NPWS
An tSeirbhís Páirceanna Náisiúnta agus Fiadhúlra
National Parks and Wildlife Service

Aerial thermal-imaging survey of seals in Ireland in August 2024

Irish Wildlife Manuals 158

Prepared by the National Parks and Wildlife Service
npws.ie

Citation: Morris, C.D, Riddoch, N.G., Duck, C.D., Waitland, S.A. & Russell, D.J.F. (2025). Aerial thermal-imaging survey of seals in Ireland in August 2024. Irish Wildlife Manuals, No. 158. National Parks and Wildlife Service, Department of Housing, Local Government and Heritage, Ireland.

Keywords: Harbour Seal, *Phoca vitulina*, Grey Seal, *Halichoerus grypus*, marine mammal, coastal, population monitoring, distribution, abundance, Special Area of Conservation

Front cover, from left to right and top to bottom:

A deep water fly trap anemone *Phelliactis* sp., Yvonne Leahy; **Common Newt** *Lissotriton vulgaris,* Brian Nelson; **Limestone pavement**, Bricklieve Mountains, Co. Sligo, Andy Bleasdale; **Garden Tiger** *Arctia caja,* Brian Nelson; **Violet Crystalwort** *Riccia huebeneriana*, Robert Thompson; **Coastal heath**, Howth Head, Co. Dublin, Maurice Eakin; **Meadow Saffron** *Colchicum autumnale*, Lorcan Scott

Bottom photograph: **Seals hauled out on sandy beach in Killala Bay**, Co. Mayo, C. Morris, SMRU

Aerial thermal-imaging survey of seals in Ireland in August 2024

Chris D. Morris, Nick G. Riddoch, Callan D. Duck, Simon A. Waitland

& Debbie J.F. Russell

Sea Mammal Research Unit, University of St Andrews, KY16 8LB, Scotland

The NPWS Project Officer for this report was: Loraine Fay; Loraine.Fay@npws.gov.ie

This IWM was edited by Loraine Fay, Sue Wilson & Domhnall Finch

ISSN 1393 – 6670

An Roinn Tithíochta, Rialtais Áitiúil agus Oidhreachta, 90 Sráid an Rí Thuaidh, Baile Átha Cliath 7, D07 N7CV

Department of Housing, Local Government and Heritage, 90 North King Street, Dublin 7, D07 N7CV

Contents

Executive Summary

In August 2024, the Sea Mammal Research Unit (SMRU) of the University of St Andrews carried out an aerial thermal-imaging survey of Harbour Seal (*Phoca vitulina vitulina*) and Grey Seal (*Halichoerus grypus*) numbers and distribution around Ireland. The survey was commissioned by the National Parks and Wildlife Service (NPWS), Department of Housing, Local Government and Heritage (DHLGH) as part of their long-term monitoring programme for Harbour Seal, an EU Habitats Directive Annex II species. It was the fourth such nationwide survey of seals in Ireland during the Harbour Seal moult season in summer. Previous thermal-imaging surveys were carried out in 2003, in 2011/2012, and in 2017/2018.

Within the low seal density areas that were not surveyed in August 2024 due to time constraints, four Harbour Seals and one Grey Seal were counted in 2017/2018. Including this count produced a total Harbour Seal count of 3,981 for August 2024. This is very similar to the Harbour Seal count in 2017/2018 of 4,007, which was the highest of the time series. Using an estimated proportion of the population hauled-out during the survey window (*i.e*. available to count) produces a total Harbour Seal population estimate for Ireland of around 5,500 (95% CI: 4,500-7,400) for 2024. Based on counts from the four nationwide August surveys, the Harbour Seal population in Ireland has increased by around 37% (95% CI: 21.7-54.2%) since 2003. The overall population is either continuing to increase at a low rate or is currently stable.

For data presentation at a smaller spatial scale, the Irish coast was divided into five regions, East, South-east, South-west, West and North. As in the last two national surveys, the greatest proportion of both seal species were found in the West region (approx. 40% in 2024). As in all previous surveys, similar numbers of Harbour Seals were counted in the North and in the South-west region. These three regions contained 92-96% of the national total counted during all four surveys. In 2024, a slightly higher number was found in the East region compared to previous years.

The total Grey Seal count for August 2024 was 3,880, which is the highest national total since these surveys began. Using an estimated proportion of the population hauled-out during the survey window (*i.e*. available to count) produces a total Grey Seal summer population estimate for Ireland of around 15,400 (95% CI: 13,300-18,000).

Grey Seal summer counts can be highly variable from day-to-day, so more caution is required when interpreting these data. Based on counts from the four nationwide August surveys, the Grey Seal population in Ireland has increased by around 190% (95% CI: 157-229%) since 2003. The summer counts suggest that the population increased rapidly pre-2015, but that growth levelled off over the last ten years and that the Grey Seal population is now stable.

Acknowledgements

These surveys were commissioned by the National Parks and Wildlife Service, Department of Housing, Local Government and Heritage. We are grateful to Loraine Fay (NPWS) for management and administration of the survey contract as well as for managing to conduct a few ground counts coinciding with the helicopter surveys. Hazel Doyle and Rory O'Hanlon (both NPWS) conducted a ground count on Great Saltee. We would like to thank PDG Aviation Services, especially pilot Keith Timpson and ground crew Phil Shewan, for making it possible to complete the flights within the short survey window available. Dublin ATC were very supportive in planning and enabling the survey flight through their control zone. A big thank you also goes to the various small airfield and hotel owners that kindly allowed us to land the helicopter at their sites.

1 Introduction

Harbour Seal and Grey Seal are included in Annex II of the European Union Council Directive 92/43/EEC (1992), commonly known as the Habitats Directive. The Directive's aim is to encourage the maintenance or restoration of biodiversity through the conservation of natural habitats and of wild fauna and flora in the territories of European Union member states. Member states are required to report on the conservation status of such protected species every six years. The surveys described in this report provide an important part of the information on numbers and distribution of Harbour Seals and Grey Seals in Ireland that are required for this reporting, complementing existing monitoring programmes for Harbour Seal (*e.g*. NPWS, 2012; Minto & Rakka, 2015; Rakka & Minto, 2015) and Grey Seal (*e.g*. Ó Cadhla & Strong, 2007; Ó Cadhla *et al*., 2007; Ó Cadhla *et al*., 2013). A key component obtained from the August aerial survey data is the assessment of the national population trend for Harbour Seal in Ireland between 2003 and 2024.

In Ireland and the UK, Harbour Seal population surveys are carried out during their annual moulting period which occurs between July and September (Thompson & Rothery, 1987). Harbour Seal haul-out numbers are relatively high and consistent at this time of year (Thompson & Harwood, 1990; Russell *et al*., 2015). Grey Seals hauled ashore are also counted during these surveys, providing information on their summer distribution which feed into at-sea density distribution estimates (Carter *et al.*, 2022). However, it should be noted that Grey Seal numbers can be highly variable from day-to-day during the summer (Russell & Carter, 2021). Summer counts for Grey Seals are being increasingly used for management purposes (SCOS, 2024), and thus the national trend was also assessed for the Grey Seal population.

In August 2024, the Sea Mammal Research Unit (SMRU) carried out an aerial survey of Harbour Seals and Grey Seals covering most of the Irish coastline. This is the fourth nationwide aerial survey carried out for the Department of Housing, Local Government and Heritage (DHLGH) by SMRU, following on from previous thermal-imaging surveys carried out in 2003 (Cronin *et al*., 2004; 2007), in 2011/2012 (Duck & Morris, 2012; 2013), and in 2017/2018 (Morris & Duck, 2019).

2 Methods

2.1 Data collection

The Sea Mammal Research Unit carried out surveys of Harbour Seals by helicopter using a multi-camera gyro-stabilised gimbal (Trakka Systems SWE-400) fitted externally beneath the cockpit. The gimbal contains a laser rangefinder (Vectronix LRF 5020), a colour High-Definition digital video camera (Sony FCB-EV7500), a mid-wavelength (3-5 µm) thermal-imaging video camera (FLIR µCore-280), and a digital single-lens reflex camera (Nikon D810) equipped with a 300 mm telephoto lens (AF-S Nikkor 300 mm f4 PF ED VR).

Thermal-imaging surveys followed the standard SMRU Harbour Seal survey protocol:

- Surveys were restricted to the peak Harbour Seal moult season
- Surveys were restricted to within two hours either side of low tides occurring between 12.00 and 19.00 local time
- There was no surveying during moderate, heavy or prolonged rainfall, as very wet weather can affect the number of seals hauling out
- The survey altitude was around 300 m above sea level, which is generally sufficiently high to avoid significant disturbance of seals and other wildlife
- All intertidal areas surveyed were searched using the thermal-image video display
- High-resolution digital photographs were taken of all groups of seals where possible
- The colour and thermal-image videos were recorded along with the digital still images onto two Microsoft Surface Pro 4 computers
- The mapping system (TrakkaMap) recorded detailed timestamps and GPS coordinates for all flight tracks and image data, including the target centre coordinates and footprint polygons for each photograph
- Complete flight tracks were recorded on two Garmin Foretrex 401 GPS units

A screenshot of the mapping software display, showing colour video, thermal-image video and the live mapping system is shown in Figure 1. A close-up from the high-resolution photograph of the same group of seals is shown in Figure 2.

In 2024, the helicopter surveys were carried out between 1st and 13th August, using a Eurocopter AS350 hired from PDG Aviation Services (Scotland). As planned, the surveys covered most of the Irish coast (Figure 3). To ensure coverage of all areas known to be important to Harbour seals within the available tide windows, the River Shannon and a southern section of the east coast were not surveyed due to time constraints. These are areas where very few animals have been found during previous aerial surveys. Along the combined coastline that was not surveyed in 2024, eight8, one, and four Harbour Seal were counted in 2003, in 2011/2012, and in 2017/2018 respectively, as well as 14, three, and one Grey Seal. All 13 Harbour Seal SACs were comprehensively surveyed.

In total, 18 survey flights were conducted on 11 different days. No surveys were conducted on 2nd and 8th August due to consistent rain and/or fog. A list of all survey flights is given in Table 1.

