony in the UK, contributing over 20% of annual UK pup production⁴.

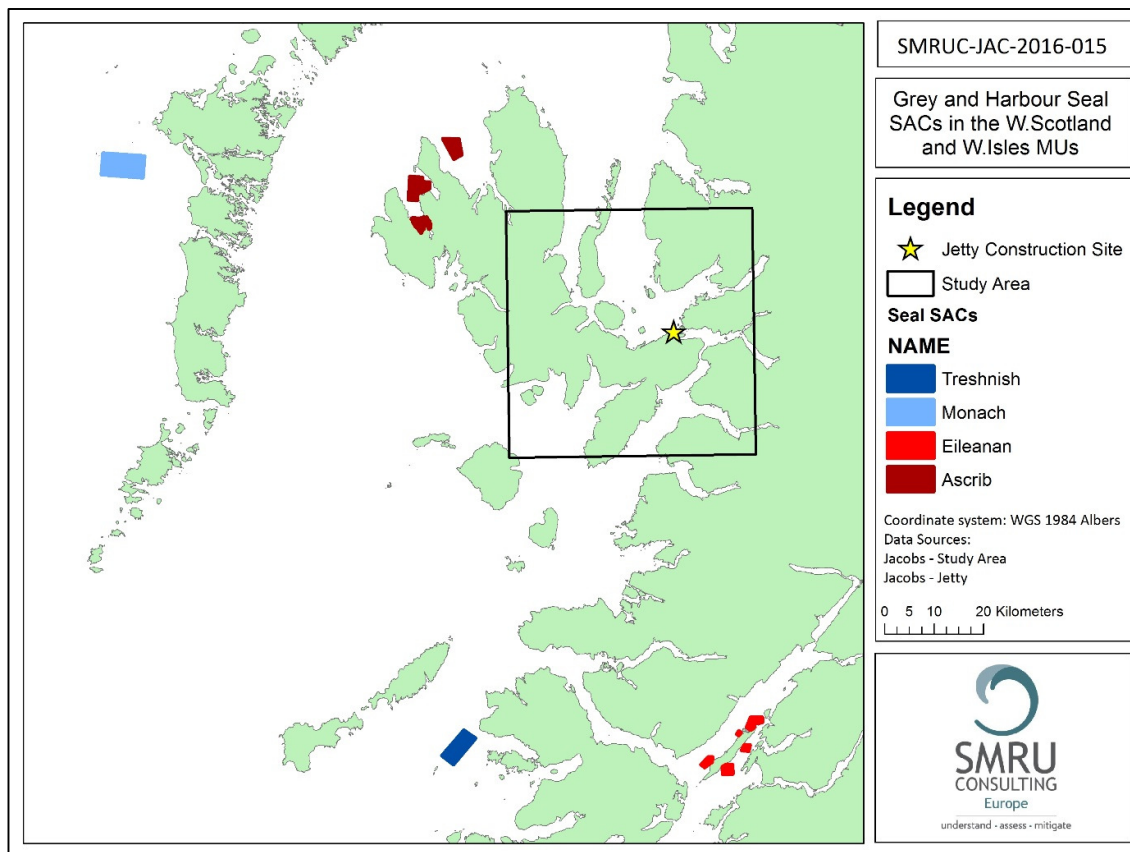


Figure 4 Grey (blue) and harbour (red) seal SACs in the West Scotland and Western Isles Management Units in relation to the Study Area (provided by the Client).

4 Harbour Seal Counts

4.1 Harbour Seal Counts in the UK

A total of 29,109 harbour seals were counted around the UK in the most recent UK wide round of counts between 2007 and 2014. Eighty percent of this total were counted in Scotland (SCOS, 2015). This value can be scaled by the estimated proportion hauled out to produce an estimated total population for the UK in 2014 of 40,414 (approximate 95% CI 33,106 - 55,029) (SCOS, 2015). In general, there has been an observed decline in harbour seal counts across the north and east coasts of Scotland, although numbers remain stable or increasing in the west coast and the Outer Hebrides

⁴ <http://jncc.defra.gov.uk/protectedsites/sacselection/sac.asp?EUcode=UK0012694>

(SCOS, 2015). The most recent total count for the Scottish coast is 25,399 harbour seals between 2011 and 2015, which is significantly higher than the total count obtained from the 2007 to 2009 surveys where only 20,430 were counted (Duck & Morris, 2016).

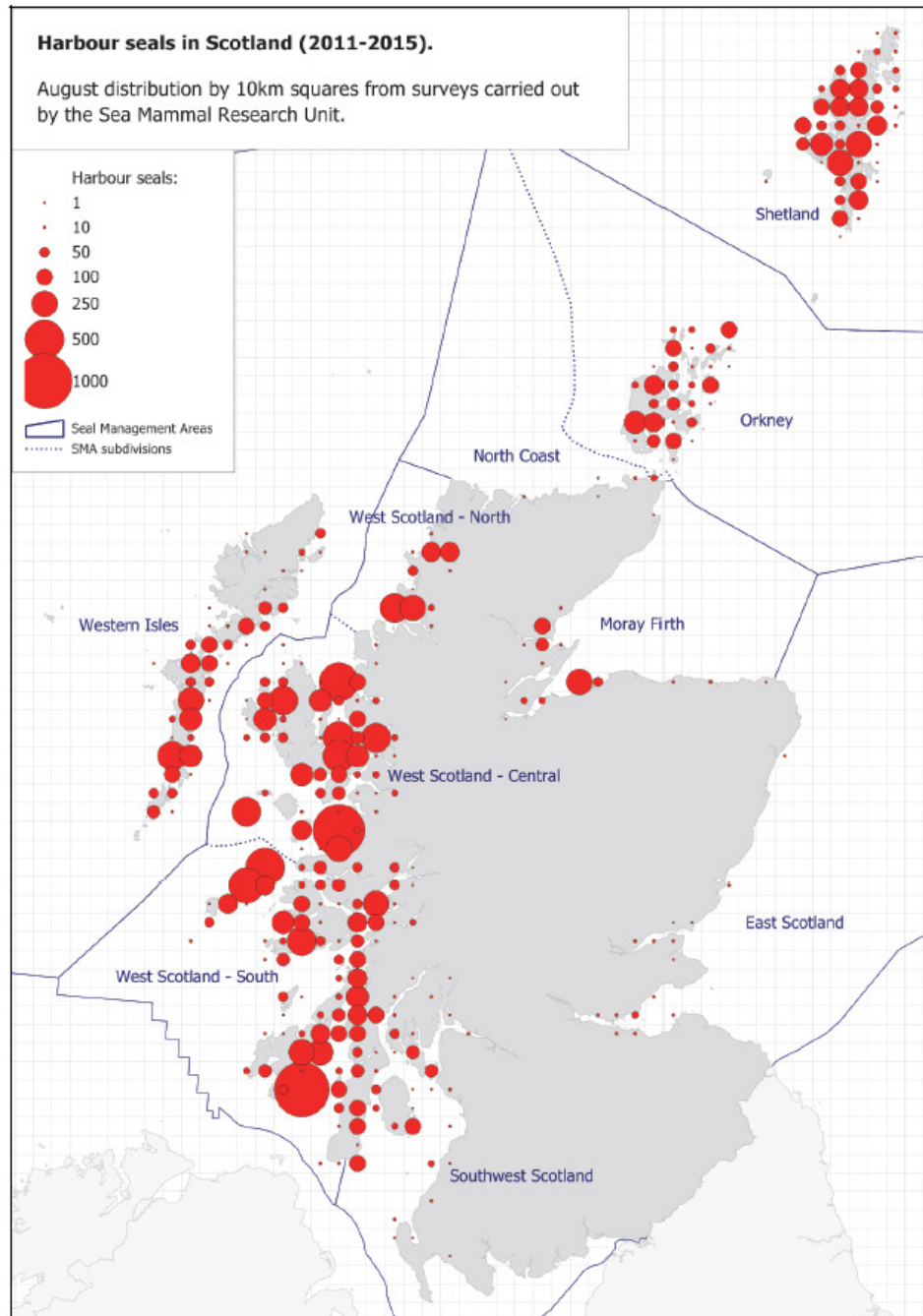


Figure 5 Number and distribution of harbour seals at haul-out sites in Scotland by 10km squares (Duck & Morris, 2016).

4.2 Harbour Seal Counts in the West Scotland and Western Isles Management Units

The Western Isles and the West Coast are clearly the most important Management Units for harbour seals with August counts in the Western Isles and the West Coast comprising 62% of the total Scottish counts (Figure 5). The most recent count data for the West Scotland Management Unit is from 2013 to 2015. The West Scotland Management Unit is comprised of three sub-divisions. The North sub-division was last counted in 2013 and 2014, the Central sub-division was last counted in 2014 and the South sub-division was last counted in 2015 (Table 3). The total harbour seal count for West Scotland from the most recent surveys between 2013 and 2015 was 15,184, which is a 43% increase from the surveys between 2007 and 2009 (Figure 6; Duck & Morris, 2016).

The number of sites counted during the August harbour seal count surveys, and the number of harbour seals counted at each site between 1996 and 2015 are presented in Table 3. It is important to note when viewing these data that the number of sites counted at each MU or sub-division each year varied from 2 sites to 394 sites. This is due to time and environmental conditions limiting survey effort so that only a part of the Scottish coast can be surveyed in one year, therefore leading to big differences in the area covered each year. It for this reason that when total count data for a MU is presented, the data is a total count over a survey period often consisting of a few years in order to capture data for all sites. Where survey effort across a region spans several years, counts are summed across years because different sites were counted in each survey year. For example, in the West Scotland South subdivision, 319 sites were counted in 2014 (these were largely located in the north of the subdivision) and a different 386 sites were counted in 2015 (these were largely located in the south of the subdivision). These counts are then summed to produce the total count across the survey period for this subdivision. It should be noted that it is possible that some seals are double counted if they moult at a different site between years, however, in general site fidelity is high in harbour seals (e.g. Sharples et al., 2012; Cordes and Thompson, 2015) therefore the risk of double counting at the regional scale is quite low.

Table 3 Number of sites and number of harbour seals counted from August surveys for the West Scotland and Western Isles Management Units. No value= not surveyed in that year.

Survey Period	Year	West Scotland - Central		West Scotland - North		West Scotland - South		Western Isles	
		# Sites	# Seals	# Sites	# Seals	# Sites	# Seals	# Sites	# Seals
1996-	1996	172	2701	3	6	393	5651	228	2821

1997	1997			38	454				
2000-2006	2000	184	3746			394	7239	215	2413
	2002							90	589
	2003							234	2067
	2005	257	3962	60	709	38	316		
	2006							165	1586
2007-2009	2007	174	3623			191	5278		
	2008	11	387	55	693			199	1804
	2009					251	4182		
2011	2011							272	2746
2013-2015	2013			75	1095				
	2014	370	6424	2	20	319	4194		
	2015					386	3451		

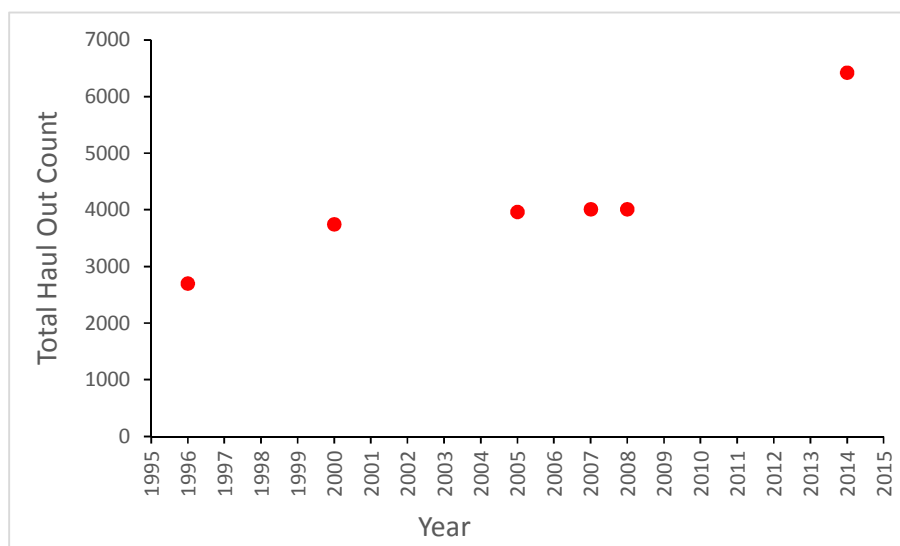


Figure 6 Total harbour seal haul out counts between 1996 and 2014 for the Central subdivision of the West Scotland MU. Note: the 2007 and 2008 counts are summed to provide one count over the two year period as only part of the subdivision was surveyed in each year (no overlap in sites counted between the two years).

4.3 Harbour Seal Counts in the Study Area

The number of harbour seals counted at any one haul out site within the Study Area in any one year ranged from one seal (single seals were counted at multiple sites across all survey years) to 139 seals (counted at one haul out site in 2000). Total counts within the Study Area have increased from 1,217 in 1996 to 2,589 in 2014 (Figure 7). . In order to provide an overview of harbour seal counts at haul

out sites closest to the construction site, the data were divided into 6 clusters of haul out sites all within ~20 km ‘swimming’ distance from the construction site (Figure 10 and Table 4). Taking total counts from across all six clusters, the 2014 count was 1,614 harbour seals within 20 km from the construction site. This accounts for 62% of the harbour seals counted in the entire Study Area in the same year and 25% of the harbour seals counted in the entire West Scotland Central subdivision MU in the same year. These data therefore show that there are relatively high numbers of harbour seals hauled out in the Study Area with high numbers hauled out close to the construction site during the August moult.

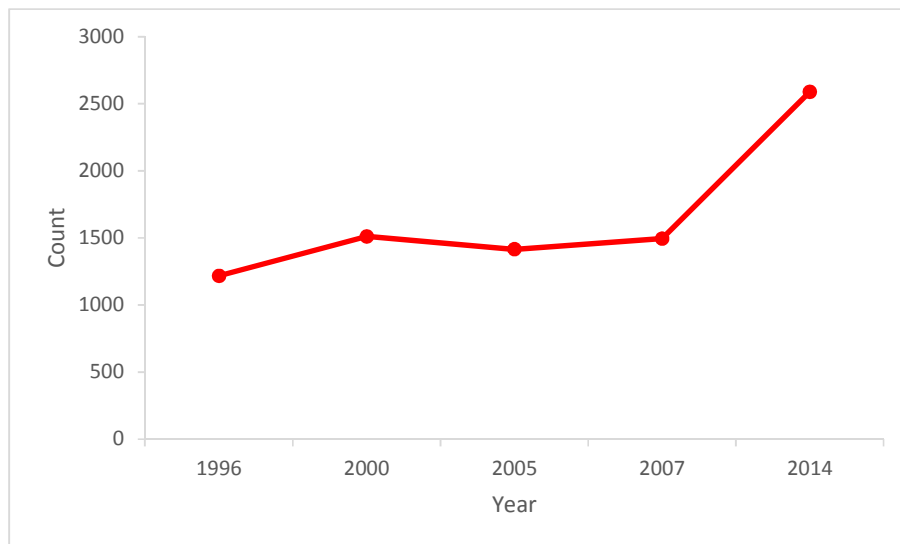


Figure 7 Total number of harbour seals counted within the Study Area during August moult surveys between 1996 and 2014.