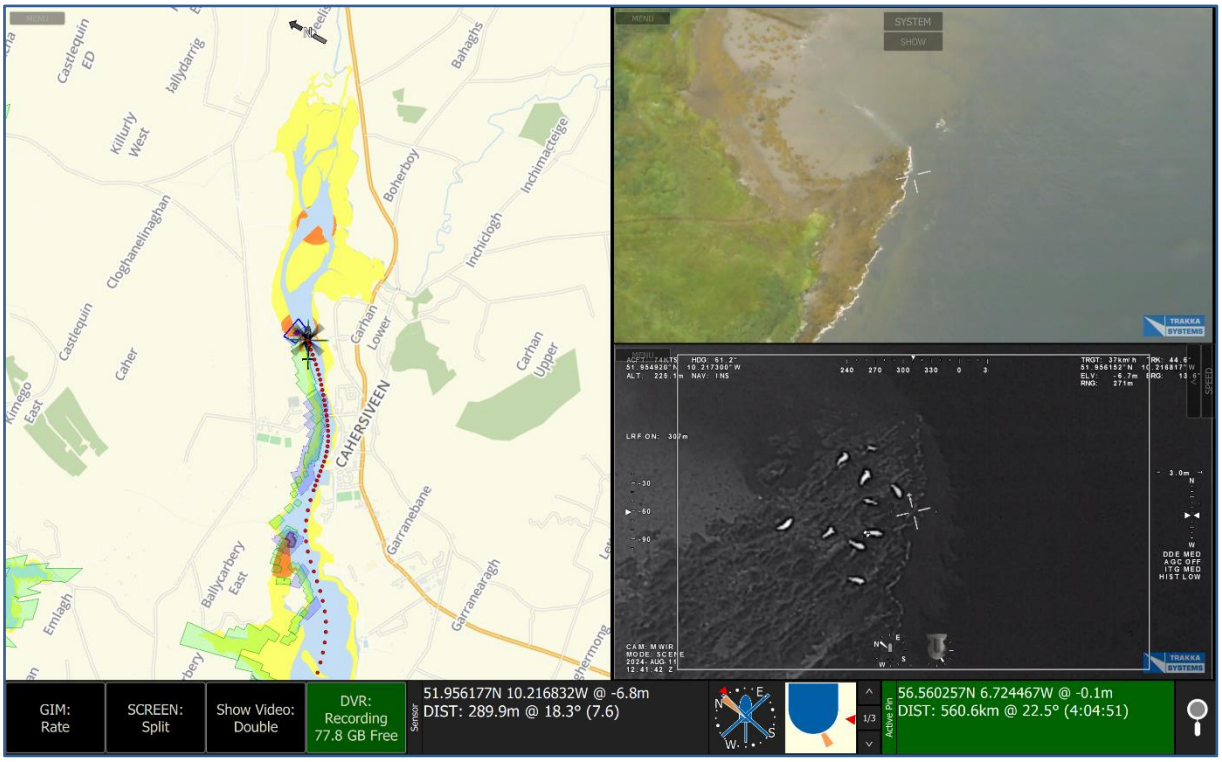

Figure 1 Screenshot of the live mapping software display with colour and thermal image video, showing a group of Harbour Seals hauled-out near Cahersiveen, Co. Kerry, on 11 August 2024.

Figure 2 Cropped view of a high-resolution digital still image of the ten Harbour Seals visible in the thermal image shown in Figure 1.

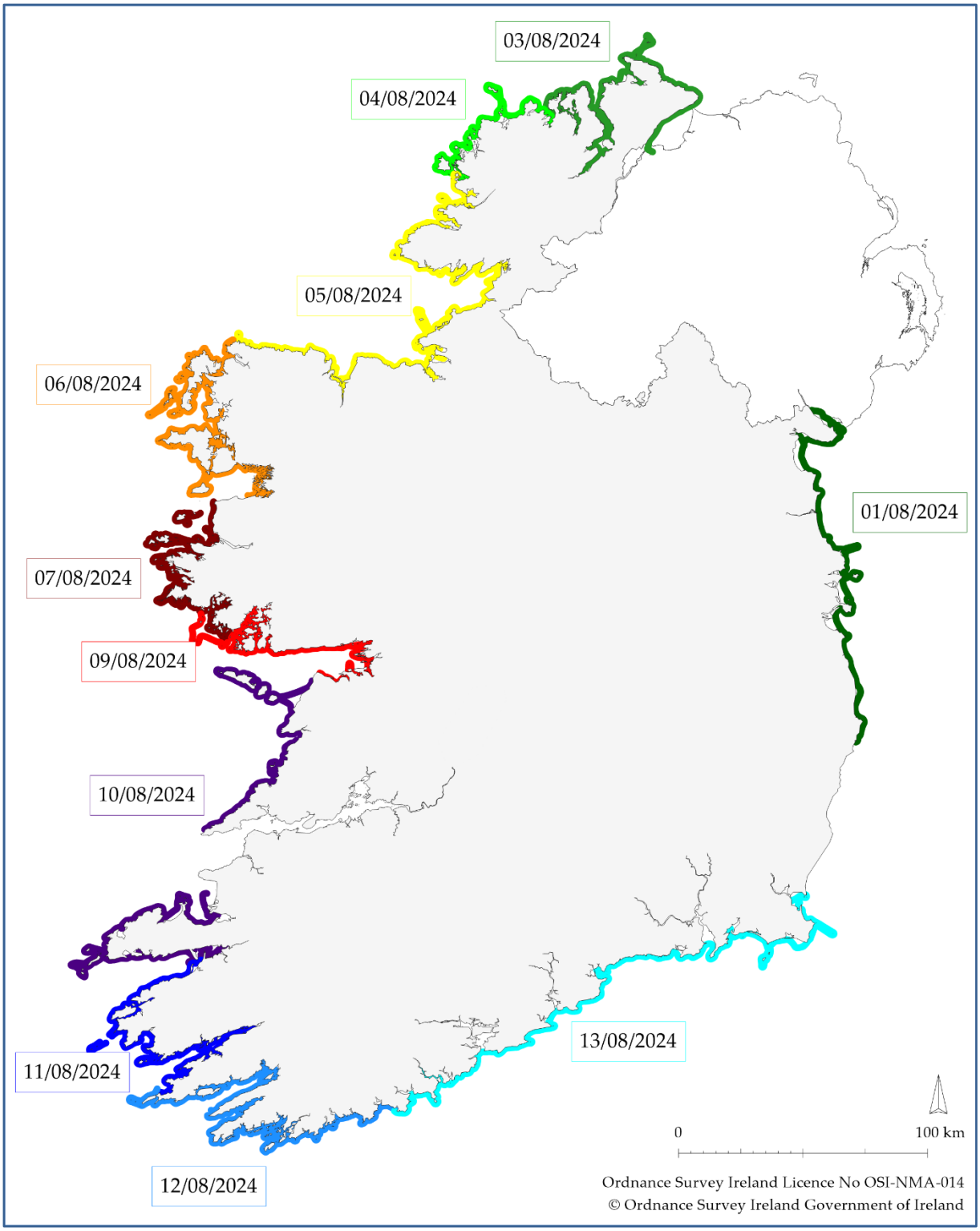

Figure 3 Helicopter flight tracks during survey effort in August 2024 coloured by day.

Table 1 Daily helicopter survey flight summary for August 2024. Survey start and end times are given in Irish Standard Time. The distance refers to the distance travelled by the helicopter and may not be an accurate representation for the total length of coastline surveyed, especially in areas with complex shorelines.

Day	Date	Survey flight on day	Survey start	Survey end	Distance (km)	Photos
1	01 August	1	13.27	15.41	245	353
2	03 August	1	10.11	12.43	319	287
3	04 August	1	10.02	12.34	160	210
4	05 August	1	10.58	12.32	168	120
4	05 August	2	13.02	15.30	301	211
5	06 August	1	11.36	13.17	198	191
5	06 August	2	13.46	16.06	217	184
6	07 August	1	11.20	13.47	161	309
6	07 August	2	14.12	16.12	195	263
7	09 August	1	12.40	15.35	185	296
7	09 August	2	15.56	16.55	110	161
8	10 August	1	13.18	14.50	193	187
8	10 August	2	15.31	17.43	244	149
9	11 August	1	13.16	15.58	288	286
9	11 August	2	16.25	16.48	42	19
10	12 August	1	14.16	15.53	175	127
10	12 August	2	16.15	19.00	287	227
11	13 August	1	15.59	18.17	360	167
Total		18			3,848	3,747

2.2 Data processing

Video and still images were reviewed by experienced observers at SMRU's base in St Andrews. Viewed in conjunction with a detailed digital map and satellite imagery of Ireland (https://maps.biodiversityireland.ie/Map), the recorded data enabled accurate positioning of all seal sightings. Using selected still photographs for each haul-out site, groups of seals were counted in DotDotGoose software (Ersts, 2024) and located in a geographic information system (Manifold System 8.0 Ultimate Edition GIS). Maps were produced using the same GIS software.

As for the last national survey reporting in 2019, the coastline of Ireland was divided into five regions: East, South-east, South-west, West and North (Figure 4; Table 2). The region boundaries were originally selected based on the distribution of haul-out sites, with cross-border swimming distances of 65-110 km separating the closest Harbour Seal haul-outs found in any two neighbouring regions. These five regions were further subdivided into 29 smaller coastal areas to enable the examination of seal distribution and abundance at a smaller spatial scale.

Although the survey timing and methodology were selected to produce haul-out counts that were as consistent as possible, day-to-day changes in haul-out behaviour were influenced by several different factors (*e.g*. weather patterns, foraging conditions, disturbance events, haul-out behaviour in the days prior to surveying) that were not accounted for when using raw count data. Electronic tracking devices temporarily deployed on wild animals can provide information on haul-out probability. Based on such telemetry tag data collected in the UK (Lonergan *et al*., 2013; Russell & Carter, 2021), the most recent estimates of the proportion of animals hauled-out during survey periods were used to scale up haul-out counts to total population size.