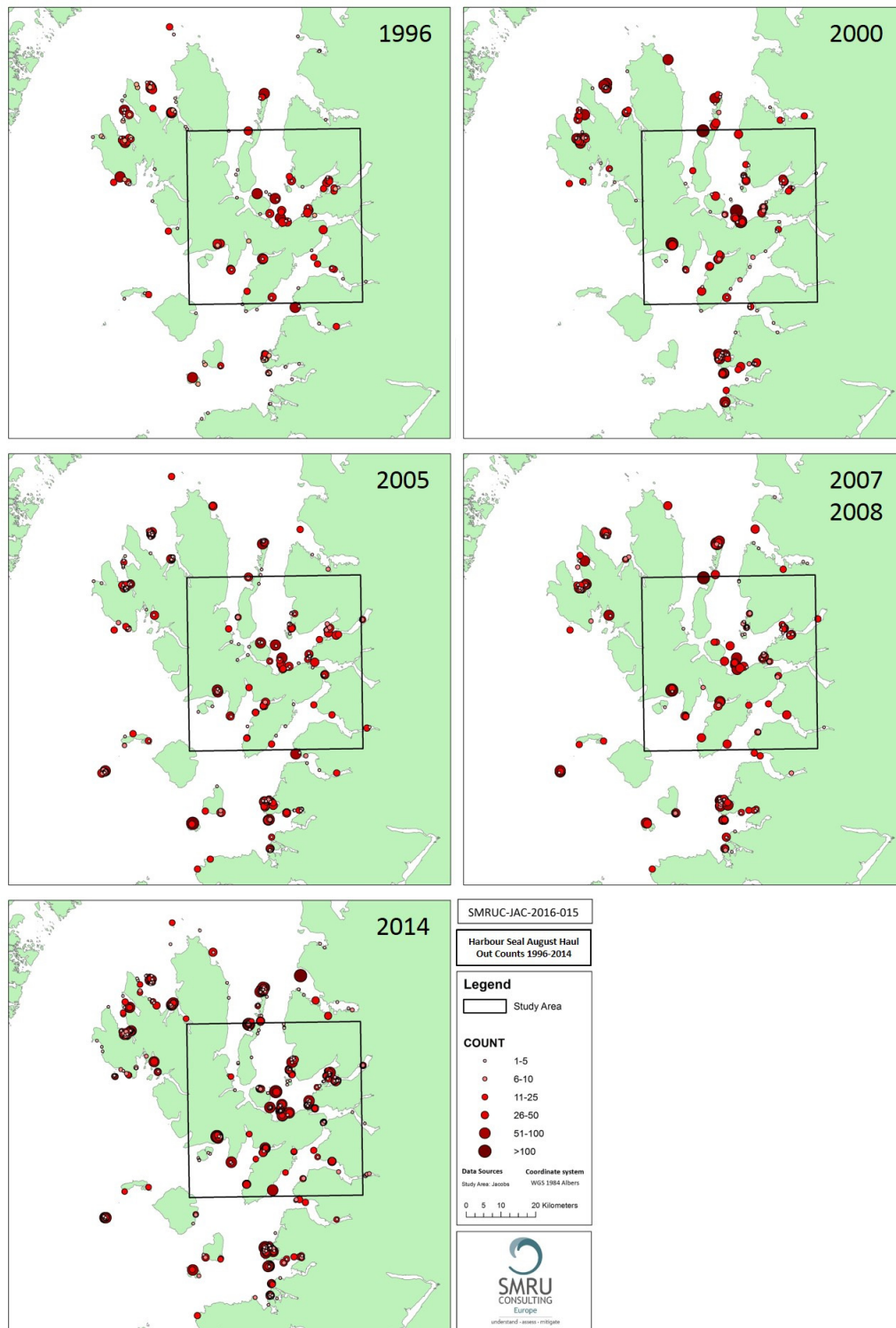


Figure 8 Harbour seal August haul out counts between 1996 and 2014 in the West Scotland Central subdivision MU.

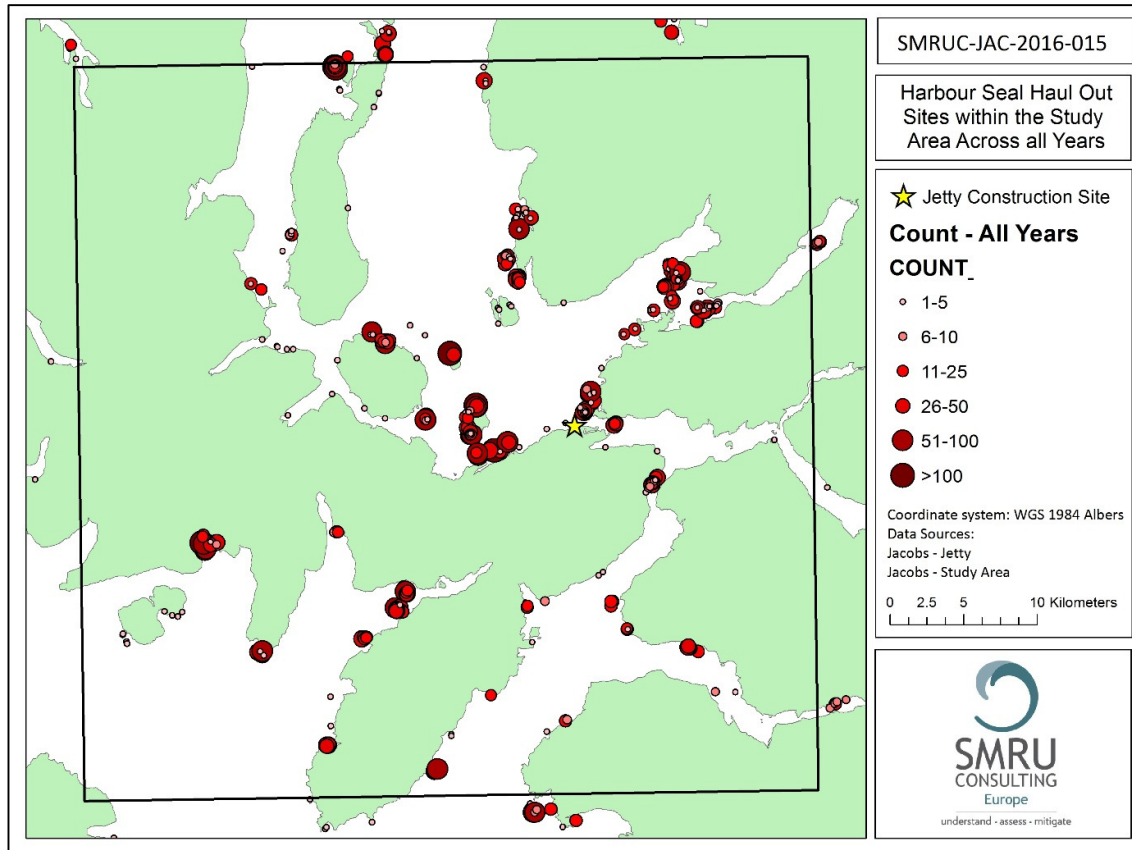


Figure 9 Harbour seal haul out sites within the Study Area across all survey years.

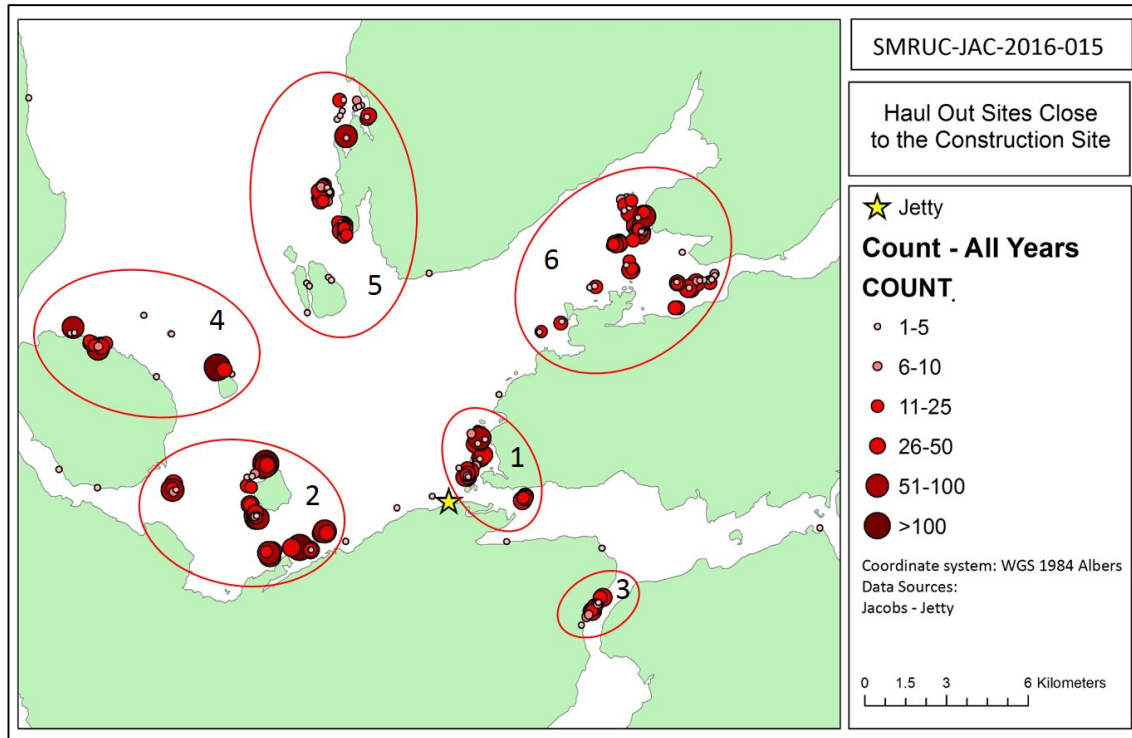


Figure 10 Clusters of haul out sites close to the construction site (within 20 km swimming distance).

Table 4 Total number of harbour seals counted at each haul out cluster close to the construction site across survey years.

	1996	2000	2005	2007	2014
Cluster 1	129	116	116	131	197
Cluster 2	215	343	240	343	396
Cluster 3	30	26	40	40	40
Cluster 4	134	32	158	68	272
Cluster 5	45	107	86	82	322
Cluster 6	156	145	169	208	387

4.4 Other Data

Land-based visual vantage-point surveys were conducted at Kyle Rhea between July 2011 and July 2012. These were combined bird and marine mammal surveys with dedicated marine mammal watches and were conducted by Natural Research Projects (NRP) Ltd to support the Kyle Rhea Tidal Array EIA. All surveys were conducted in sea states 0-3, with the majority of surveys conducted in sea states 0 or 1 (Royal Haskoning, 2012). The data collected during these surveys showed that

harbour seal sightings were relatively low between September and March with most winter months having sighting rates below five harbour seals per hour of effort (Figure 11). By contrast, the sightings rate was considerably higher between April and August with highest sightings rate in May with >45 seals per hour of effort (Figure 11). These data clearly show a seasonal trend in the sightings data with sightings rates being considerably higher in the summer months. Due to the very low numbers of pups or juveniles sighted in Kyle Rhea during the breeding months June and July, it is highly unlikely that this area is used by harbour seals to breed (Royal Haskoning, 2012).

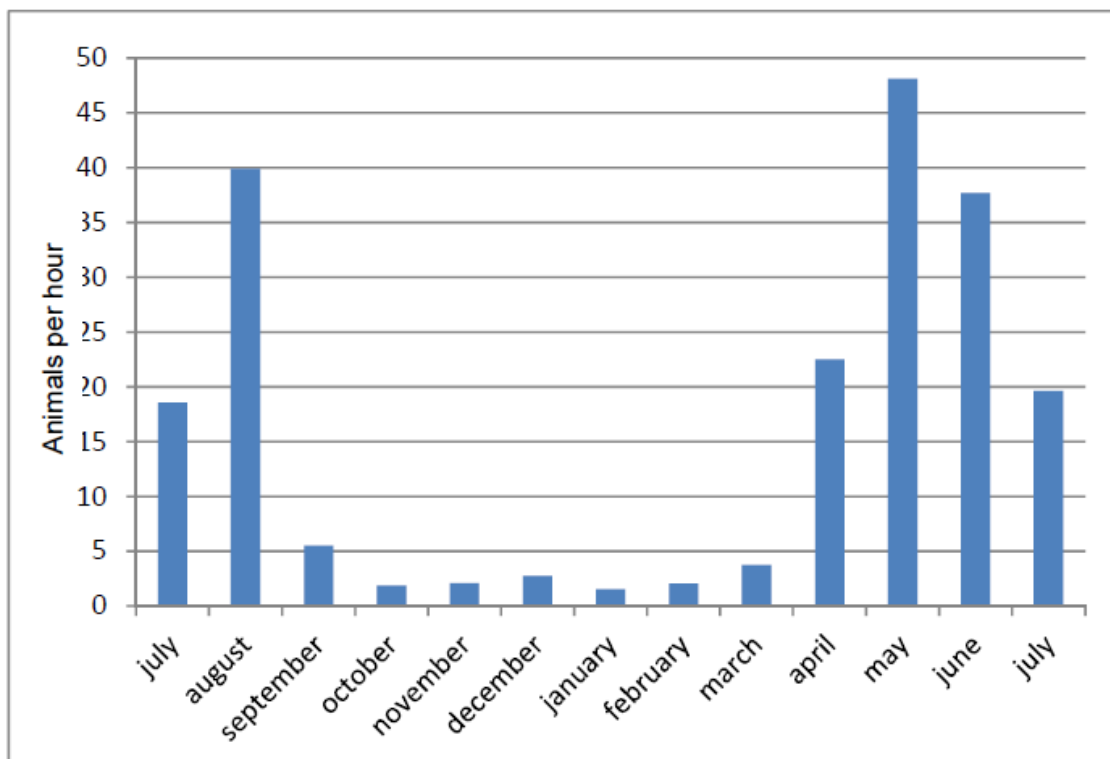


Figure 11 Monthly harbour seal sightings per hour of effort during vantage point surveys in Kyle Rhea in 2011 and 2012 (Royal Haskoning, 2012).

5 Harbour Seal Telemetry

5.1 Harbour Seal Telemetry in the West Scotland and Western Isles Management Units

A total of 77 harbour seals have been tagged by SMRU between 2003 and 2012 in the West Scotland MU at the following locations: Islay, Jura, Shildaig, Kyle Rhea, the Ascrib, Isay and Dunvegan SAC and the Eileanan agus Sgeiran Lios mor SAC at Lismore. Of these, 24 were female pups, 23 were females aged 1+ and 30 were males aged 1+ (Table 5, Figure 12).

A total of 21 harbour seals were also tagged by SMRU in 2006 in the Western Isles MU at the following locations: Barra, Sound of Harris and Eriskay. Of these, 13 were females aged 1+ and 8 were males aged 1+ (Table 5, Figure 12).

Table 5 Number of female and male harbour seals tagged in the West Scotland MU and the Western Isles MU between 2003 and 2012. The grey shaded cell represent pup, while the others were all seals aged 1+. A=tagged with ARGOS tag, P=Tagged with GPS phone tag.

MU	Tagging Location	Distance from Project site	2003		2004		2005		2006		2007	2009	2011		2012	
			F	M	F	M	F	M	F	M	F	M	F	M		
West Scotland	Islay	~175-200 km	2A	2A	1A	3A								7P	7P	3P
	Jura	~205 km	2A													
	Lismore	~130-150 km								24A						
	Shieldaig	~50 km										1P	3P			
	Skye, Loch Bay & Dunvegan	~100 km			1A	4A	3A	5A								
	Kyle Rhea, Skye	~8 km													3P	6P
Western Isles	Barra & Eriskay	~120-130 km							5A	5A						
	Sound of Harris	~110-125 km							6A	1A						
									2P	1P						

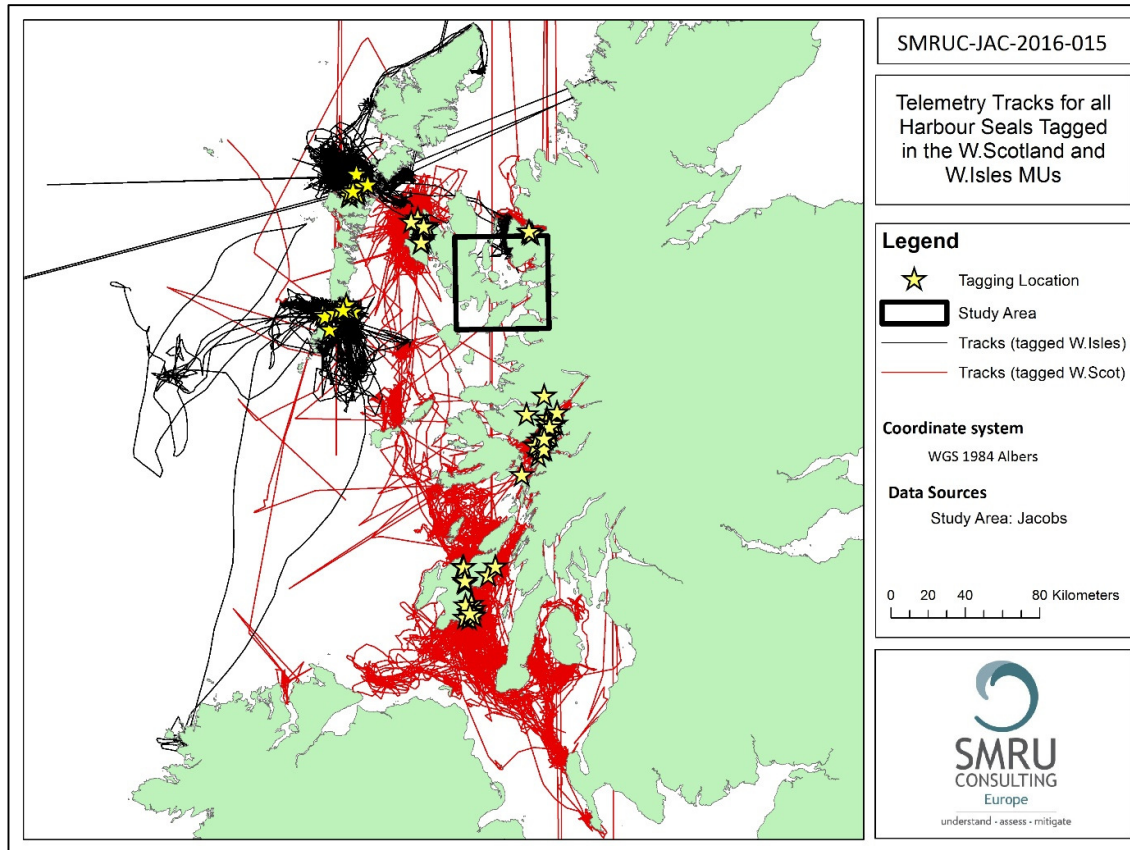


Figure 12 Tagging locations and tracks for all harbour seals tagged in the West Scotland and Western Isles Management Units (this excludes the Kyle Rhea seals).

5.2 Harbour Seal Telemetry in the Study Area

In addition to those seals tagged in Kyle Rhea in 2012, a total of three tagged harbour seals entered the Study Area, two of these were tagged in the West Scotland MU and one travelled from the tagging location in the Western Isles MU (Outer Hebrides). The number of harbour seal locations within the Study Area ranged between 9.3 and 21.5% of their total recorded GPS locations. The telemetry data show that two of the three harbour seals that entered into the Study Area also visited an SAC. One seal (ID pv19a-Nancy-06) visited the Ascrib, Isay and Dunvegan SAC and one seal (ID pvsurv-13-07) spent time at the Eileanan agus Sgeiran Lios mor SAC (Figure 13).

Note: Seal IDs pv19a-Nancy-06 and pvsurv-13-07 were tagged with Argos tags. The low temporal resolution and spatial accuracy of the locational data from these tags means that errors can be large

and often precludes the identification of very fine scale movement. It is apparent in Figure 13 and Figure 14 that there are unfiltered errors in location data.

None of the 13 harbour seals tagged at Loch Bay and Loch Dunvegan within the Ascrib, Isay and Dunvegan SAC in 2004 and 2005 entered into the Study site (Figure 15). This highlights a lack of connectivity between the Project construction site and the SAC; however, the movement behaviour of these 13 seals may not be representative of all seals that haul out at the SAC and these data are now over ten years old so connectivity cannot be completely ruled out.

Table 6 Details of the three harbour seals that entered into the Study Area and demonstrated any connectivity with SACs (this does not include the 9 seals tagged at Kyle Rhea in 2012).

	Tagging Location	Sex	Age	# GPS locations	# locations in Study Area	% locations in Study Area	SAC Visited	# locations in SAC	% locations in SAC
pv19a-Nancy-06	Sound of Harris (W. Isles MU)	F	1+	1064	229	21.5%	Ascrib, Isay and Dunvegan	1	0.1%
pl03-02-09	Shieldaig (W.Scot MU)	F	1+	4312	561	13.0%	-	0	0.0%
pvsurv-13-07	Lismore (W.Scot MU)	F	Pup	108	10	9.3%	Eileanan agus Sgeiran Lios mor	14	13.0%

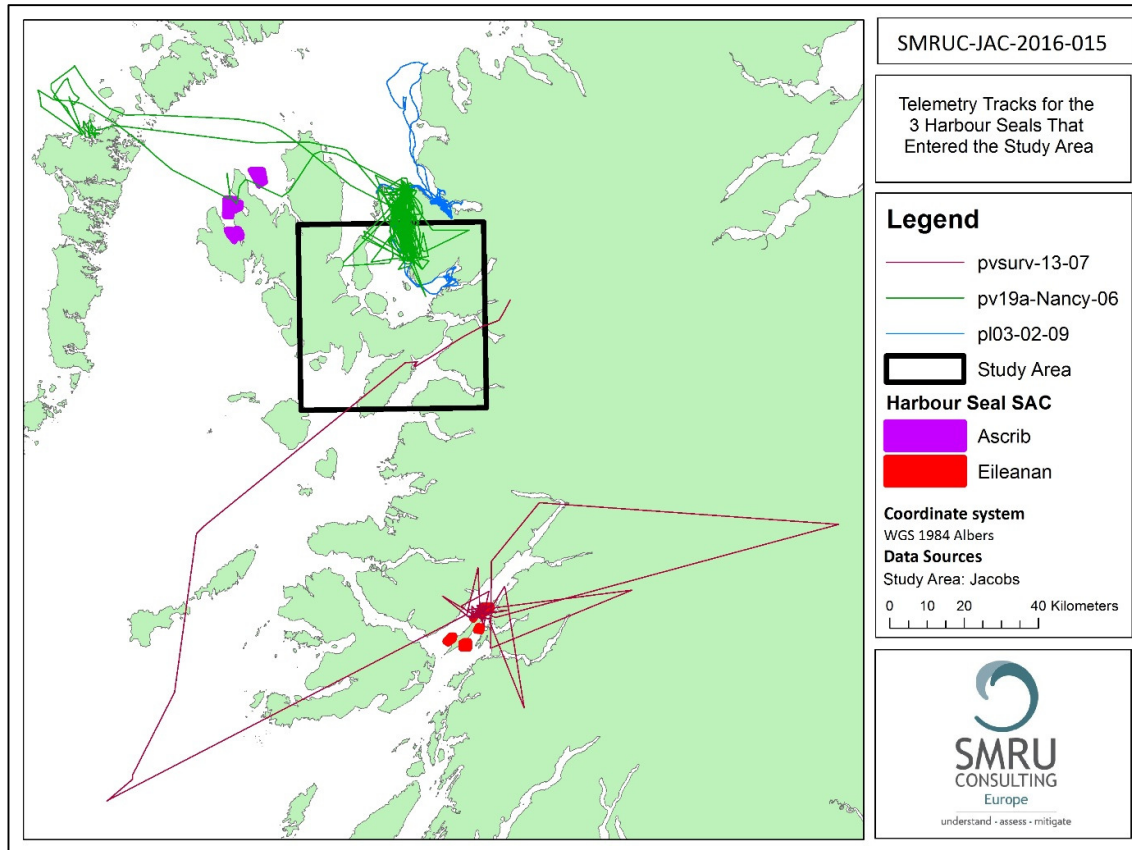


Figure 13 Telemetry tracks for the 3 harbour seals that entered the Study Area and SACs (this does not include the 9 seals tagged at Kyle Rhea in 2012). Ascrib= Ascrib, Isay and Dunvegan SAC, Eileanan= Eileanan agus Sgeiran Lios mor SAC.

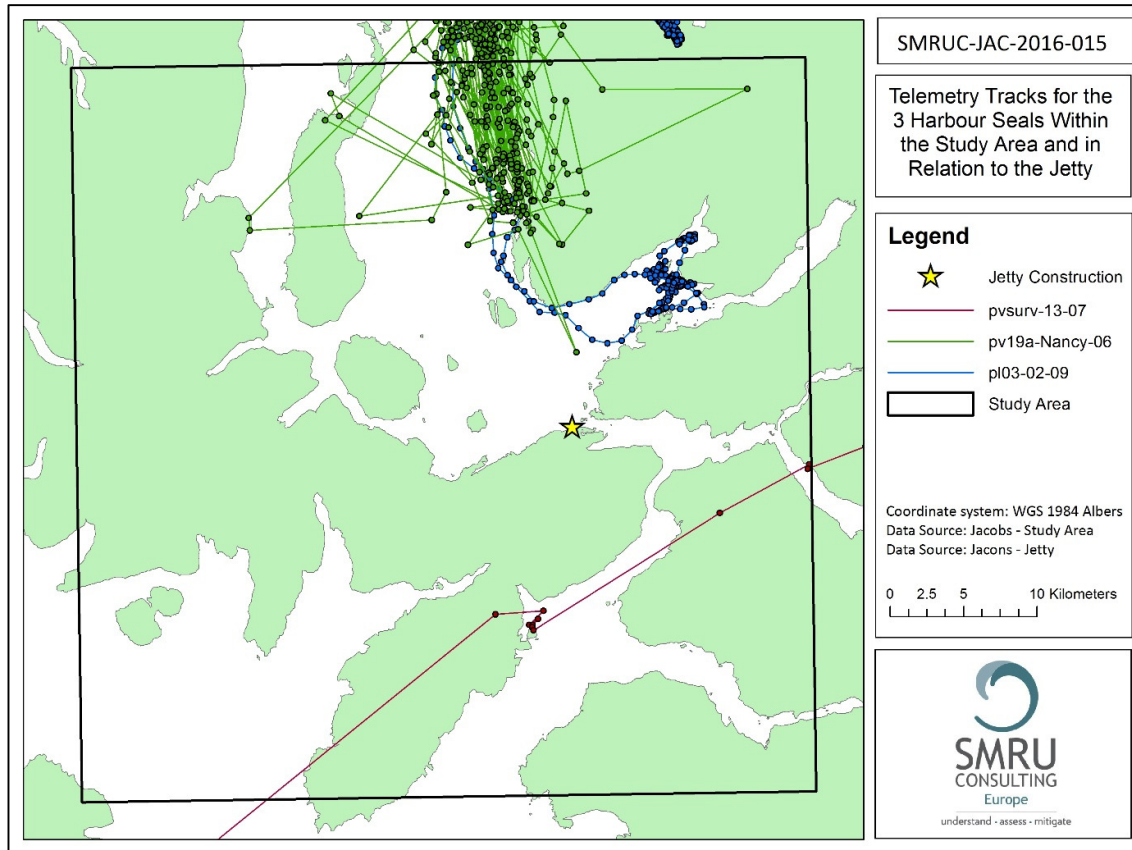


Figure 14 Telemetry tracks and GPS points for the 3 harbour seals with points within the Study Area and in relation to the project site (this does not include the 9 seals tagged at Kyle Rhea in 2012).

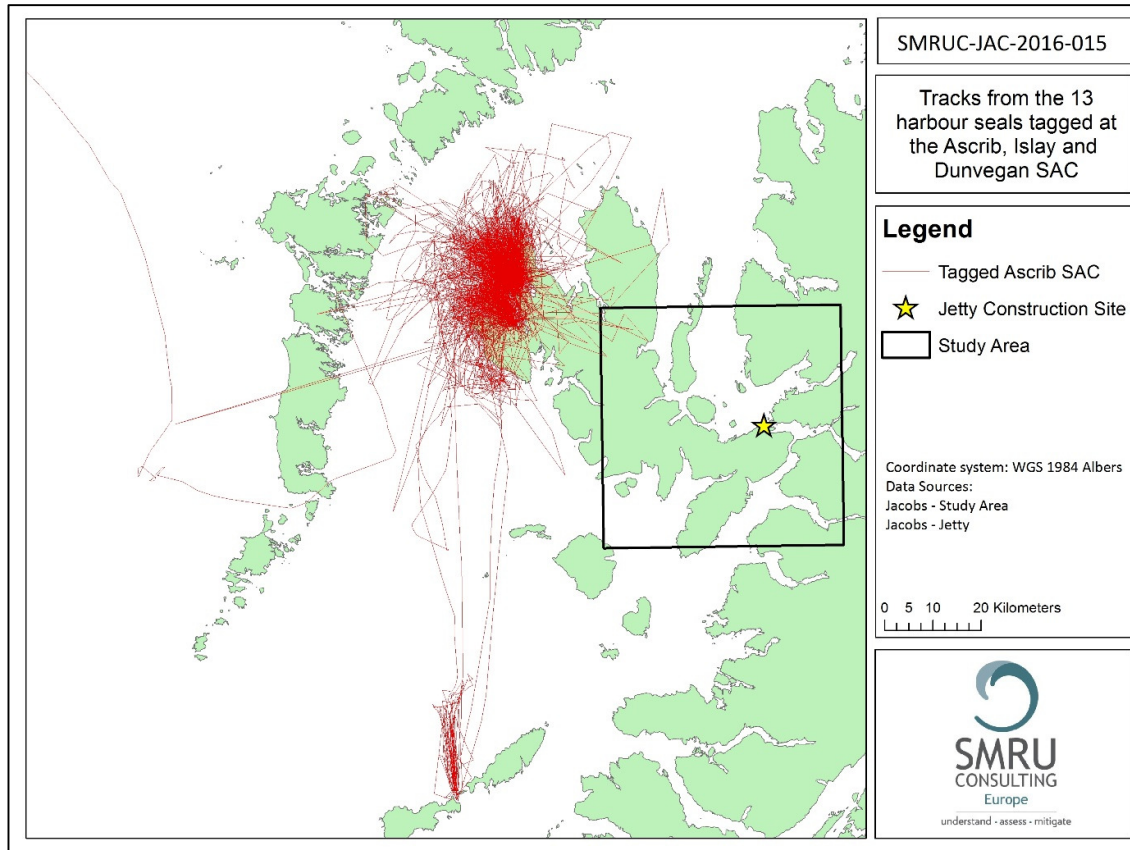


Figure 15 Telemetry tracks from the 13 harbour seals tagged at Loch Bay and Loch Dunvegan within the Ascrib, Islay and Dunvegan SAC in 2004 and 2005.

5.2.1 Kyle Rhea data

The telemetry data from the Kyle Rhea study shows a very high density of tracks moving through and/or foraging within the channel between Skye and mainland Scotland (Figure 16). In total, 93.4% of all the GPS positions obtained from these nine seals were inside the Study Area. Only two seals left the Study Area for a significant portion of their time. Seal pv43-394-12 recorded 75% of its GPS positions inside the Study Area; for the remaining 25% of the time it travelled south out of the narrows at Kyle Rhea and west to off the south east coast of South Uist (Figure 16). Seal pv43-350-12 recorded 50% of its GPS positions inside the Study Area; for the remaining 50% of the time it travelled north out of the Study Area directly to the Butt of Lewis (Figure 16).

Of these nine tagged seals, six left the narrows at Kyle Rhea at travelled north and west round the coast of Skye past the Project Site (Figure 16). One seal (pv43-376-12) moved along the coast of Skye, directly past the jetty construction site, with GPS location positions only 90 m from the construction site (Figure 17). These data show that there is clear connectivity between the Project

construction site and the harbour seal haul out in Kyle Rhea. None of the nine harbour seals tagged at Kyle Rhea had tracks that entered into an SAC.

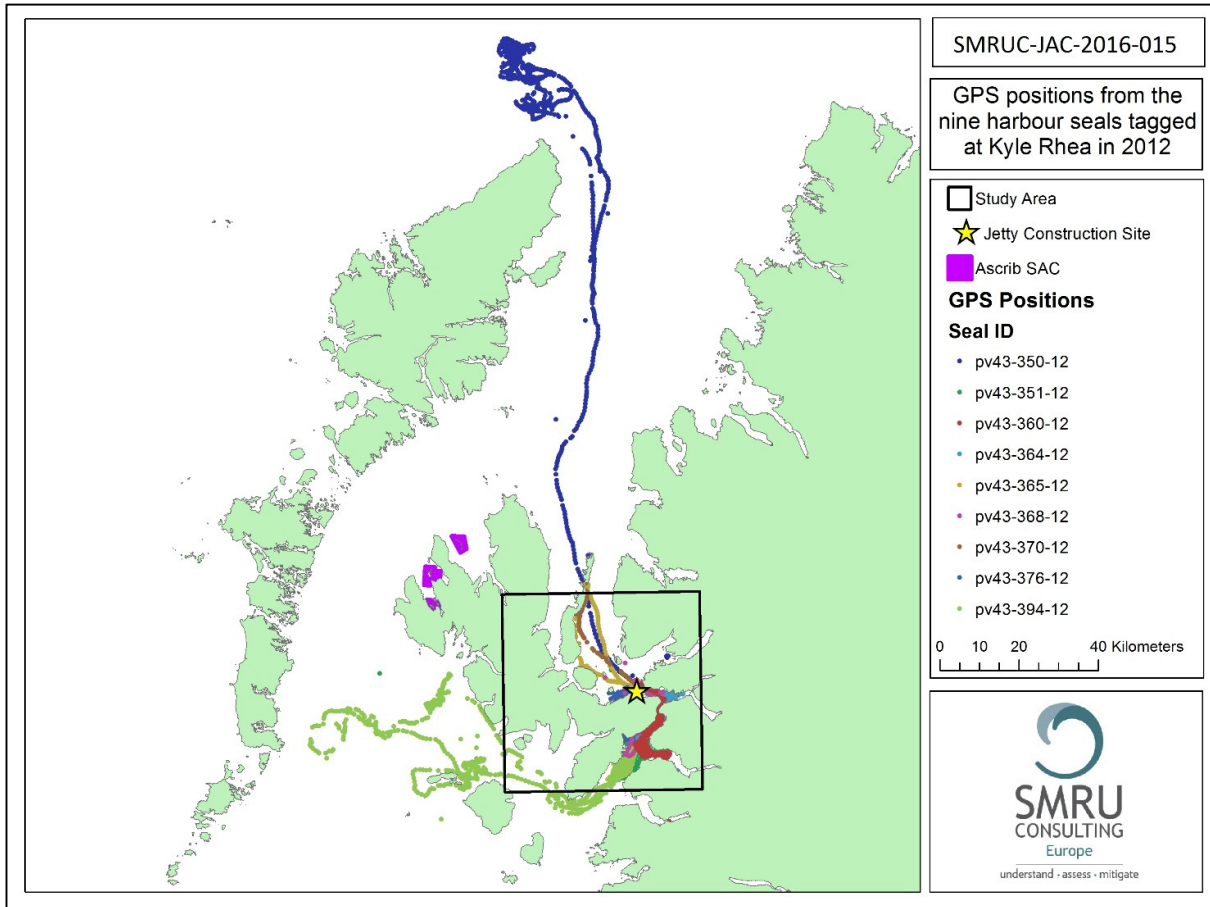


Figure 16 GPS telemetry positions of the nine harbour seals tagged in Kyle Rhea in 2012.