2.3 Trend analysis

To quantitatively assess Harbour Seal and Grey Seal trends on a national scale between 2003 and 2024, a trend analysis was conducted that broadly followed methods (Thompson *et al*., 2019) used for seal populations in the UK and Europe, as reported to the Special Committee on Seals (Russell *et al*., 2024) and OSPAR (Banga *et al*., 2022). The data from all four nationwide surveys were used: 2003, 2011/2012, 2017/2018 and 2024. For the purposes of this analyses, the counts from the 2011/2012 and 2017/2018 surveys were assigned to the years in which the most Harbour Seals were counted; 2011 and 2017, respectively.

Counts were modelled as a function of year assuming negative binomial errors (see Thompson *et al*., 2019, for more details). As in Russell *et al*. (2024), the Akaike information criterion (AIC) was used for model selection. Three models were fitted: an intercept-only Generalized Linear Model (GLM; null model, *i.e*. no trend), an exponential (linear on the link scale) year effect within a GLM, and a nonlinear smooth year effect within a Generalized Additive Model (GAM). In contrast to Russell *et al*. (2024), in which the GAM models were restricted to 5 knots, here the number of knots were further restricted to the minimum number needed to fit a GAM (3 knots). This was necessary due to the limited number of data points available (n = 4). Limiting the number of knots essentially limits the flexibility of the smooth relationship between year and counts.

The fitted trends were used to estimate the changes in abundance since the beginning of the time-series (2003) and the current annual rate of change (change between 2023 and 2024). Specifically, the percentage difference between the predicted count in 2024, and both 2003 and 2023 was calculated. The 95% confidence intervals (CIs) around these estimates were generated via parametric bootstrapping. Changes were termed significant if the confidence intervals did not encompass zero.

3 Results

The distribution of the actual haul-out sites of Harbour Seal and Grey Seal counted during the 2024 survey is shown in Figure 4. As observed during previous surveys, there was generally little overlap between major Harbour Seal and Grey Seal haul-out areas. Whereas most Harbour Seal aggregations were found in more sheltered coastal areas and estuaries, most large groups of Grey Seals were located on more exposed shorelines, rocky skerries and offshore islands.

For both species, counts from all four nationwide surveys are shown in Table 2, with totals given for Ireland, for five major regions, and for smaller areas within each region.

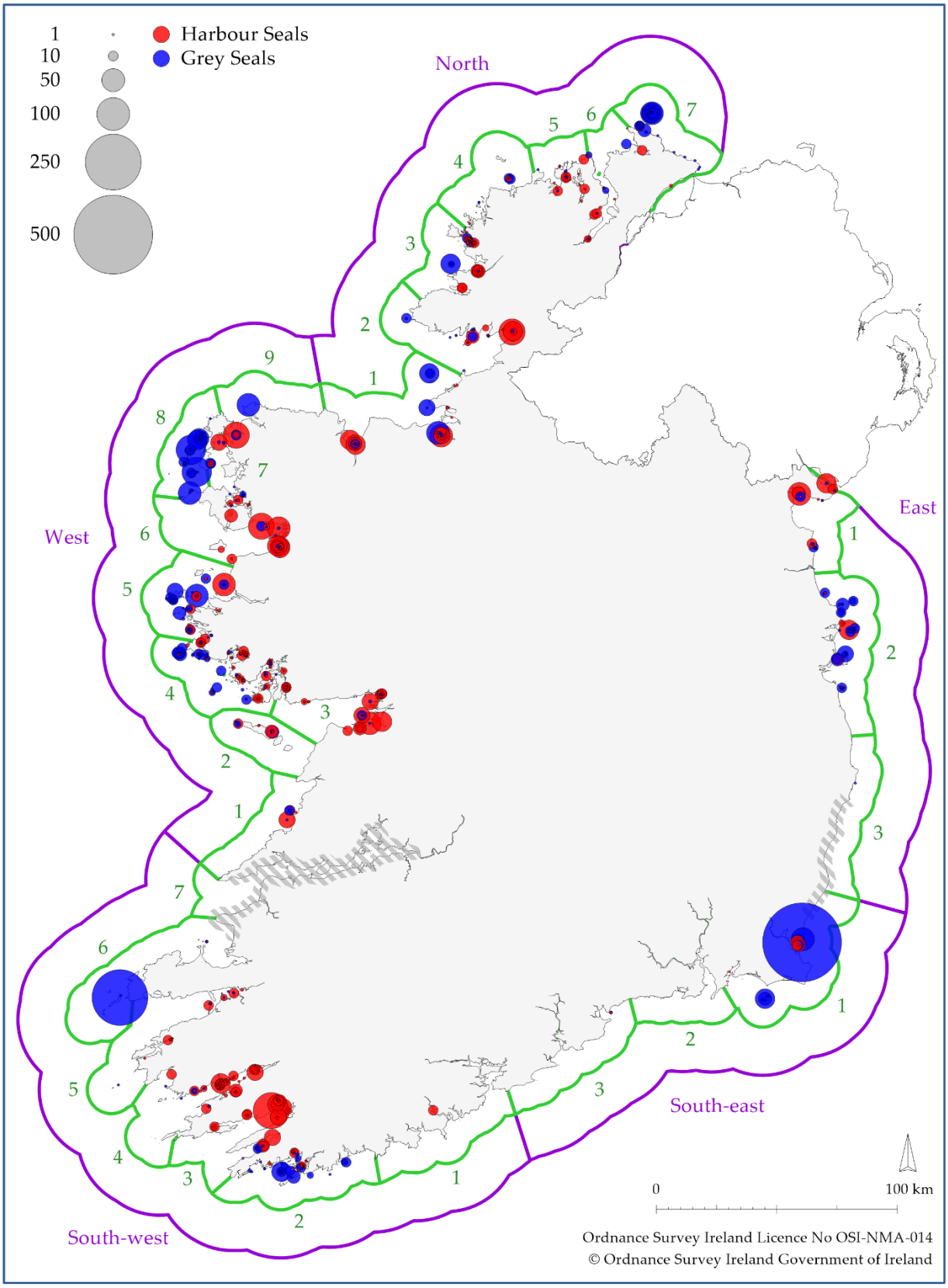

Figure 4 Numbers and distribution of Harbour Seals (red circles) and Grey Seals (blue circles) counted in Ireland in August 2024. The striped areas of coast were not surveyed in 2024. The displayed symbol size represents the recorded group size with count guides given in the legend (top left). Numbers of seals counted in each region (purple) and area (green) are given in Table 2.

Table 2 Counts of Harbour Seals and Grey Seals in Ireland from four national censuses obtained using thermal imaging helicopter surveys during the Harbour Seal moult period in August 2003, 2011/2012, 2017/2018, and August 2024. Regions and areas are shown in Figure 4 together with the distribution of seal haul-out groups counted.

		Harbour Seals				Grey Seals			
Region	**Area**	**2003**	**2011/12**	**2017/18**	**2024**	**2003**	**2011/12**	**2017/18**	**2024**
East	1	89	61	61	178	39	48	83	70
	2	34	29	70	69	211	172	335	260
	3 [1]	0	0	0	0	12	3	0	1
South-east	1	17	49	33	66	189	239	550	667
	2	0	0	0	0	0	0	1	0
	3	1	4	1	3	0	4	5	4
South-west	1	10	0	5	10	13	28	46	0
	2	52	88	115	85	58	198	411	224
	3	422	363	393	484	10	55	88	33
	4	399	345	441	355	8	11	12	16
	5	36	90	131	79	2	11	12	8
	6	0	1	11	6	45	150	222	271
	7 [2]	8	1	4	4	2	0	1	1
West	1	17	27	48	53	11	64	55	28
	2	39	53	41	40	11	73	53	46
	3	396	501	570	482	7	11	32	30
	4	152	358	349	270	58	238	192	306
	5	36	106	134	195	61	100	107	330
	6	124	282	311	398	4	17	21	27
	7	144	134	90	89	21	49	38	66
	8	0	0	0	0	176	304	531	548
	9	47	34	87	95	22	343	154	75
North	1	377	309	366	321	134	211	184	199
	2	150	204	218	194	27	87	59	39
	3	327	338	374	309	90	219	169	131
	4	12	19	18	10	27	45	77	42
	5	57	73	76	97	7	7	32	18
	6	5	20	49	71	0	3	23	28
	7	4	0	11	18	64	274	205	412
East		123	90	131	247	262	223	418	331
South-east		18	53	34	69	189	243	556	671
South-west		927	888	1,100	1,023	138	453	792	553
West		955	1,495	1,630	1,622	371	1,199	1,183	1,456
North		932	963	1,112	1,020	349	846	749	869
Ireland		2,955	3,489	4,007	3,981	1,309	2,964	3,698	3,880

[1] The east coast between Mizen Head and Wexford Bay (in Area East 3) was not surveyed in 2024 due to timing of low water. Only one Grey Seal was seen along this section during previous national censuses (in 2003).

[2] The River Shannon (Area South-west 7) was not surveyed in 2024 due to time constraints. Only very few animals were counted here during the previous three national censuses. To complete the national count for 2024, the latest available River Shannon counts from 2017/2018 (four Harbour and one Grey Seal) have been used for 2024 (SW 7 values shown in light grey).

3.1 Harbour Seals

The total number of Harbour Seals counted onshore in Ireland in August 2024 was 3,977. Including the most recent available count for the River Shannon (four Harbour Seals counted during the 2017/2018 census), the main area not covered by the 2024 survey, 3,981 can be used as a minimum Harbour Seal population estimate for Ireland. This is just 26 animals fewer than counted during the last national census in 2017/2018 but is markedly higher than in 2003 and 2011/2012 (Table 2).

In 2013, Lonergan *et al*. used ARGOS telemetry data from flipper tags, deployed at two different sites in Scotland, to estimate the mean proportion of the Harbour Seal population hauled out during the standard SMRU survey window (*i.e*. available to count). Using their results of 72% (95% CI: 54-88%) to scale the 2024 haul-out counts would give a total Harbour Seal population of around 5,500 (95% CI: 4,500-7,400).