There are two groups of haul out sites near to the Project construction site that were visited by Kyle Rhea seals (Figure 17). At the closest group of haul out sites (~1 km to the north of the construction site, blue circle in **Error! Reference source not found.**) the annual count has varied between 36 harbour seals in 1996 to 51 in 2014. At the next closest group of haul out sites used by the Kyle Rhea seals (~5 km to the west of the construction site, orange circle in Figure 17) the annual count has varied between 36 harbour seals in 2005 and 141 in 2000.

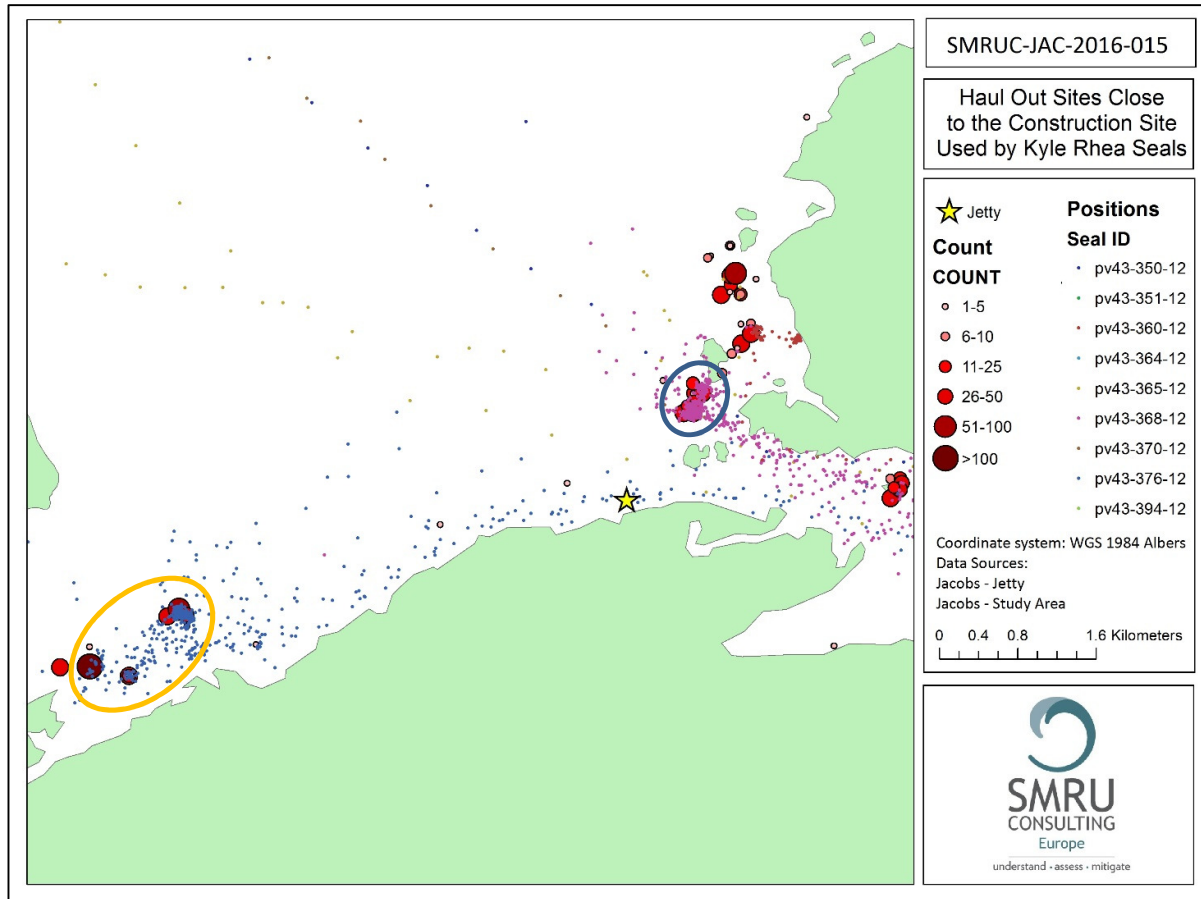


Figure 17 GPS positions from the nine harbour seals tagged in Kyle Rhea 2012 in relation to the Project construction site and close by haul out sites.

6 Grey Seal Counts

6.1 August Grey Seal Counts in the UK

A total of 30,625 grey seals were counted in the UK and Northern Ireland during the August harbour seal moult surveys between 2007 and 2014, with 20,449 of these counted in Scotland (SCOS, 2015). This is only 2% lower than the Scottish count obtained during the August harbour seal moult surveys between 2000 and 2006 (SCOS, 2015).

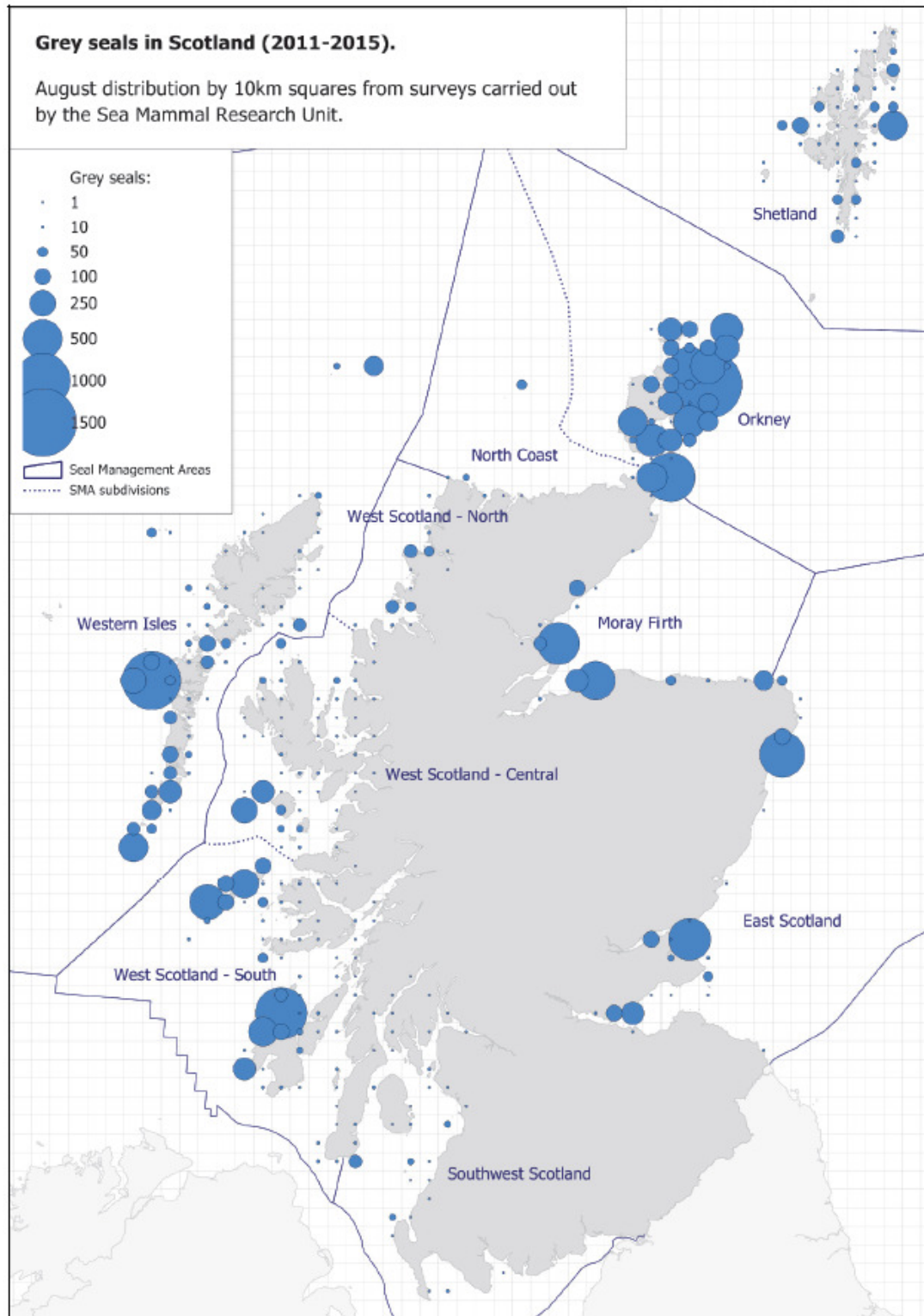


Figure 18 Number and distribution of grey seals at haul-out sites during August count surveys in Scotland by 10km squares (Duck & Morris, 2016).

6.2 August Grey Seal Counts in the West Scotland and Western Isles Management Units

On the west of Scotland, the areas with the highest grey seal counts are the Western Isles MU and the South subdivision of the West Scotland MU (Figure 18; Table 7). The West Coast MU North sub-division was last counted in 2013 and 2014, the Central sub-division was last counted in 2014 and the South sub-division was last counted in 2015 (Table 7).

The most recent UK wide total grey seal population size estimate was estimated based on pupping counts for the survey period between 2013 and 2015. The total grey seal August count for the West Scotland MU from the same survey period between 2013 and 2015 was 5,064 grey seals, which represents only 4.5% of the total UK grey seal population estimate based on pupping counts. Where survey effort across a region spans several years, counts are summed across years because different sites were counted in each survey year. These counts are then summed to produce the total count across the survey period for this subdivision. There is a risk that grey seals are double counted if they haul out at different sites between years; which is highly likely given that, unlike harbour seals who show site fidelity to moult sites, grey seals often move between haul out sites at a local and regional scale (eg: McConnell et al., 1999; Russell & McConnell, 2014) and are neither moulting nor breeding at the time of the survey.

Table 7 Grey seal counts from August harbour seal moult surveys for the West Scotland and Western Isles Management Units. No value= not surveyed in that particular year.

Survey Period	Year	West Scotland Central		West Scotland North		West Scotland South		Western Isles	
		# Sites	# Seals	# Sites	# Seals	# Sites	# Seals	# Sites	# Seals
1996-1997	1996	56	931	2	15	98	2125	213	4062
	1997			36	364				
2000-2006	2000	59	358			157	1771	205	5179
	2002							51	679
	2003							199	3064
	2005	76	361	32	251	7	10	3	401
	2006							164	3270
2007-2009	2007	50	221			175	1661		
	2008	36	340	33	177			251	3407
	2009					99	1232		
2011	2011							289	2322
2013-2015	2013			54	348				
	2014	185	1056	6	42	198	1538	13	295

	2015				194	2080		
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6.3 Grey Seal Counts in the Study Area

The number of grey seals counted at any one haul out site in any one year during the August harbour seal moult count surveys within the Study Area ranged from one seal (single seals were counted at multiple sites across all survey years) to 147 seals (at one haul out site counted in 1996). Total grey seal counts within the Study Area have varied greatly between surveys with lowest count in 2000 of 14 grey seals and highest in 2014 with a count of 85 grey seals (Figure 19). The closest haul out site counted was 4.8 km from the Jetty, where one grey seal was counted in 2007. Unlike harbour seals, there are no haul out sites where grey seals have been counted over multiple years close to the Jetty (within 5 km). The closest haul out site where >10 grey seals were counted in one year was 34 km from the Jetty, where 16 grey seals were counted in 2014.

As stated previously, while these grey seal counts provide information on the abundance and distribution of hauled out grey seals in August, they cannot be used as a population estimate nor are they necessarily representative of grey seal usage in the area out with the timing of these surveys.

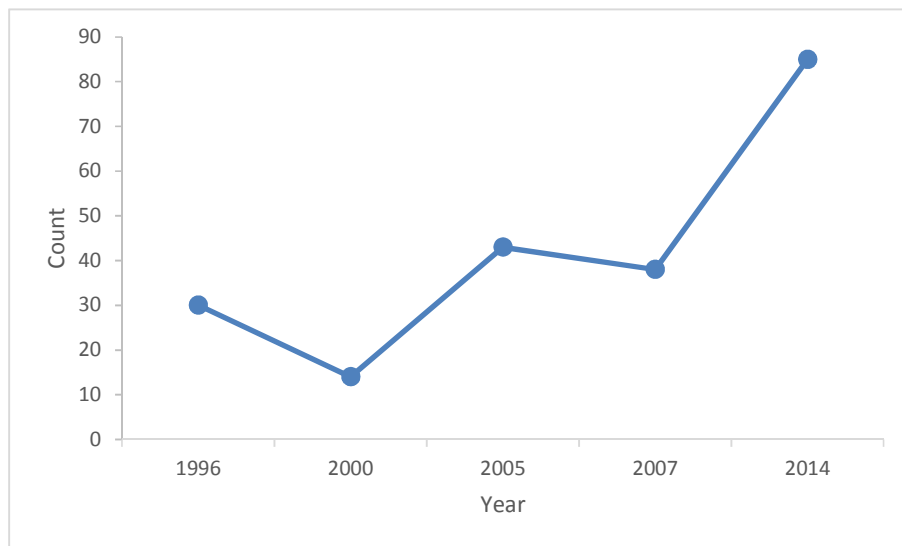


Figure 19 Total number of grey seals counted within the Study Area during August harbour seal moult surveys between 1996 and 2014.

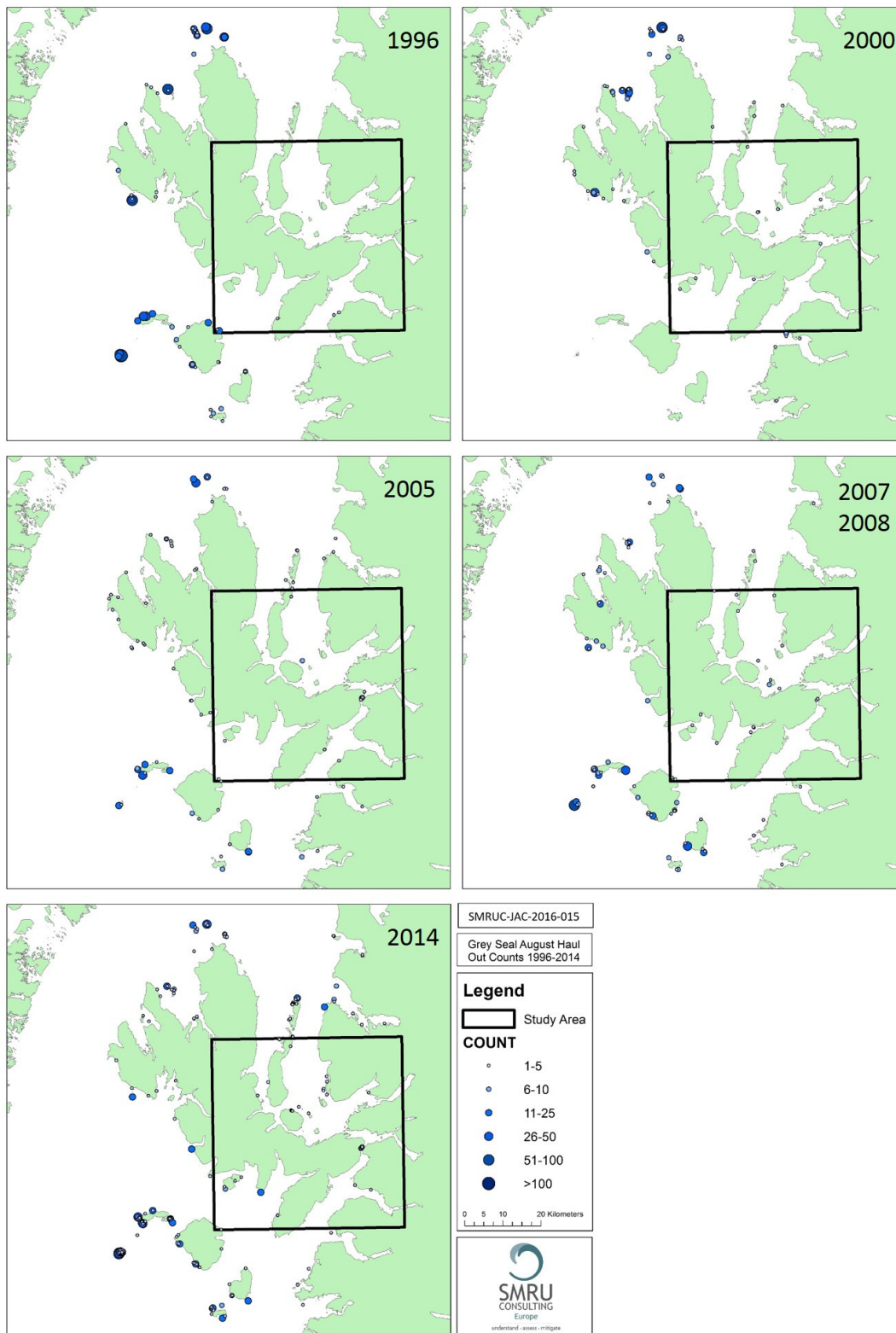


Figure 20 Grey seal August haul out counts between 1996 and 2014.

6.4 Other Data

Land-based visual vantage-point surveys were conducted at Kyle Rhea between July 2011 and July 2012 by Natural Research Projects (NRP) Ltd to support the Kyle Rhea Tidal Array EIA. The data collected during these surveys showed that in a similar pattern to harbour seals, grey seal sightings were relatively low or even absent between September and April with all winter months having sighting rates between zero and four grey seals per hour of effort (Figure 21). By contrast, the sightings rates were higher between May and August with highest sightings rate in July with 28.6 seals per hour of effort (Figure 21). These data show that the Kyle Rhea area is not an important breeding area or moult haul out site since numbers were low during these periods (grey seals breed between September and October and moult between January and March).

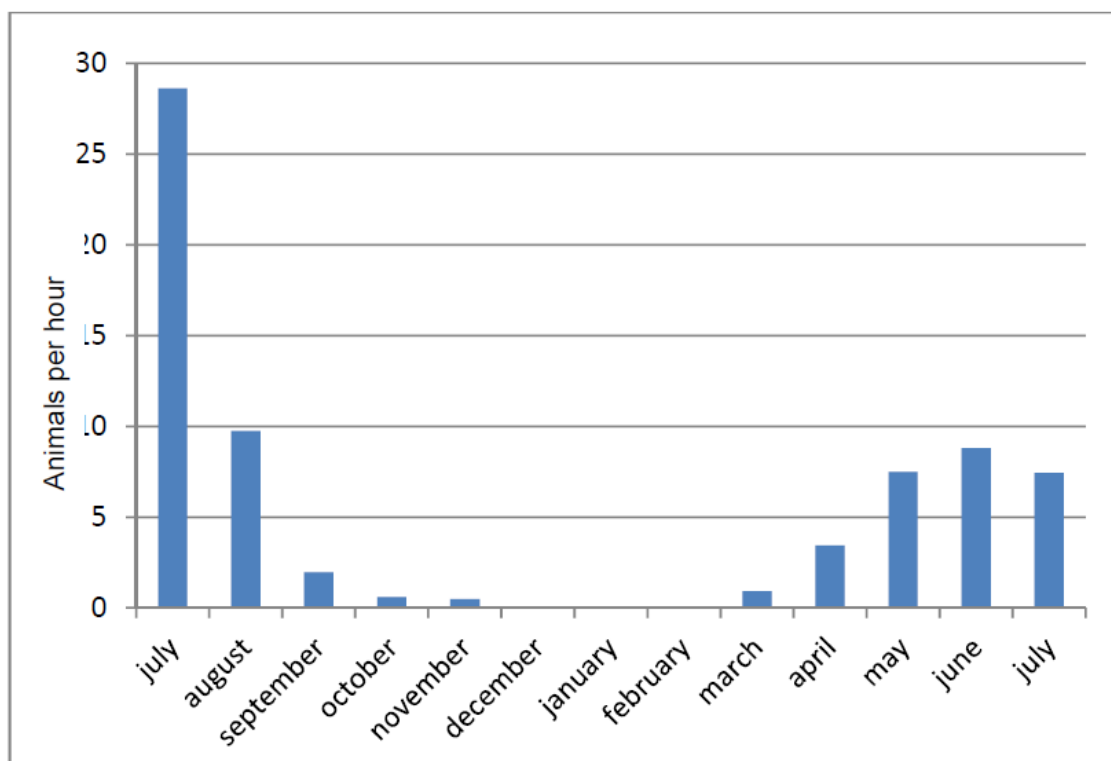


Figure 21 Monthly grey seal sightings per hour of effort during the 2011 to 2012 vantage point surveys (Royal Haskoning, 2012).

7 Grey Seal Pup Production

Approximately 38% of the world’s grey seals breed in the UK and 88% of these breed at colonies in Scotland with the main concentrations in the Outer Hebrides and in Orkney (SCOS, 2015). The latest total UK pup production estimate available is for 2012 when a total of 56,988 pups were estimated

to have been born in the UK and Northern Ireland; this was an increase of 6.5% from the estimate in 2010 (SCOS, 2015). These pup counts are converted into estimates of population size using a mathematical model. The most recent population estimate for UK grey seals is 111,600 grey seals aged 1+ (95% CI 91,400-139,200; SCOS, 2015).

There are no grey seal breeding colonies that are regularly counted by SMRU within the Study Area. The closest group of grey seal breeding colonies to the Study Area is the Outer Hebrides pupping region (Figure 23), where 14,348 pups were estimated to have been born in 2014, which is an 11.6% increase from the 2010 estimate and a 1.5% increase from the 2012 estimate (Figure 22). The pup counts in the Outer Hebrides pupping region are concentrated at the Monach Islands breeding colony (Figure 23) which has been identified as the largest grey seal breeding colony in the UK, contributing over 20% of the total UK grey seal pup production⁵. Given the high pup counts, the Monach Islands has been designated as an SAC with grey seals as the primary reason for site selection.

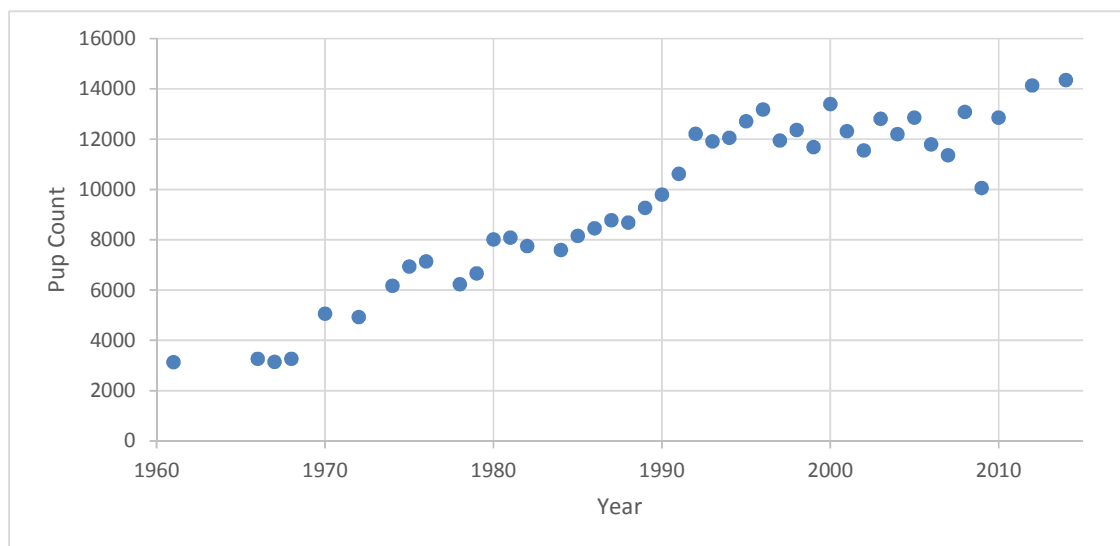


Figure 22 Annual total grey seal pup counts for the Outer Hebrides group of breeding colonies between 1961 and 2014.

⁵ <http://jncc.defra.gov.uk/protectedsites/sacselection/sac.asp?EUcode=UK0012694>

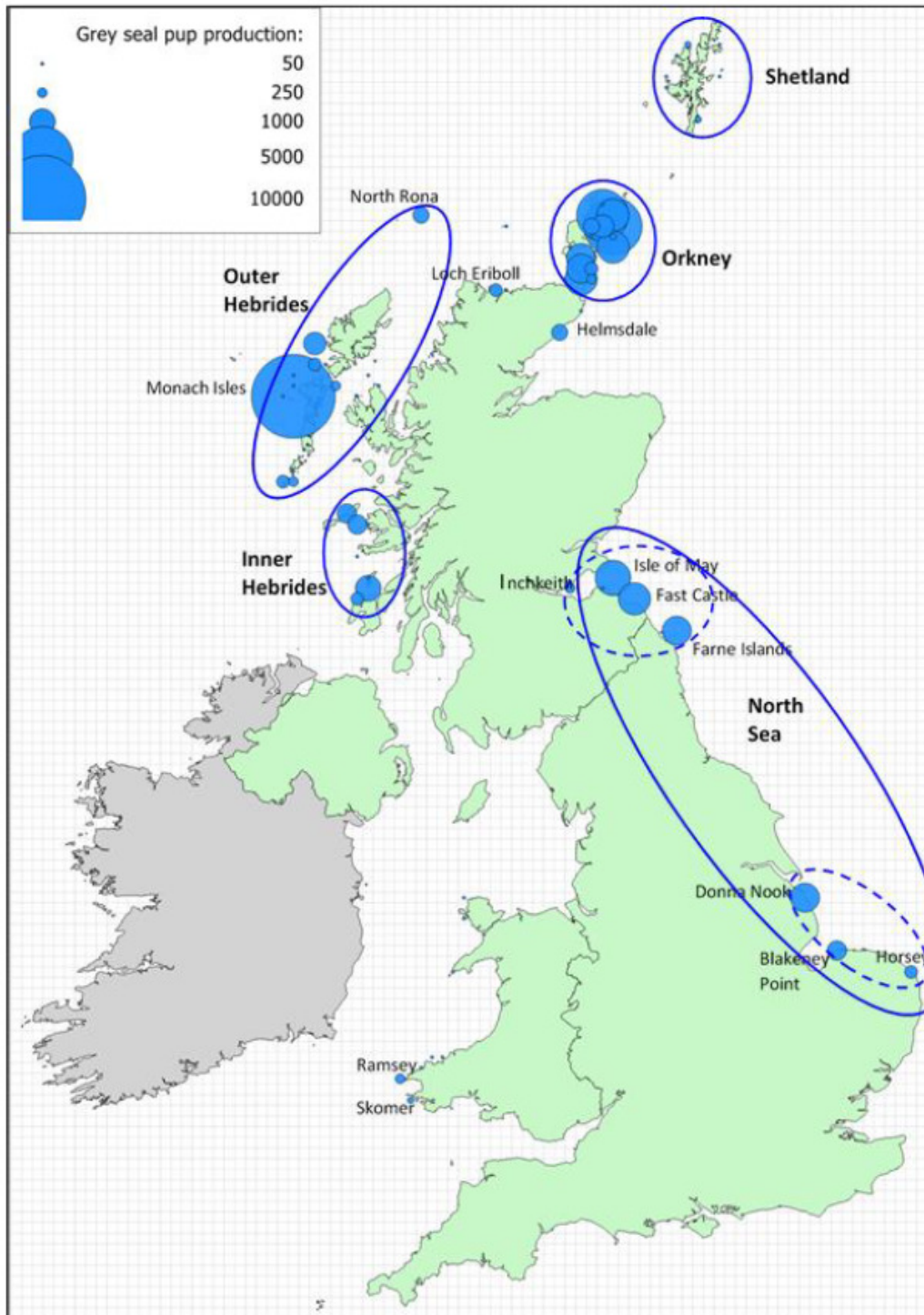


Figure 23 Distribution and size of grey seal breeding colonies (SCOS, 2015). Blue ovals indicate groups of colonies within each pupping region.

8 Grey Seal Telemetry

8.1 Grey Seal Telemetry in the West Scotland MU

A total of 34 grey seals have been tagged by SMRU between 2003 and 2004 in the West Scotland MU at the following locations: Colonsay, Tiree, Islay, Coll and Oronsay. Of these, 15 were females aged 1+ and 19 were males aged 1+ (Table 8). All 34 of these grey seals were tagged with ARGOS tags.

Table 8 Number of female and male grey seals tagged in the West Scotland MU between 2003 and 2004. All grey seals listed here were tagged with ARGOS tags.

Tagging Location	Distance from Project Site	2003		2004	
		F	M	F	M
Islay, Colonsay & Oronsay	~155-180 km	8	14		
Tiree & Coll	~100-125 km			7	5

The grey seals tagged in the West Scotland MU show wide ranging movements with distances travelled from the tagging locations of over 350 km for some seals (Figure 24). One adult male grey seal travelled from the tagging location at Islay to the River Dee in Wales, one adult male grey seal tagged at Oronsay travelled north to Sanday in the northern Orkney Islands and south to County Mayo in western Ireland and another adult male tagged at Oronsay travelled south to the Dublin area in eastern Ireland during the duration of the tag deployment.

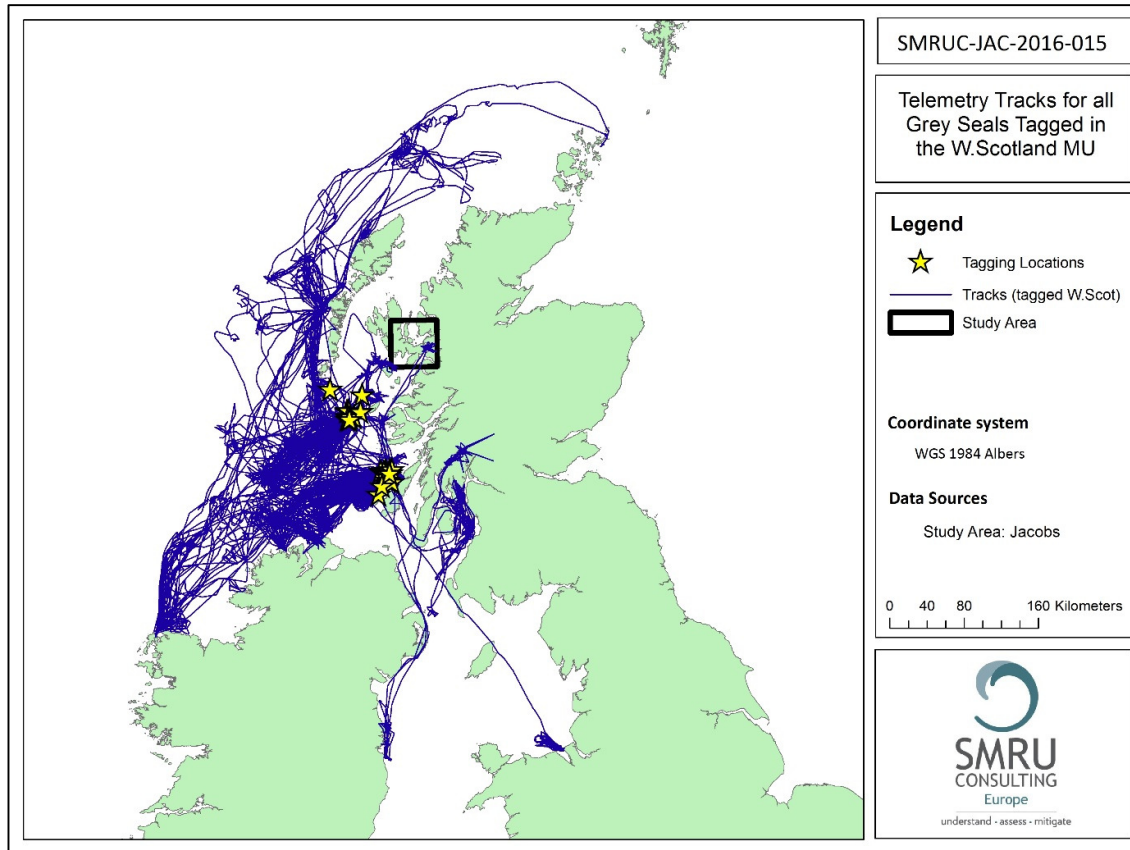


Figure 24 Tagging locations and tracks for all grey seals tagged in the West Scotland Management unit.