Figures 5 and 6 show the percentage of Harbour Seals found in each of the five regions (East, South-east, South-west, West, and North) and how numbers within these regions have changed from 2003 to 2024. Apart from the increase in numbers counted in the West region between 2003 and 2011, there are no obvious regional trends in Harbour Seal counts. The West region still contributed the largest number to the national total (41%), with the numbers counted in the North and in the South-west being very similar once again (26% each). The apparent increase in the northern area of the East region could (at least partly) be due to the proximity to the larger Harbour Seal haul-out sites in the Northern Irish part of Carlingford Lough, where significantly fewer seals were counted in 2024 (104) compared to 2003 (247), 2012 (209), and 2017 (321). Sites in the northern half of the Lough are only 1.5-2 km from the sites on the Irish side. If all seals counted in Carlingford Lough were included with the East Ireland region, the 2024 count would be the second lowest of the four totals.

Figure 7 shows the distribution of Harbour Seals in 2024 aggregated by 10 km grid squares. The relative density of Harbour Seals across Ireland is more obvious at this scale than in Figure 4, as numbers at closely adjacent sites are aggregated rather than superimposed on top of each other. For comparison, Figures 8-10 show the 10 km grid distribution of Harbour Seals during the three previous national surveys.

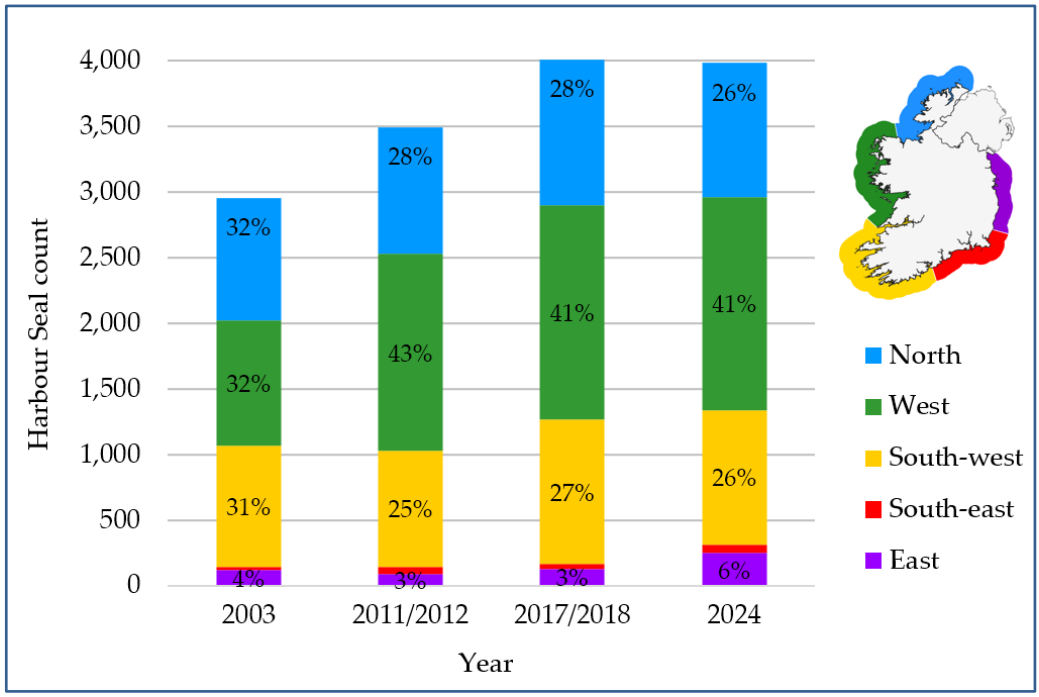

Figure 5 A comparison of the counts of Harbour Seals from all four nationwide surveys in five coastal regions of Ireland. Only 1-2% were found in the East region. The region boundaries are shown in Figure 4.

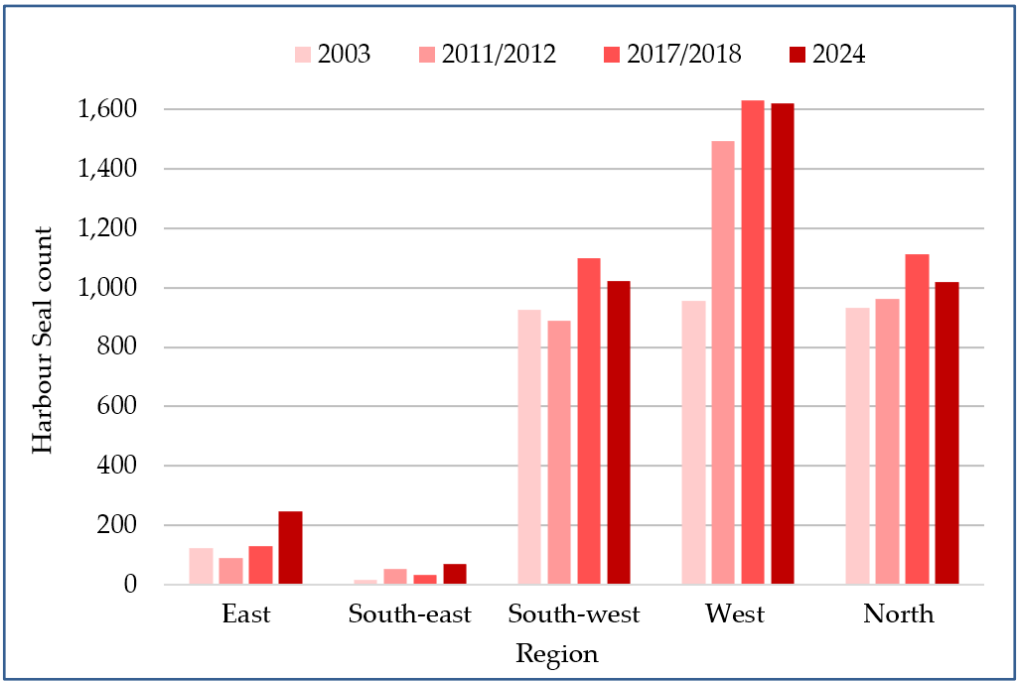

Figure 6 A comparison of the number of Harbour Seals counted in coastal regions of Ireland during four nationwide surveys between 2003 and 2024. The region boundaries are shown in Figure 4.

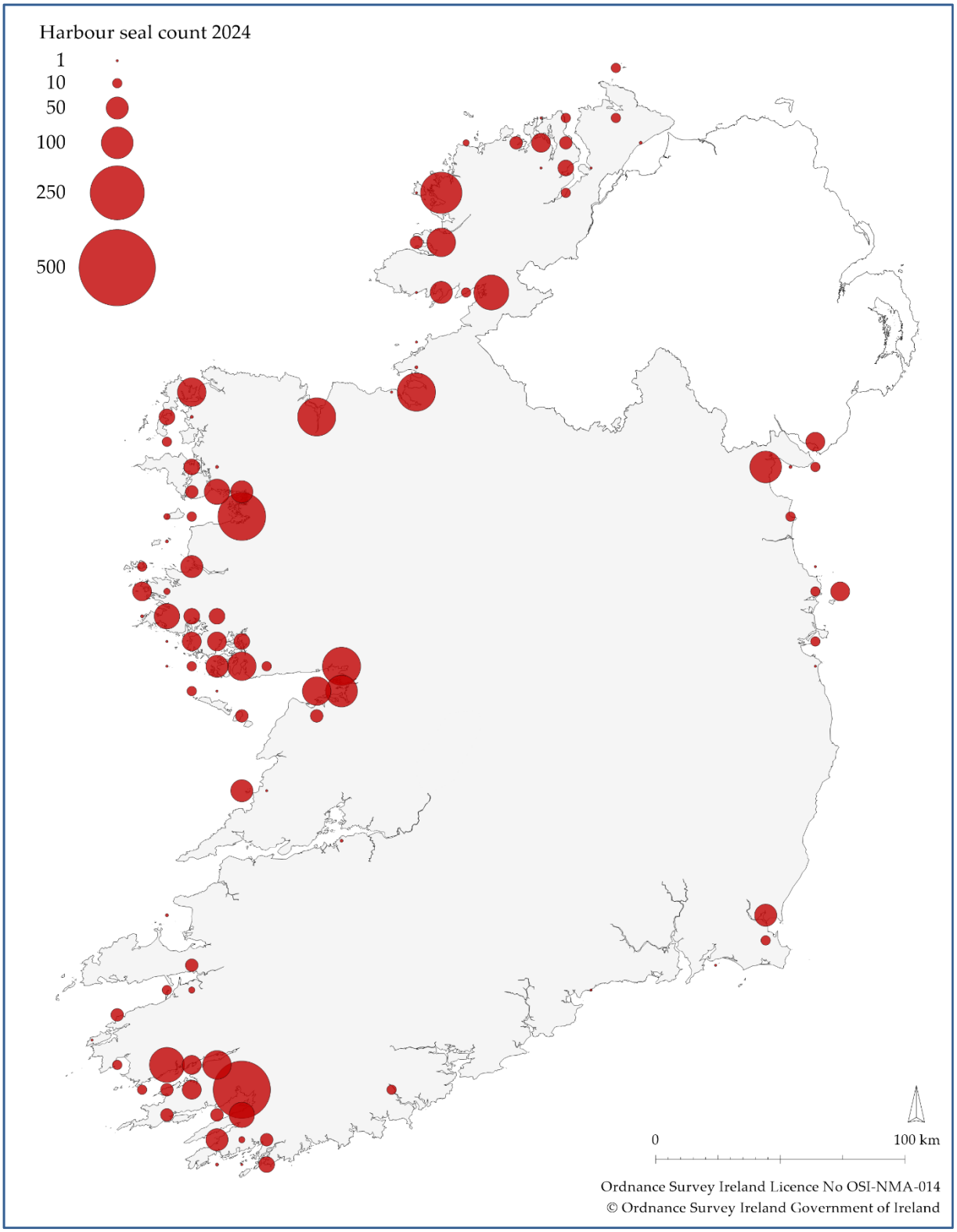

Figure 7 Distribution of Harbour Seals in Ireland from aerial surveys carried out in August 2024. These are the same data as the red circles shown in Figure 4, but counts are aggregated by 10 km grid squares. The small point in the River Shannon, which was not surveyed in 2024, is the count from 2017. Symbol size is in proportion to numbers counted with size guides given in the Legend (top left).

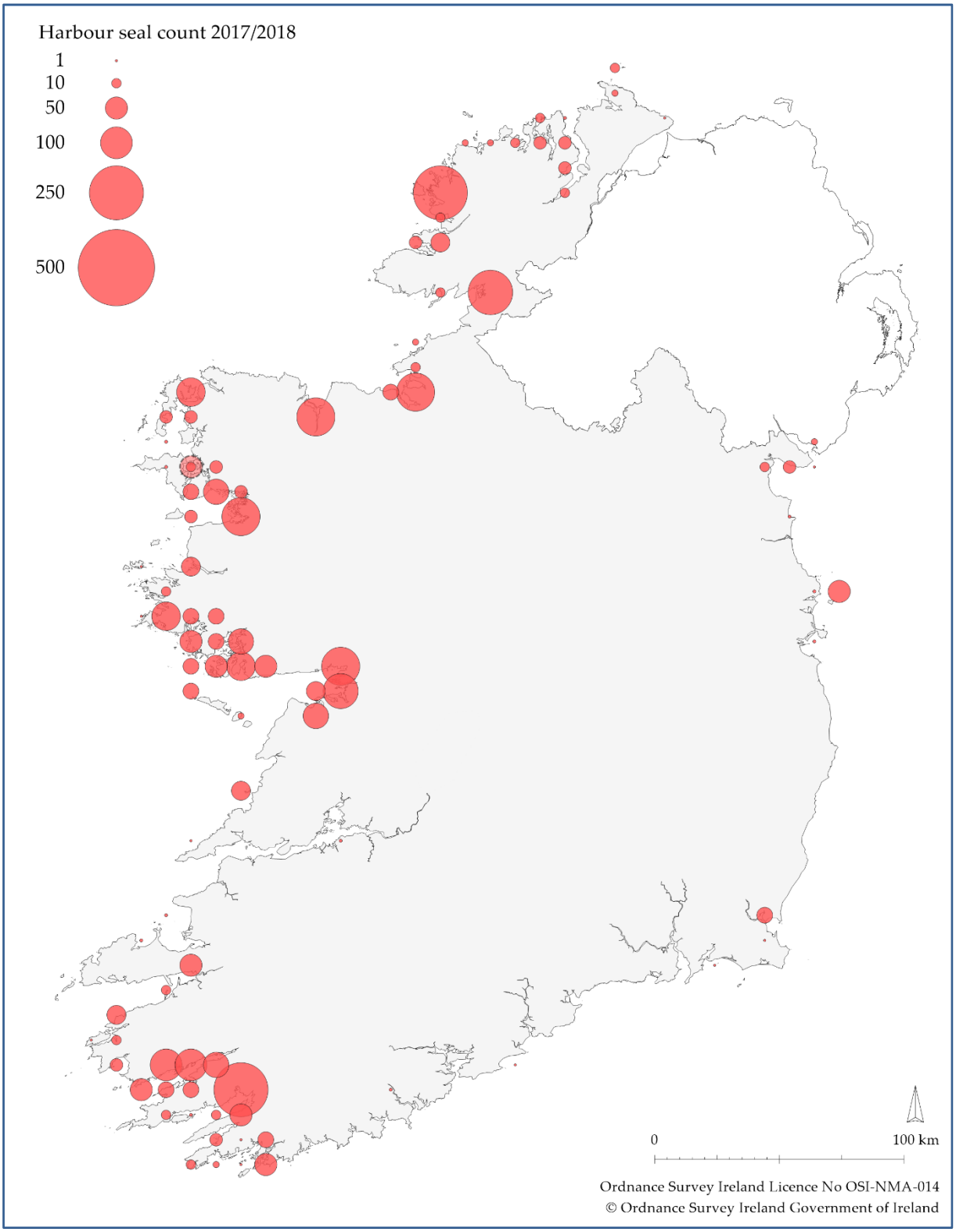

Figure 8 Distribution of Harbour Seals in Ireland from aerial surveys carried out in August 2017/2018. Counts are aggregated by 10 km grid squares. Symbol size is in proportion to numbers counted with size guides given in the Legend (top left). The dotted black circle lying east of Achill Island in the west of Ireland indicates the number of Harbour Seals for this grid cell if adding an estimated 30-40 individuals to the 2017/2018 count to accommodate the segment of coastline missed in 2017.

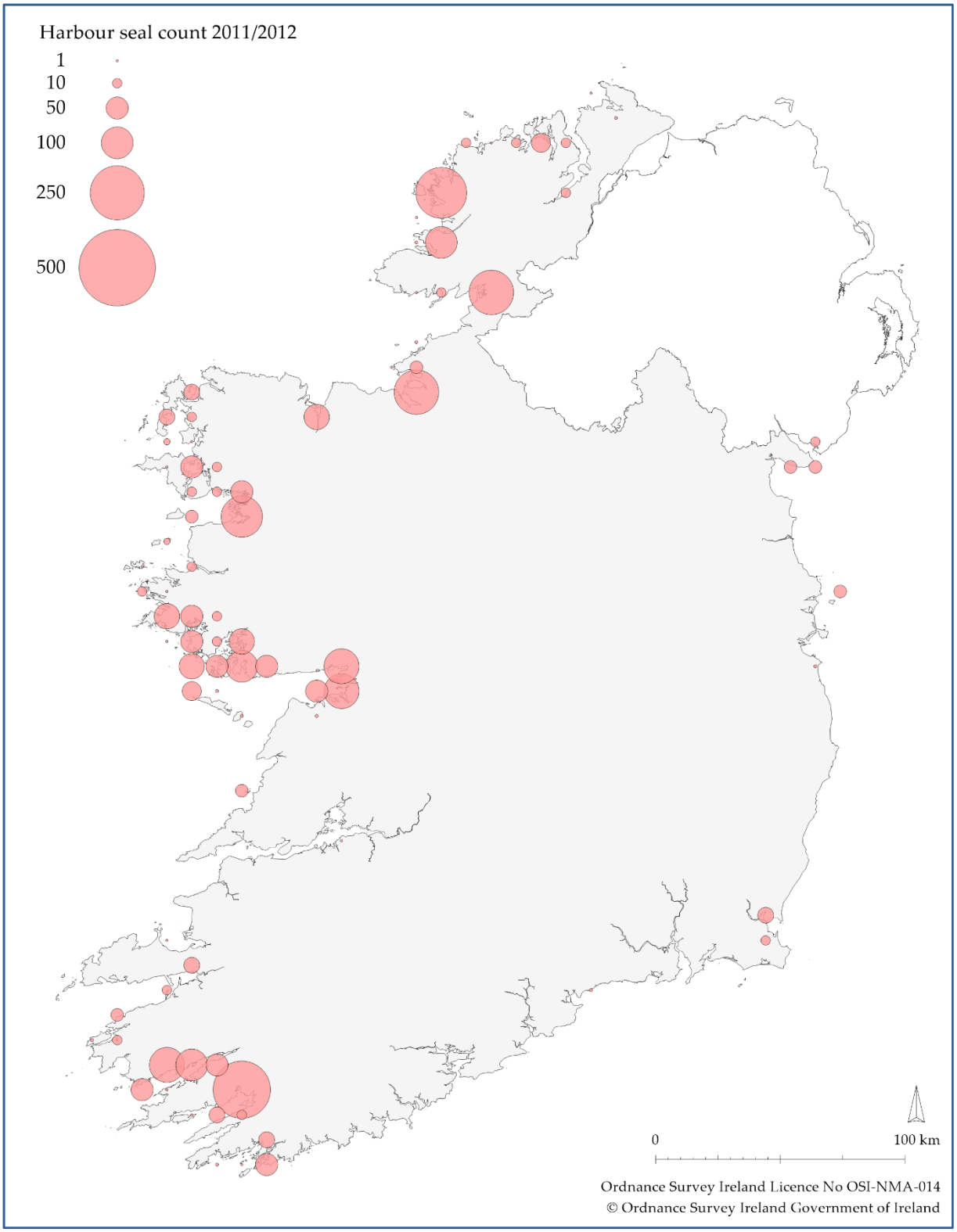

Figure 9 Distribution of Harbour Seals in Ireland from aerial surveys carried out in August 2011/2012. Counts are aggregated by 10 km grid squares. Symbol size is in proportion to numbers counted with size guides given in the Legend (top left).