8.2 Grey Seal Telemetry in the Study Area

SMRU tagged nine grey seal pups on the Monach Islands in the Western Isles MU in 1995. None of these pups entered into the Study Area, however, since this is a very small sample size and data from 11 years ago, it may not be representative of grey seal pup movement in more recent years. Therefore it is not possible to totally rule out the possibility of grey seal pups entering into the Study Area from the Monach Islands breeding colony.

Of the 43 grey seals tagged in the West Scotland MU, only two entered the Study Area (Table 9). One was tagged at Colonsay and the other at Tiree. The number of grey seal locations within the Study Area was 31.2% and 4.6% of their total recorded GPS locations respectively. The former spent most of its time within the Study Area at Kyle Rhea between the Isle of Skye and mainland Scotland while the latter spent most of its time within the Study Area at the north east side of the Isle of Rum (Figure 26). The closest telemetry GPS position recorded to the jetty where construction work will

take place was 5.4 km away. One of these seals also passed through the Treshnish Isles SAC, although didn't appear to spend any significant time there (Figure 25).

Note: Both grey seals that entered into the Study Area were tagged with Argos tags. The low temporal resolution and spatial accuracy of the locational data from these tags means that distance errors can be large and often precludes the identification of very fine scale movement. It is apparent in Figure 26 that there is some unfiltered error in locations.

Table 9 Details of the two grey seals that entered into the Study Area and connectivity with SACs.

	Tagging Location	Sex	Age	# GPS Points	# Points in Study Area	% Points in Study Area	SAC Visited	# Points in SAC	% Points in SAC
hg1-kintara-03	Colonsay	1+	F	1785	557	31.2%	Treshnish Isles	2	0.1%
hg6-133M8-04	Tiree	1+	M	632	29	4.6%			

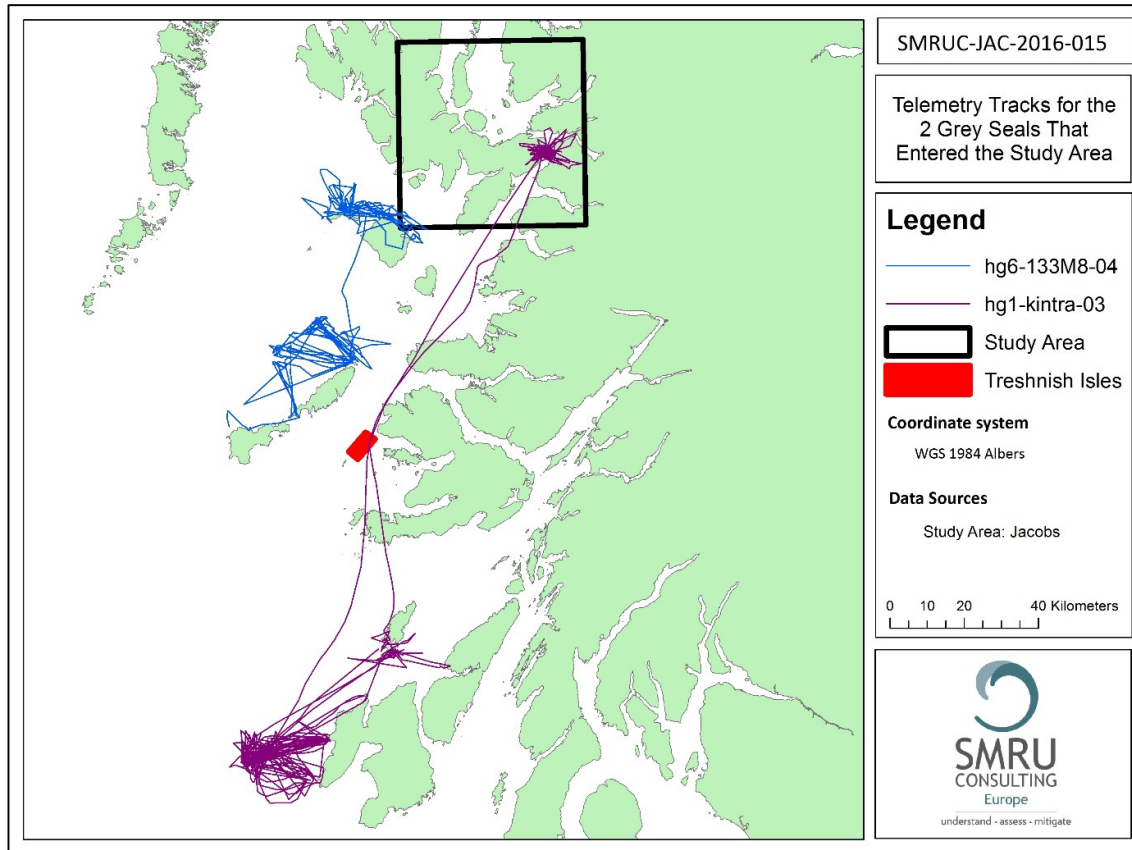


Figure 25 Telemetry tracks for the 2 grey seals that entered the Study Area and connectivity with SACs.

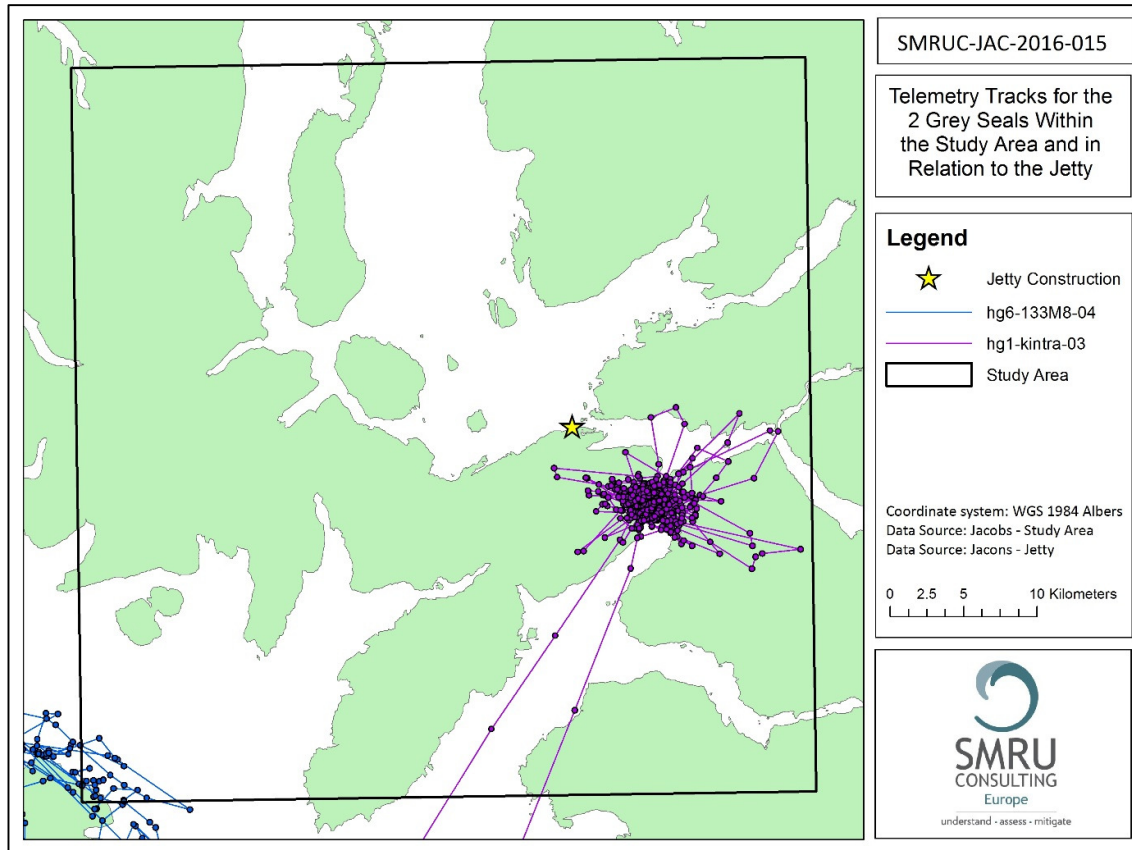


Figure 26 Telemetry tracks and location points for the 2 grey seals with points within the Study Area and in relation to the jetty construction site.

9 Conclusions

9.1 Count Data

The Western Isles and the West Coast are clearly important Management Units for harbour seals in Scotland, with August counts in the Western Isles and the West Coast comprising 62% of the total Scottish counts. Total counts within the Study Area have increased from 1,217 in 1996 to 2,589 in 2014 which shows that harbour seal numbers in the Study Area are relatively high, at least during the August moult period. During the August moult, haul out sites within 20 km of the Project site accounted for 62% of all harbour seals hauled out in the Study Area in 2014 and 25% of the total central subdivision of the West Scotland management unit.

Data from vantage point surveys have shown that harbour seals are mainly present in the Kyle Rhea area in the summer months, with sightings rates of >45 harbour seals per hour of effort. The lack of

pup sightings during the breeding months suggests that Kyle Rhea is not a breeding site for harbour seals. There is no equivalent survey data at other times of year elsewhere in the Study Area.

Unlike harbour seals, the West Scotland MU does not represent a major haul out area for grey seals, at least in August. The closest haul out site counted was 4.8 km from the Jetty, where one grey seal was counted in 2007. There are no haul out sites close to the construction site where grey seals have been counted over multiple years. The closest haul out site where >10 grey seals were counted in one year was 34 km from the Jetty, where 16 grey seals were counted in 2014. Data from vantage point surveys have shown that grey seals are mainly present in the Kyle Rhea area in the summer months, with sightings rates up to ~30 seals per hour of effort, while grey seals were either absent or present in low numbers during the winter surveys which suggests this area is not used for either breeding or moulting.

9.2 Telemetry Data

The telemetry data show some overlap of both harbour and grey seal movements with the Study Area. Three of the five seals that entered the Study Area had also spent time at an SAC, with one harbour seal also visiting the Ascrib, Isay and Dunvegan SAC, one harbour seal visiting the Eileanan agus Sgeiran Lios mor SAC and one grey seal passing through the Treshnish Isles SAC.

Excluding the Kyle Rhea harbour seal telemetry data, a very low proportion of the harbour seals tagged in the West Scotland and the Western Isles MU entered into the Study Area (3 out of 89 tagged, 3.4%). While there is some limited evidence for connectivity between the Study site and harbour seal SACs, the amount of time that the seals spent in either an SAC or in the Study Area was very small (eg: pv19a-Nancy-06 only spent 0.1% of its time in the Ascrib, Isay and Dunvegan SAC). This is further demonstrated by the fact that none of the 13 harbour seals tagged at the nearest SAC (Ascrib, Isay and Dunvegan) entered into the Study Area. Therefore, while some degree of connectivity cannot be ruled out, there is no evidence in this dataset to suggest any significant connectivity between the Study Area and the nearest harbour seal SAC.

Telemetry data from the nine harbour seals tagged in Kyle Rhea in 2012 show that there is connectivity between the haul out site in Kyle Rhea and the Project construction site, with six of the nine tagged seals exiting the narrows at Kyle Rhea and moving west round the cost of Skye past the Project Site. None of these seals showed any connectivity with an SAC.

There was very little overlap of tagged grey seal tracks with the Study Area. The grey seal telemetry data show that a low proportion of the grey seals tagged in the West Scotland MU entered into the Study Area (2 out of 34 tagged, 5.9%). There is also very limited evidence of connectivity between the Study Area and grey seal SACs (eg: hg1-kintara-03 only spent 0.1% of its time in the Treshnish Isles SAC). However, it should be noted that grey seal tagging in the West Scotland and the Western Isles MU has been limited to only two tagging studies (one in 2003 and one in 2004) and a sample size of only 34 tagged individuals. Since these two tagging studies took place 12/13 years ago, the at-sea movement data obtained from these seals may not be representative of grey seal movement in more recent years. In addition to this there has been no tagging of grey seals at either of the grey seal SACs in the West Scotland or the Western Isles MU and so it is difficult to draw conclusions from these telemetry data as to the level of expected connectivity between the Study Area and grey seal SACs.

9.3 Grey seal Pup Count Data

There are no grey seal breeding colonies that are regularly counted by SMRU within the Study Area. The closest group of grey seal breeding colonies to the Study Area are in the Outer Hebrides pupping region where pup counts are concentrated at the Monach Isles SAC and breeding colony. No pups tagged at the Monach Islands SAC and breeding colony entered the Study Area, however, this was a very small sample and the study took place 11 years ago so it may not be representative of grey seal pup movement in more recent years.

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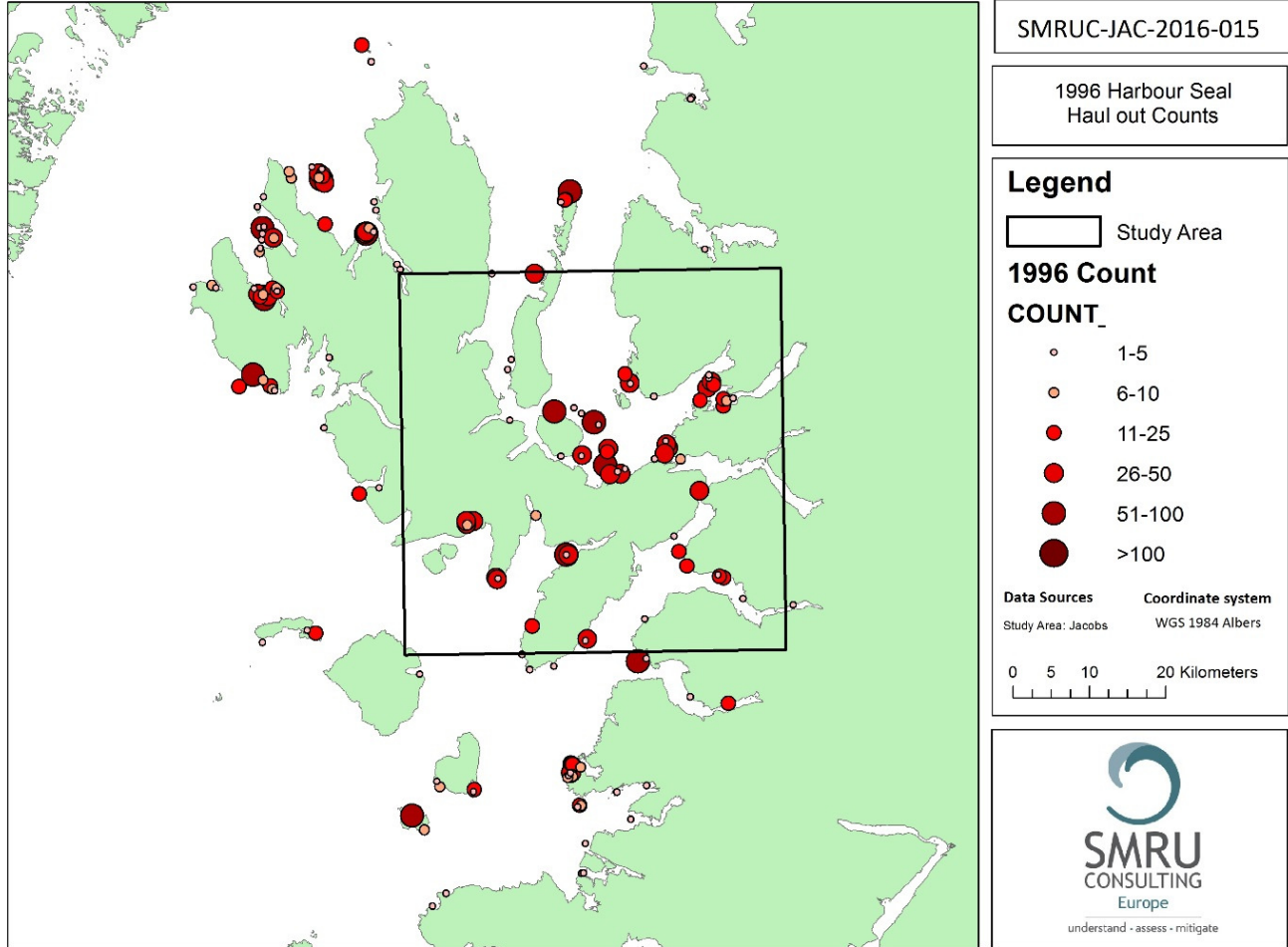
Sharples, R. J., Moss, S. E., Patterson, T. A., & Hammond, P. S. (2012). Spatial variation in foraging behaviour of a marine top predator (*Phoca vitulina*) determined by a large-scale satellite tagging program. *PLoS One*, 7(5), e37216.