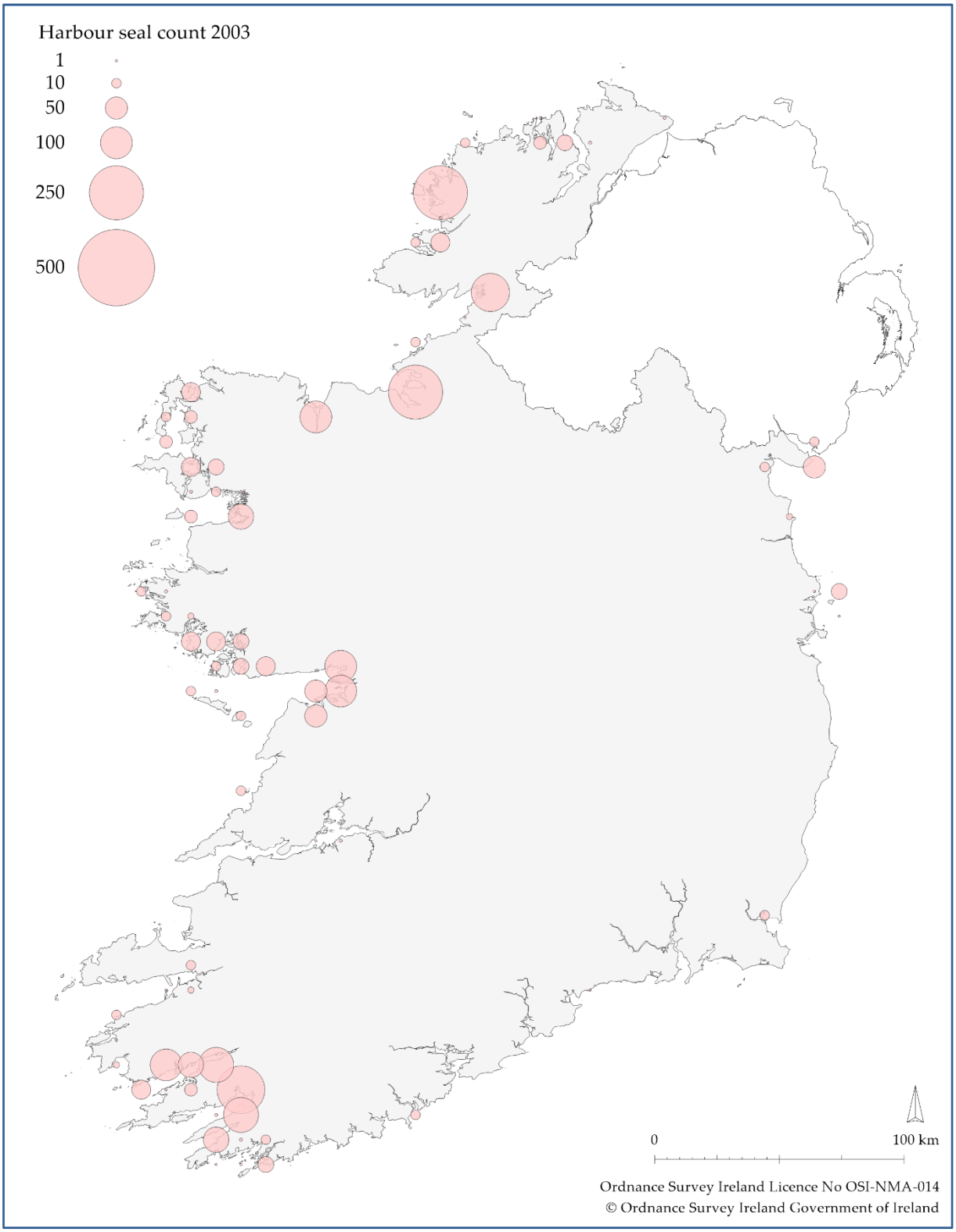

Figure 10 Distribution of Harbour Seals in Ireland from aerial surveys carried out in August 2003. Counts are aggregated by 10 km grid squares. Symbol size is in proportion to numbers counted with size guides given in the Legend (top left).

3.1.1 National population trend analysis for Harbour Seal

The aim for this data exploration was to identify the national population trend for Harbour Seal in Ireland from counts collected during the four nationwide surveys between 2003 and 2024.

There were significant trends through the time series. Although the GAM model had a higher deviance explained, the simpler GLM with a year effect was the final selected model (by AIC). For completeness, the output of both models is presented here.

The GLM indicated an increasing trend in Harbour Seal abundance throughout the time series (Figure 11a). The GAM indicated that the rate of increase has slowed as abundance levelled off (Figure 11b). Predictions from both models indicated that abundance in 2024 was ~37% higher than in 2003 (95% GLM CI: 21.7–54.2%). From the GLM, the current (2023-2024) rate of increase was estimated to be 1.5% (95% GLM CI: 0.9-2.1). However, this significant positive rate of increase was not confirmed by the GAM estimates for which the confidence intervals encompassed zero (0.6%; 95% CI: -0.7–1.8%).

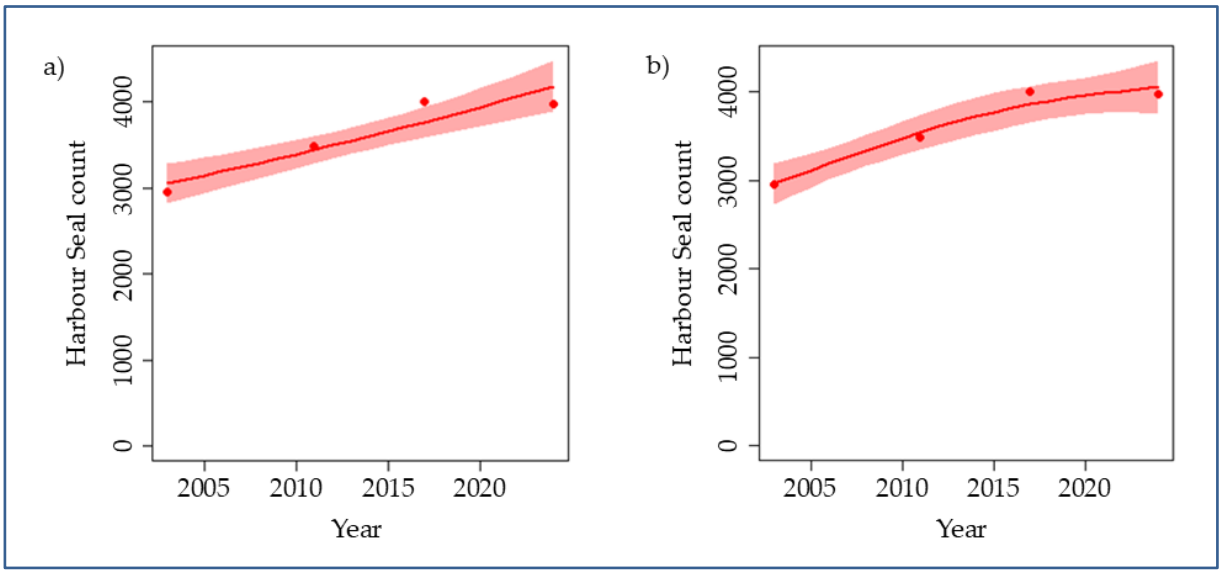

Figure 11 The predicted trend and associated 95% confidence intervals for Harbour Seal August counts in Ireland estimated using a GLM (a) and GAM (b). The points represent the values used to fit the trends.

3.1.2 Special Areas of Conservation for Harbour Seal

Figure 12 shows the locations of 13 Special Areas of Conservation (SAC) for Harbour Seals in Ireland, including the site code for each SAC. Table 3 shows the number of Harbour Seals counted during SMRU's aerial thermal-imaging surveys in each of these SACs.

All 13 SACs were comprehensively surveyed. During the three previous nationwide censuses, 63-66% of all Harbour Seals were counted within Harbour Seal SACs (Table 3 and Figure 12). In 2024, this proportion dropped slightly to 57%. Given that SACs are generally designated for a given species based on relatively high counts, it is often more likely for numbers to decline over time rather than increase further. In Scotland, significant declines have been observed at several Harbour Seal SACs (Morris *et al*, 2021). In some regions, these declines were compensated by increases in surrounding areas. Because of this, SACs are not always reliable indicators of wider populations. In Ireland, not all 13 SACs, for which Harbour Seals are a primary reason for selection or a qualifying feature, contained high numbers of Harbour Seals when they were first designated. Whereas counts from the thermal imaging surveys indicate possible declines at a small number of SACs (*e.g*. Ballysadare Bay), numbers at other sites appear to have increased continuously (*e.g*. Clew Bay Complex).

Table 3 Counts of Harbour Seals in Special Areas of Conservation (SAC) designated for Harbour Seal in Ireland. Numbers are derived from thermal-imaging helicopter surveys conducted during the moult season in August.

Site Code	SAC Name	2003	2011/12	2017/18	2024
000090	Glengarriff Harbour And Woodland SAC	134	155	158	139
000133	Donegal Bay (Murvagh) SAC	148	190	202	132
000197	West Of Ardara/Maas Road SAC	59	107	90	124
000204	Lambay Island SAC	31	23	60	40
000268	Galway Bay Complex SAC	317	333	421	368
000458	Killala Bay/Moy Estuary SAC	108	81	158	164
000622	Ballysadare Bay SAC	257	200	185	147
000627	Cummeen Strand/Drumcliff Bay (Sligo Bay) SAC	0	24	15	7
000781	Slaney River Valley SAC	17	49	32	65
001482	Clew Bay Complex SAC	95	241	248	356
002111	Kilkieran Bay And Islands SAC	116	264	261	181
002158	Kenmare River SAC	391	345	419	345
002283	Rutland Island and Sound SAC	268	230	284	185
	All Harbour Seal SACs	1,941	2,242	2,533	2,253
	Percentage of Ireland total	65.7%	64.3%	63.2%	56.6%
	Ireland Total	2,955	3,489	4,007	3,981