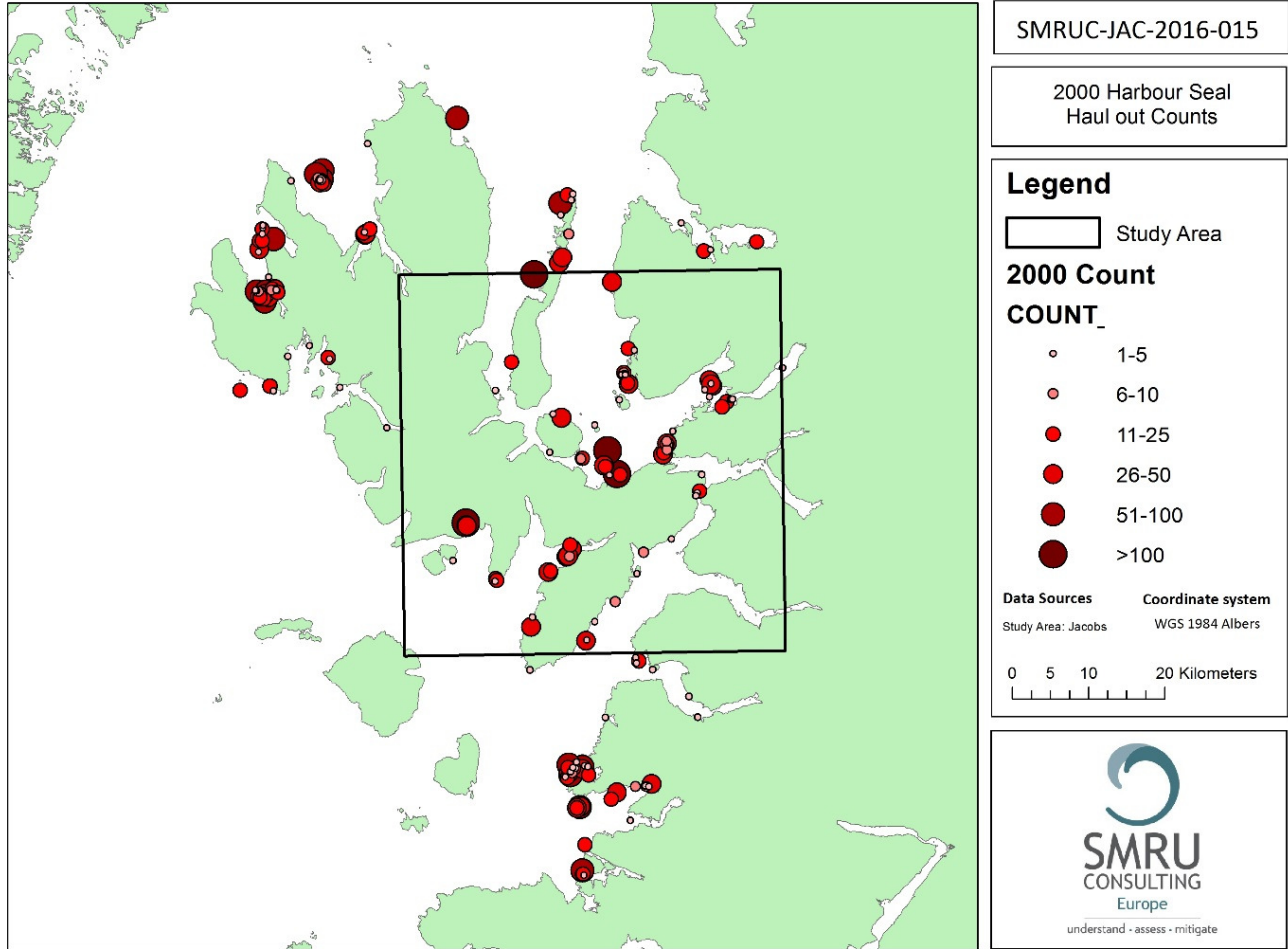
1 1 Glossary of Terms, Acronyms and Abbreviations

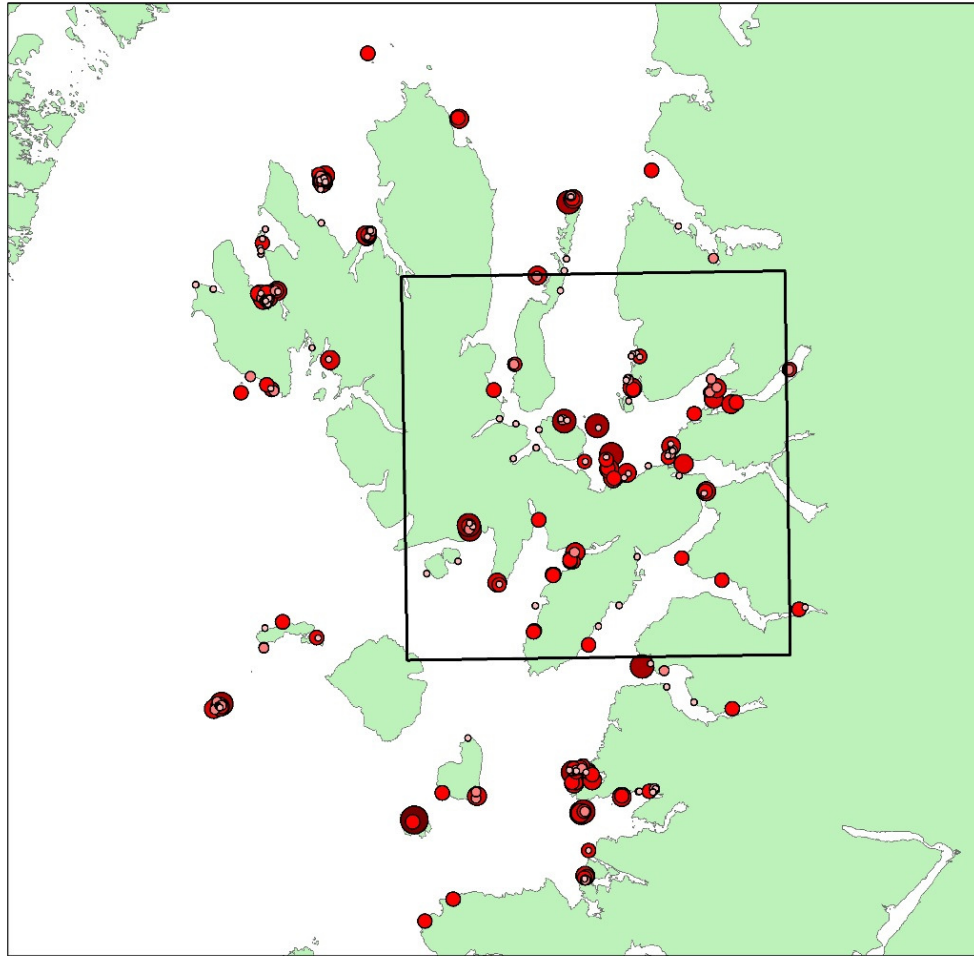
Term	Description
SMRU	Sea Mammal Research Unit
SAC	Special Area of Conservation
MU	Management Unit



Appendix 1 – Harbour Seal Count Maps for individual years







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2005 Harbour Seal
Haul out Counts

Legend

Study Area

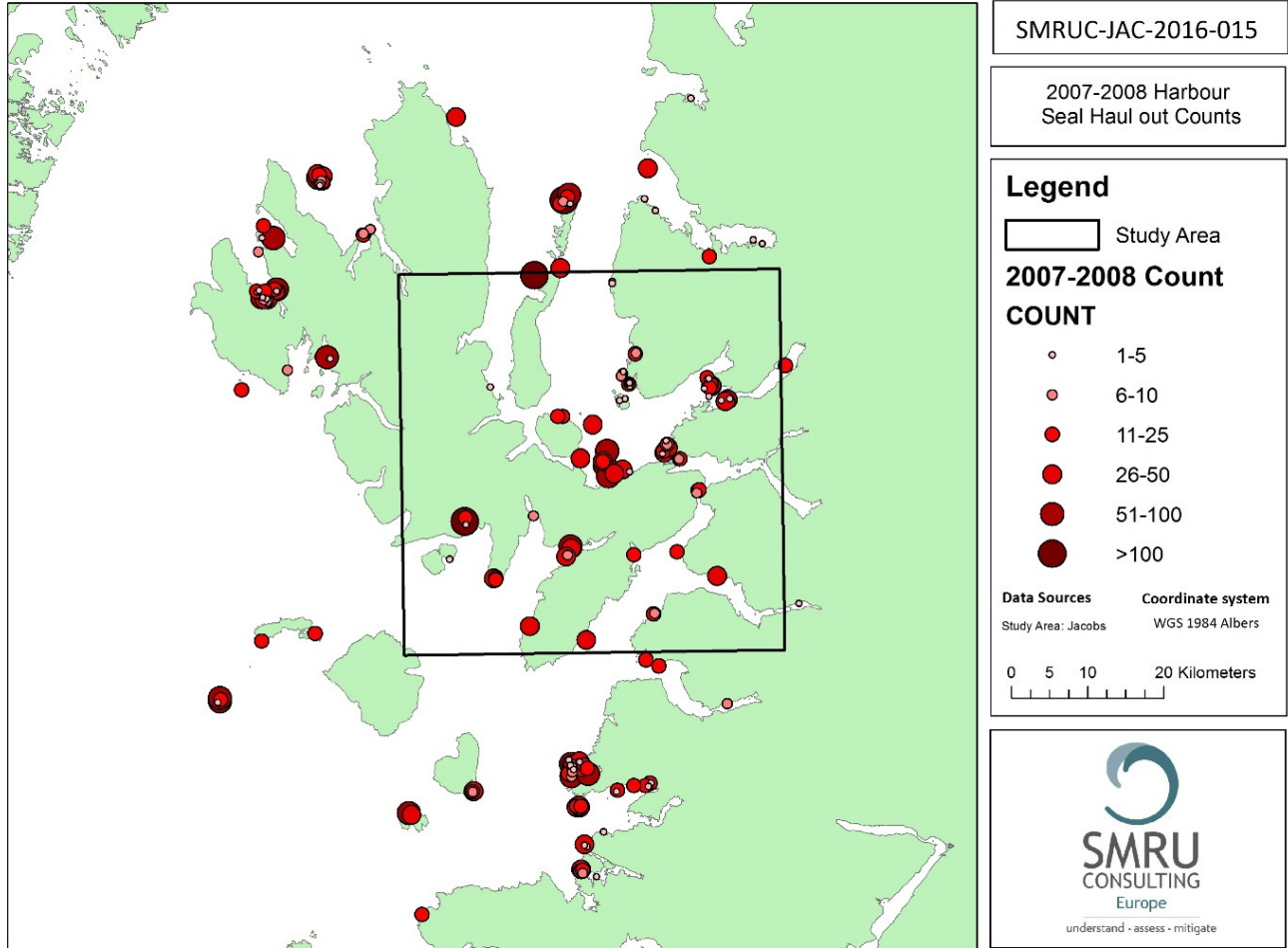
2005 Count
COUNT_

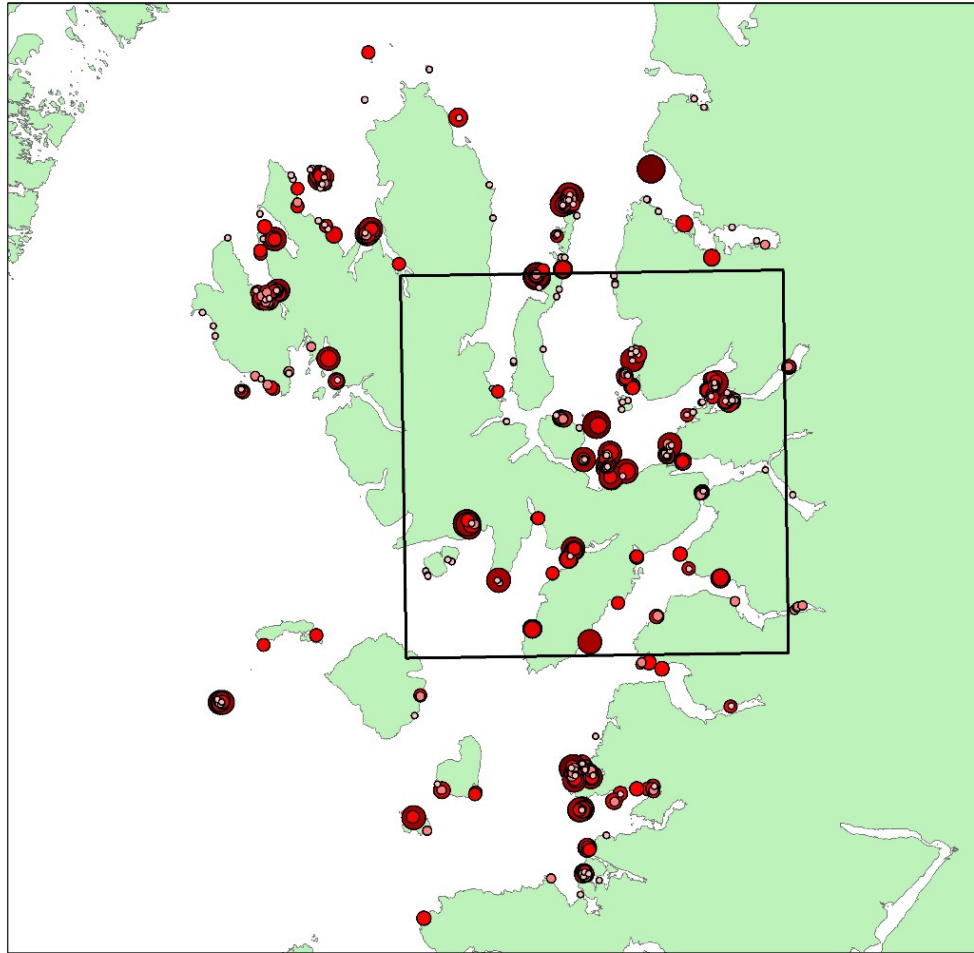
- 1-5
- 6-10
- 11-25
- 26-50
- 51-100
- >100