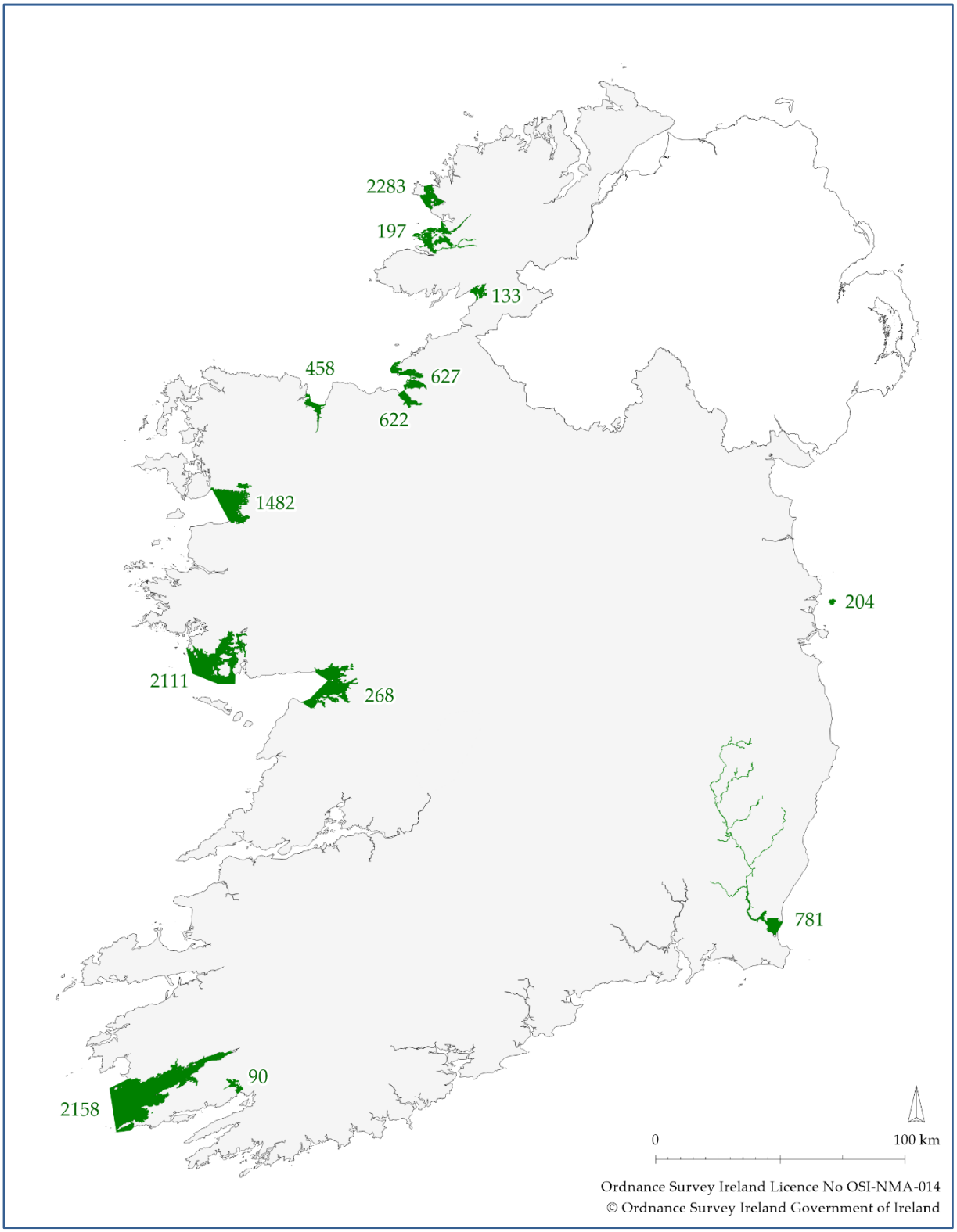

Figure 12 Special Areas of Conservation (SAC) for Harbour Seals in Ireland, with corresponding site codes. See Table 3 for SAC names and Harbour Seal counts.

3.2 Grey Seals

The total number of Grey Seals counted onshore in Ireland in August 2024 was 3,879. Including the most recent available count for the River Shannon (one Grey Seal counted during the 2017/2018 census), the main area not covered by the 2024 survey, produces a total count of 3,880 Grey Seals for Ireland. This is the highest of the four nationwide counts obtained since 2003 (Table 2).

Russell & Carter (2021) estimated the mean proportion of the Grey Seal population hauled-out during a standard August survey window to be 25.2% (95% CI: 21.5-29.1%). Using these values to scale the 2024 haul-out counts would produce a total summer Grey Seal population of around 15,400 (95% CI: 13,300-18,000).

Figures 13 and 14 show the percentage of Grey Seals found in each of the five regions (East, South-east, South-west, West, and North) and how total counts within these regions have changed from 2003 to 2024. As for Harbour Seals, the highest proportion of Grey Seals was found in the West region (38%). Given that Grey Seals often travel much greater distances compared to Harbour Seals, regional changes in haul-out counts may not be as meaningful.

Figure 15 shows the distribution of Grey Seals in 2024 aggregated by 10 km grid squares. The density of seals across Ireland is more obvious at this scale than in Figure 4, as numbers at closely adjacent sites are aggregated rather than superimposed on top of each other. For comparison, Figures 16-18 show the 10 km grid distribution of Grey Seals during the three previous national surveys.

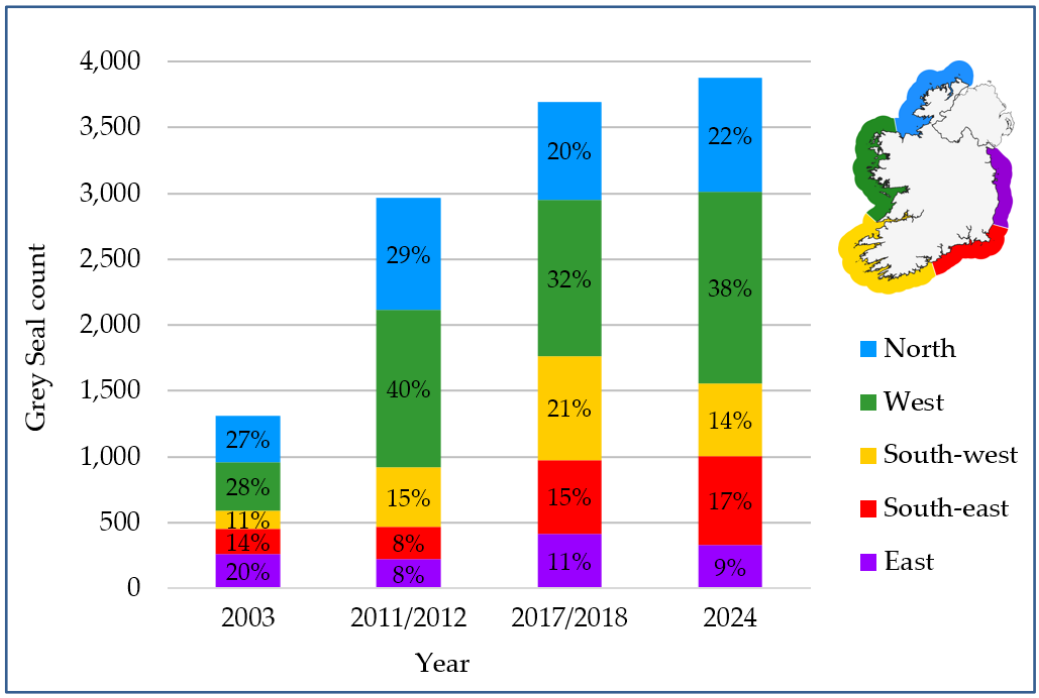

Figure 13 A comparison of Grey Seal counts from all four nationwide surveys in five coastal regions of Ireland. The region boundaries are shown in Figure 4.

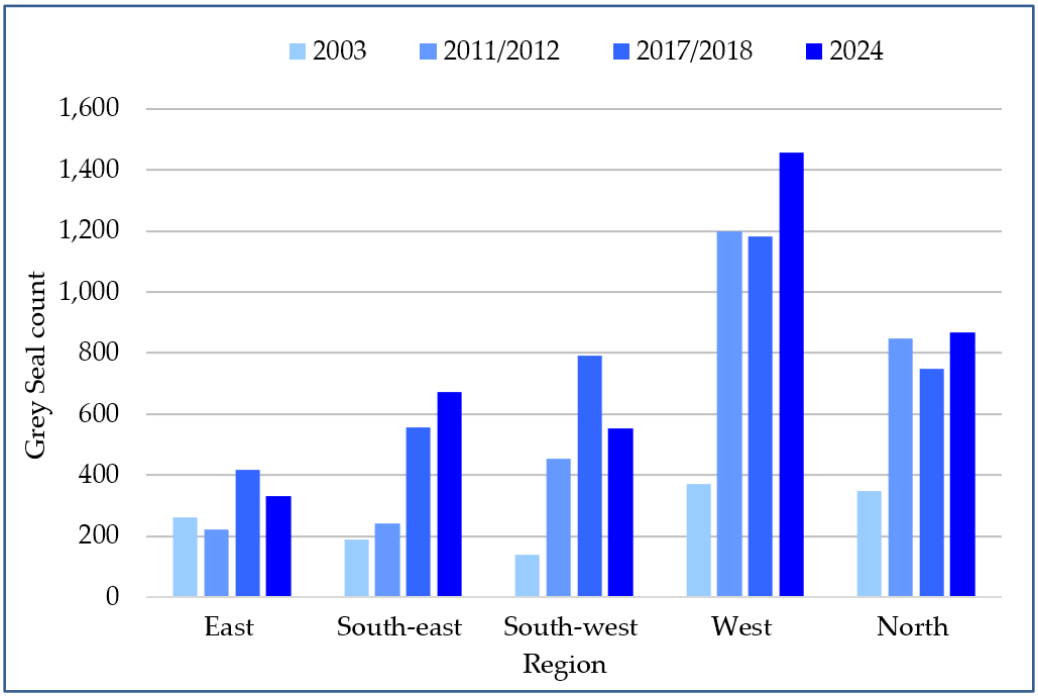

Figure 14 A comparison of the number of Grey Seals counted in coastal regions of Ireland during four nationwide surveys between 2003 and 2024. The region boundaries are shown in Figure 4.