Data Sources **Coordinate system**
Study Area: Jacobs WGS 1984 Albers

0 5 10 20 Kilometers







SMRUC-JAC-2016-015

2014 Harbour Seal Haul out Counts

Legend

Study Area

2014 Pv Central COUNT

- 1-5
- 6-10
- 11-25
- 26-50
- 51-100
- >100

Data Sources **Coordinate system**
Study Area: Jacobs WGS 1984 Albers

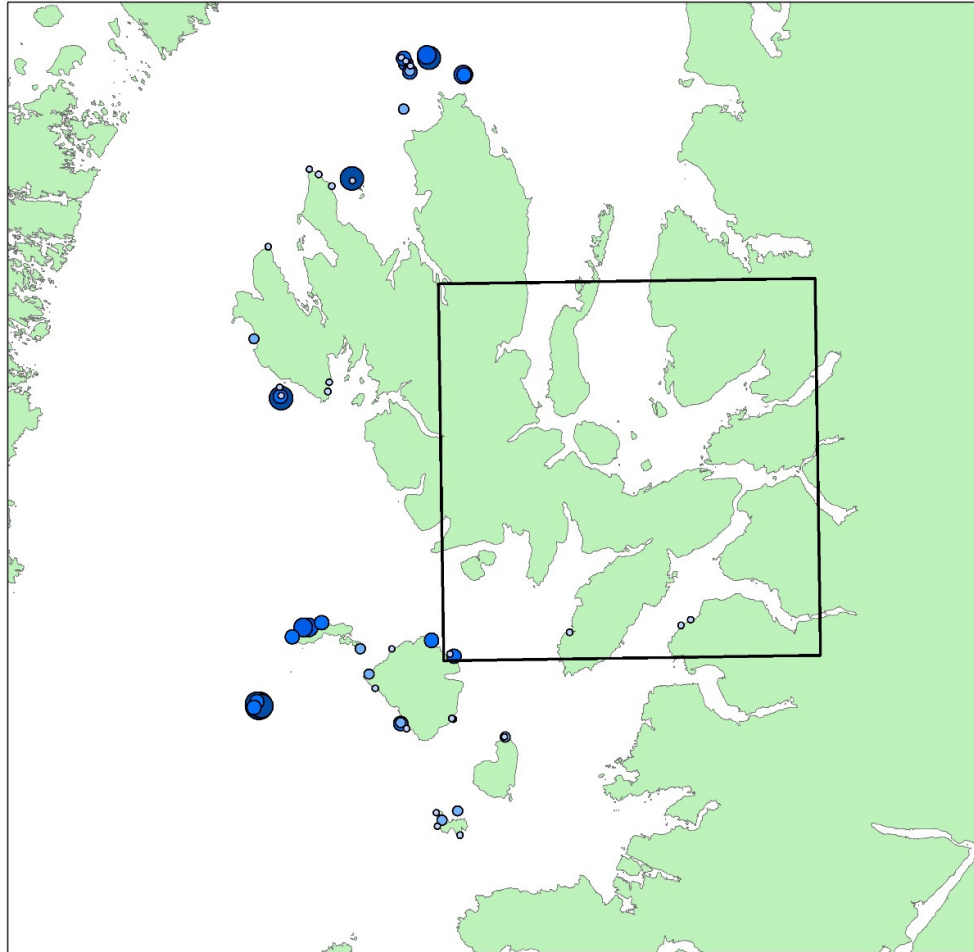
0 5 10 20 Kilometers

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Appendix 2 – Grey Seal Count Maps for individual years



SMRUC-JAC-2016-015

1996 Grey Seal Haul Out Counts

Legend

Study Area

1996

COUNT_

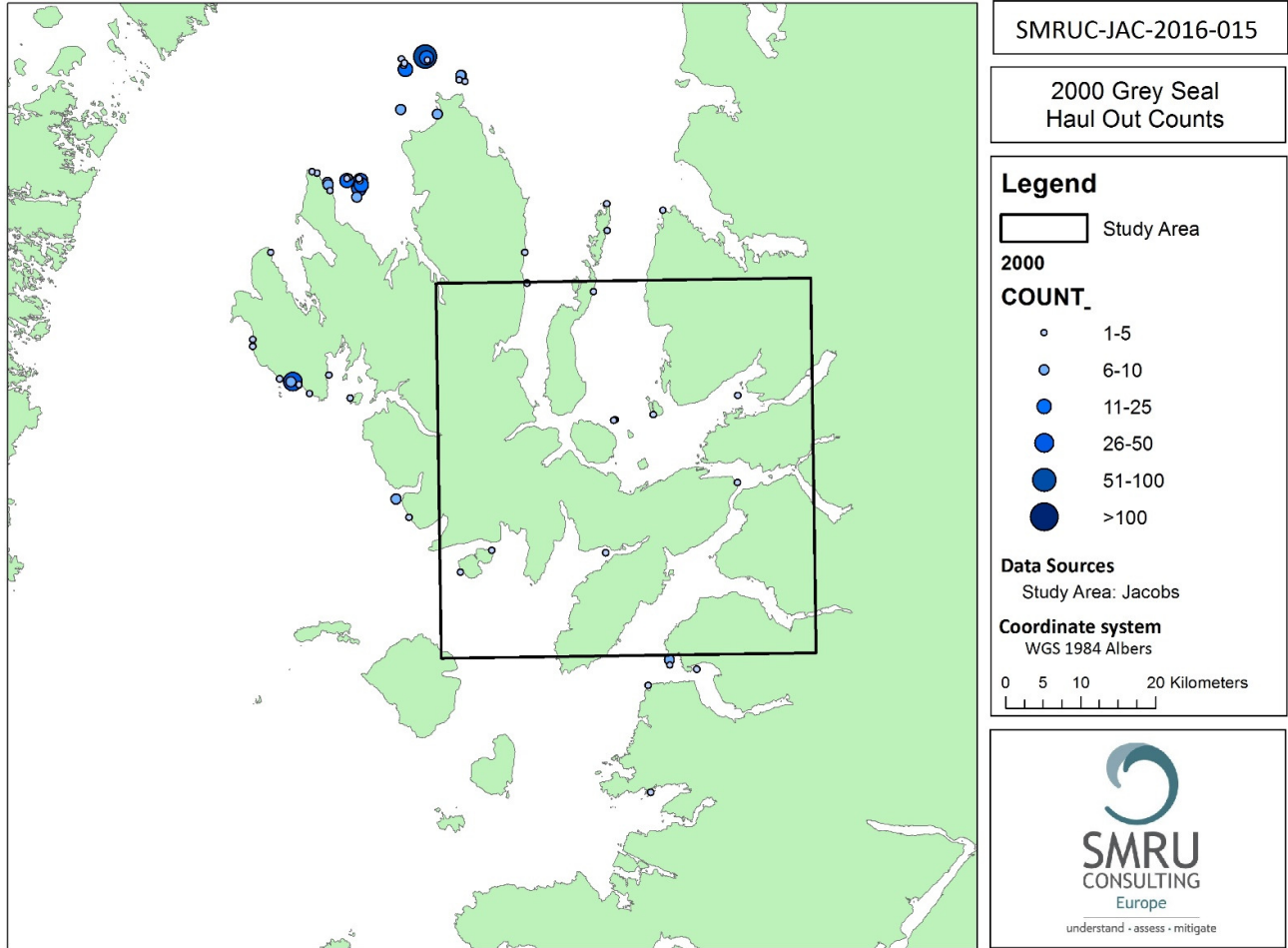
- 1-5
- 6-10
- 11-25
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- 51-100
- >100

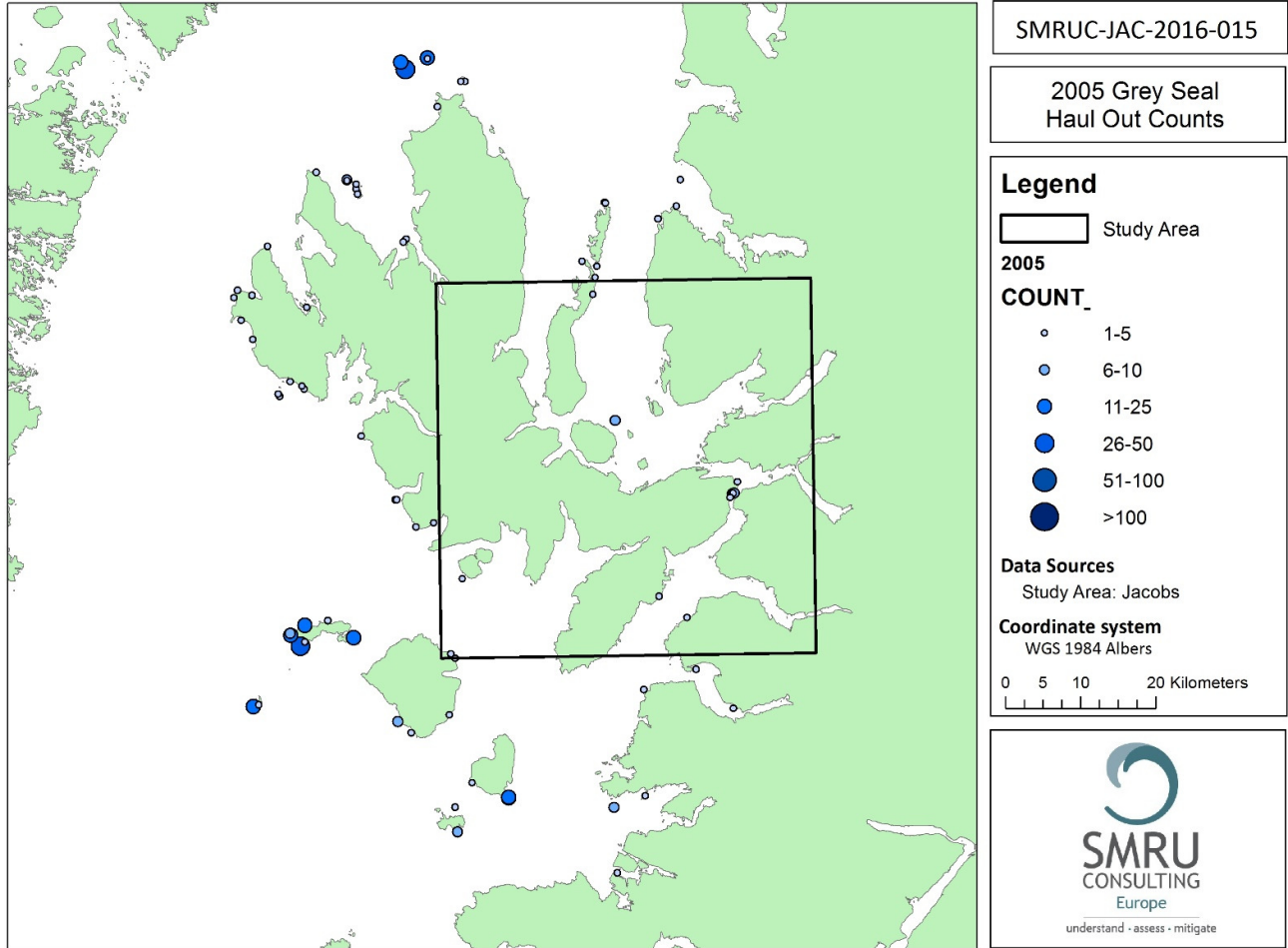
Data Sources
Study Area: Jacobs

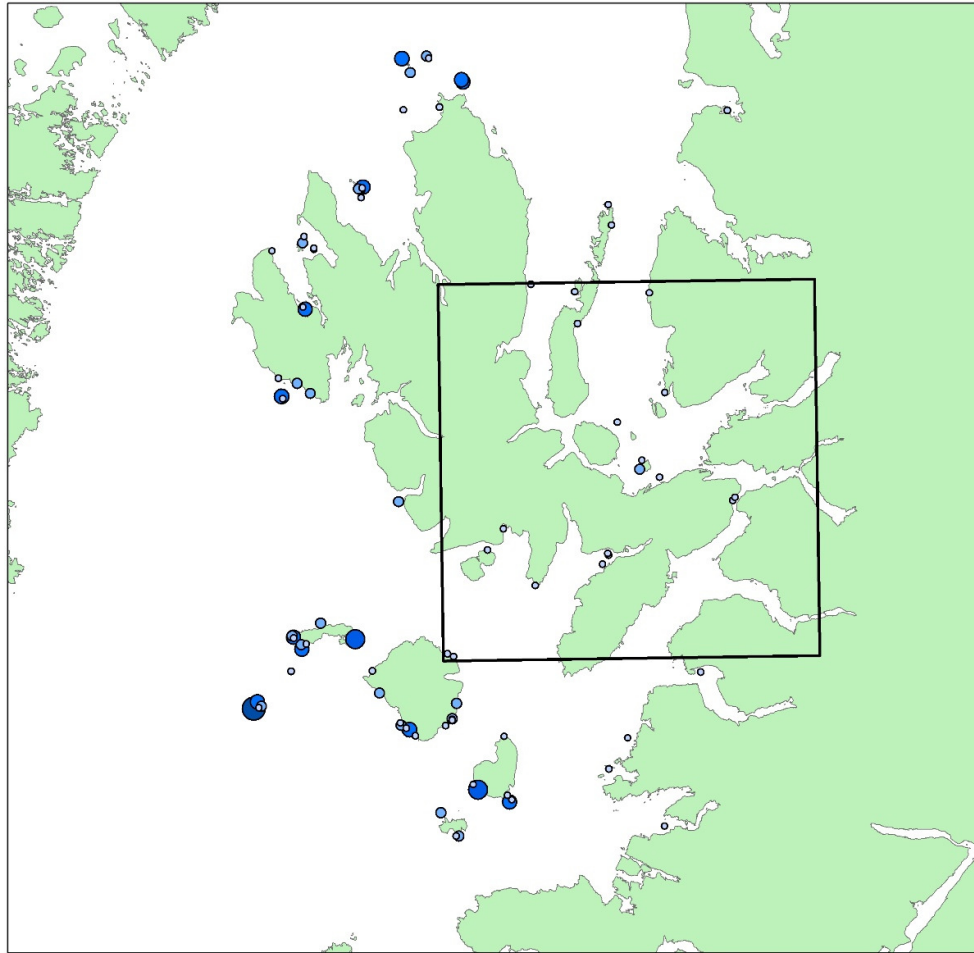
Coordinate system
WGS 1984 Albers

0 5 10 20 Kilometers










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





2007-2008 Grey Seal Haul Out Counts

Legend

 Study Area

2007-8

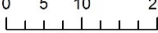
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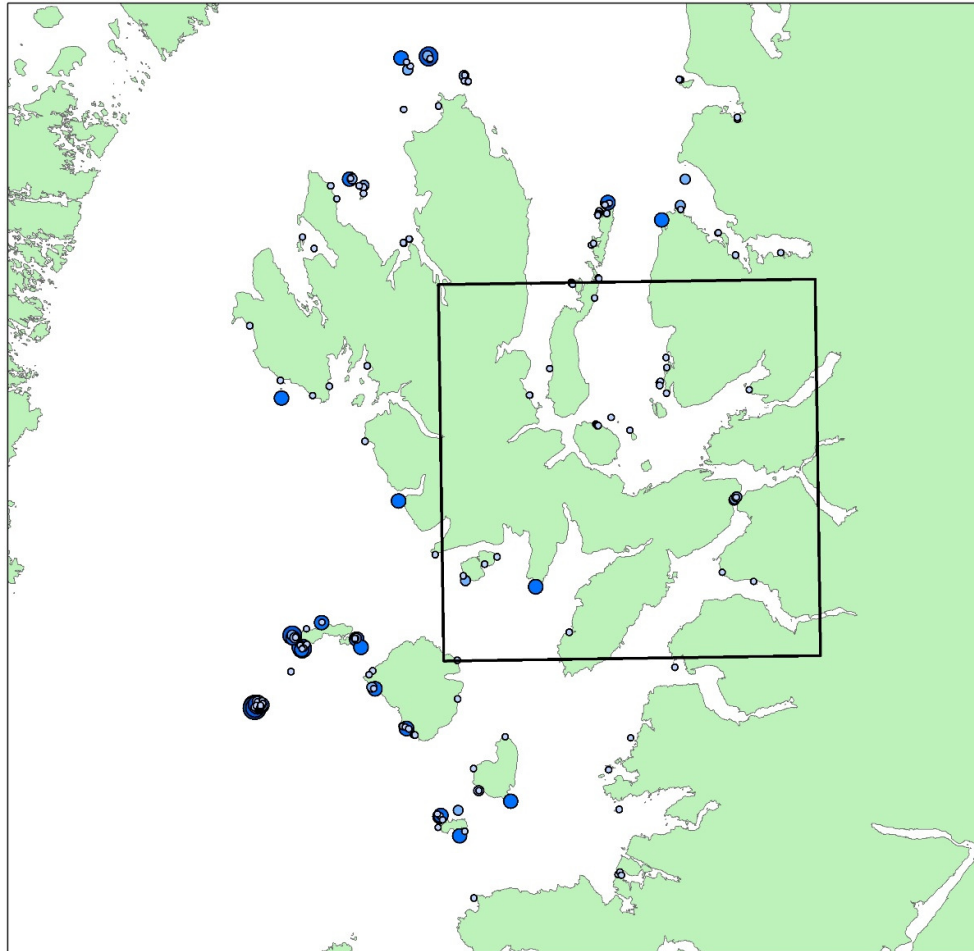
-  1-5
-  6-10
-  11-25
-  26-50
-  51-100
-  >100

Data Sources
Study Area: Jacobs

Coordinate system
WGS 1984 Albers

0 5 10 20 Kilometers





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2014 Grey Seal
Haul Out Counts

Legend

Study Area

2014

COUNT_

- 1-5
- 6-10
- 11-25
- 26-50
- 51-100
- >100

Data Sources
Study Area: Jacobs

Coordinate system
WGS 1984 Albers

0 5 10 20 Kilometers

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