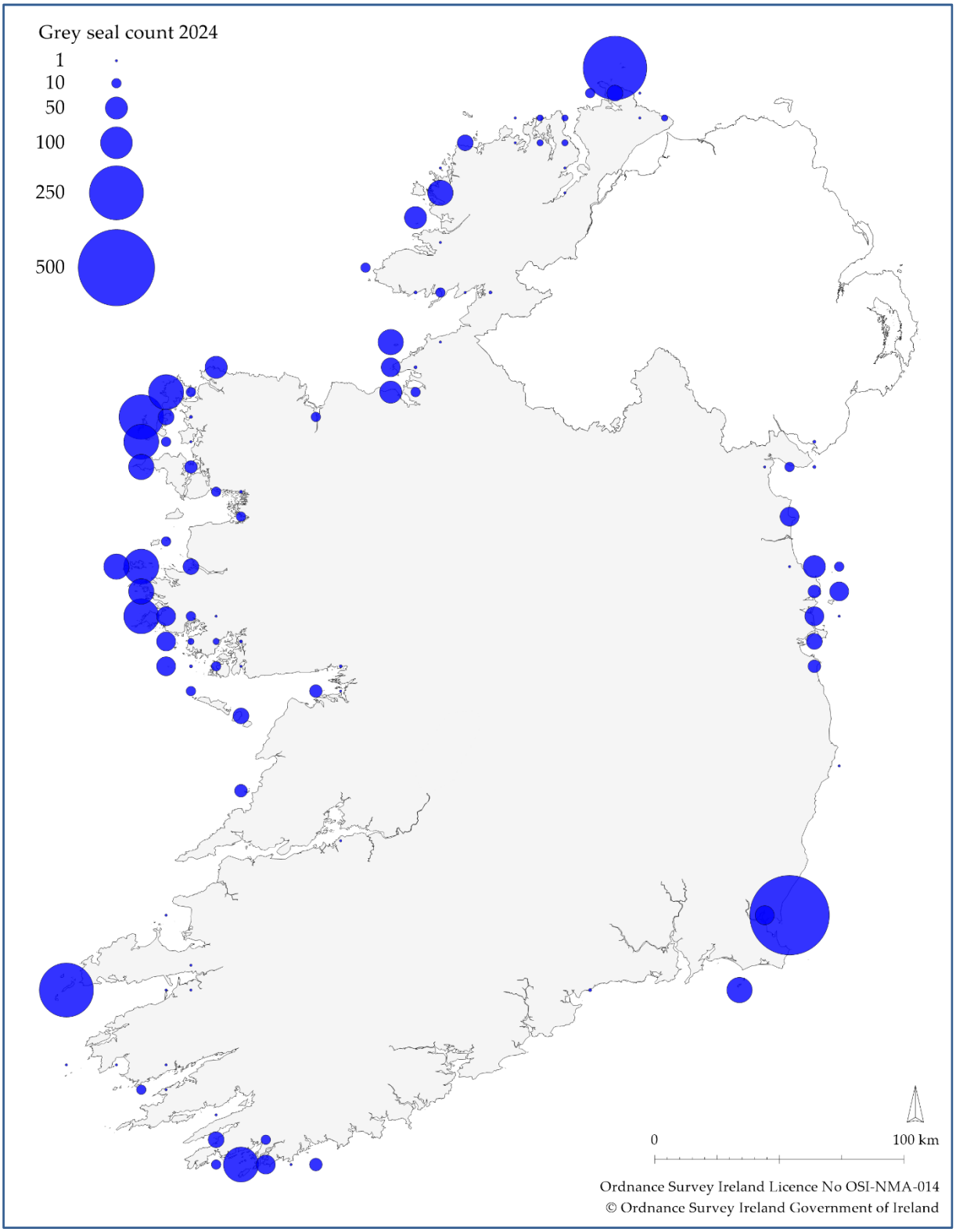

Figure 15 Distribution of Grey Seals in Ireland from aerial surveys carried out in August 2024. These are the same data as the blue circles show in Figure 4, but counts are aggregated into 10 km grid squares. The small point in the River Shannon, which was not surveyed in 2024, is the count from 2017. Symbol size is in proportion to numbers counted with size guides given in the Legend (top left).

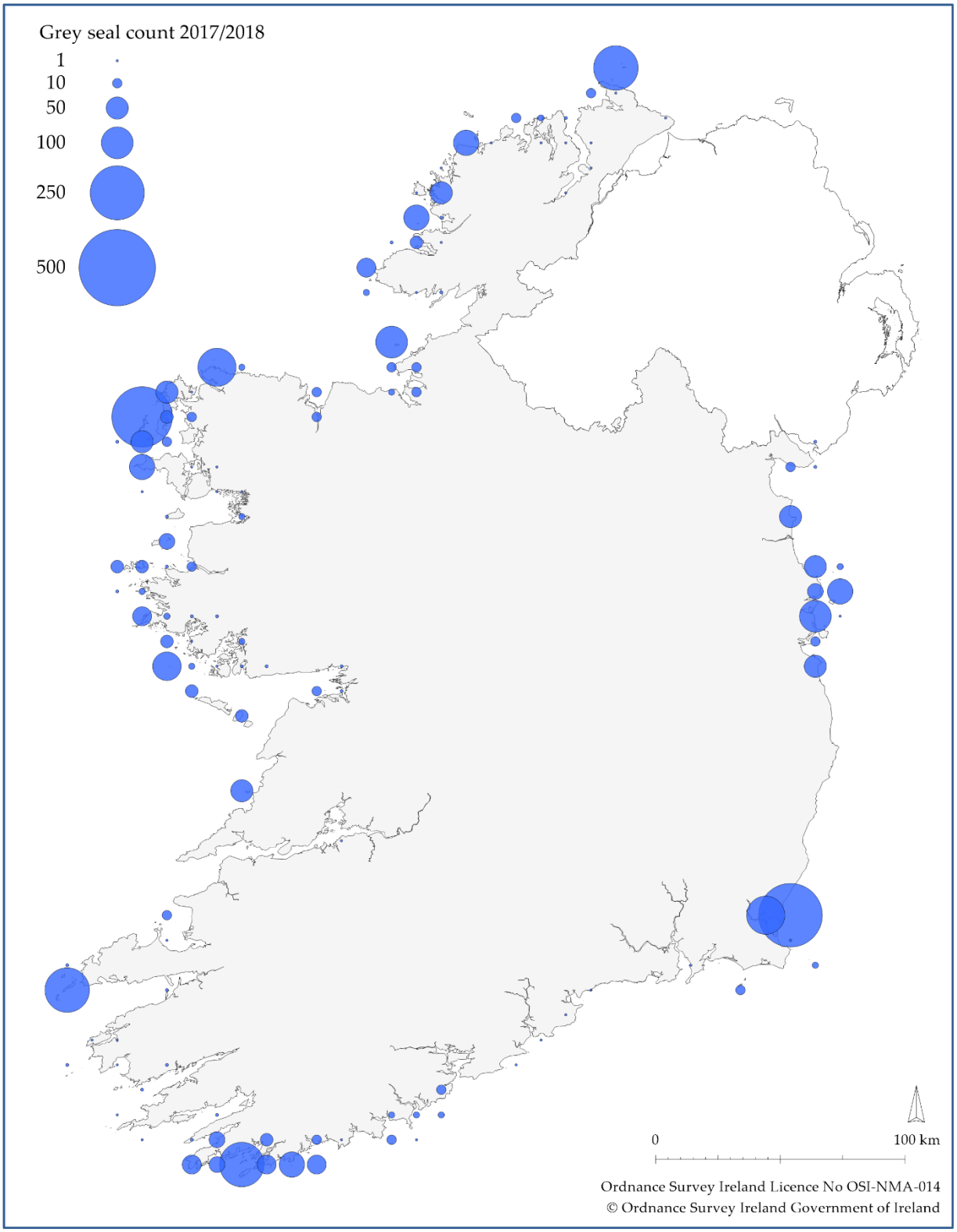

Figure 16 Distribution of Grey Seals in Ireland from aerial surveys carried out in August 2017/2018. Counts are aggregated by 10 km grid squares. Symbol size is in proportion to numbers counted with size guides given in the Legend (top left).

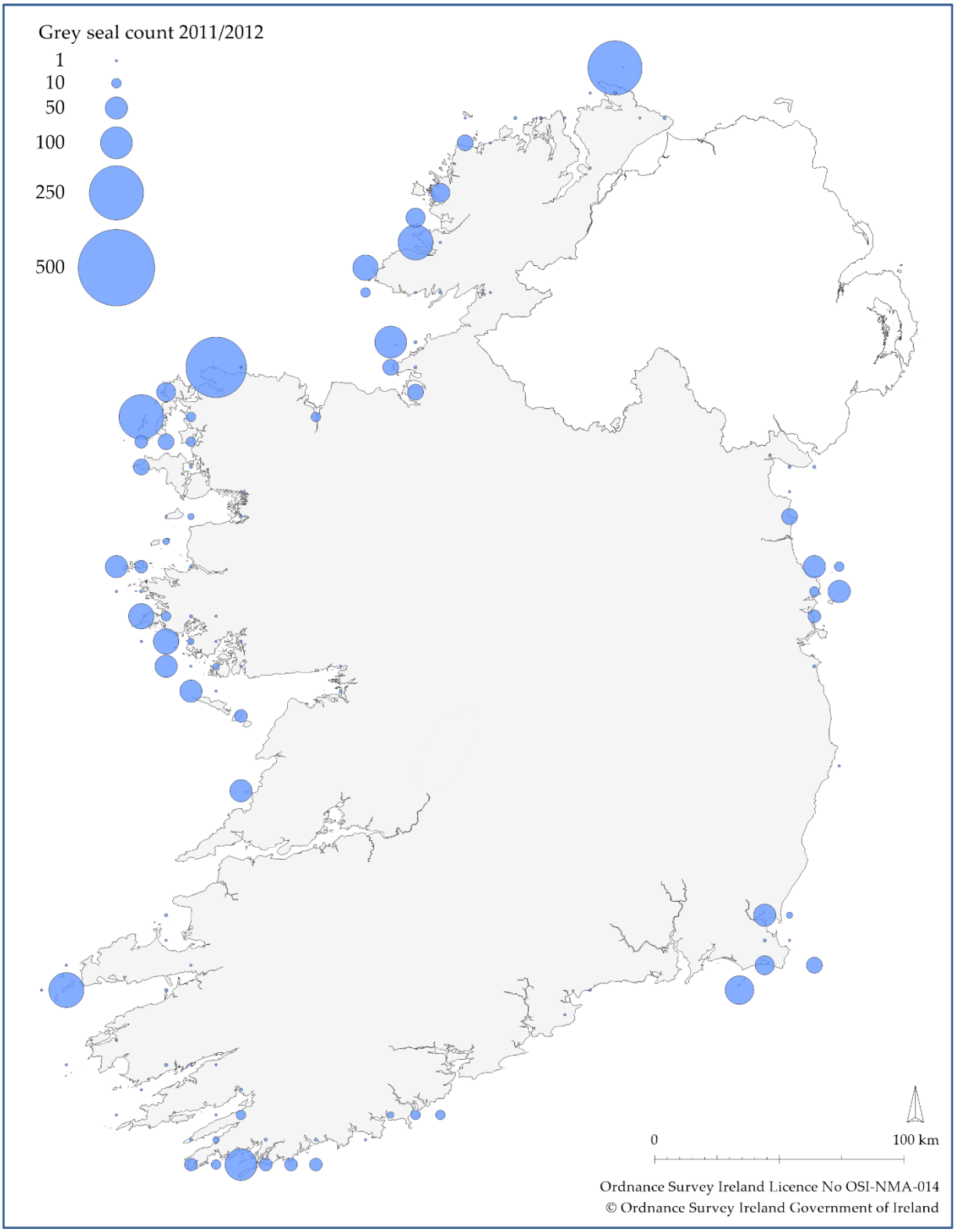

Figure 17 Distribution of Grey Seals in Ireland from aerial surveys carried out in August 2011/2012. Counts are aggregated by 10 km grid squares. Symbol size is in proportion to numbers counted with size guides given in the Legend (top left).

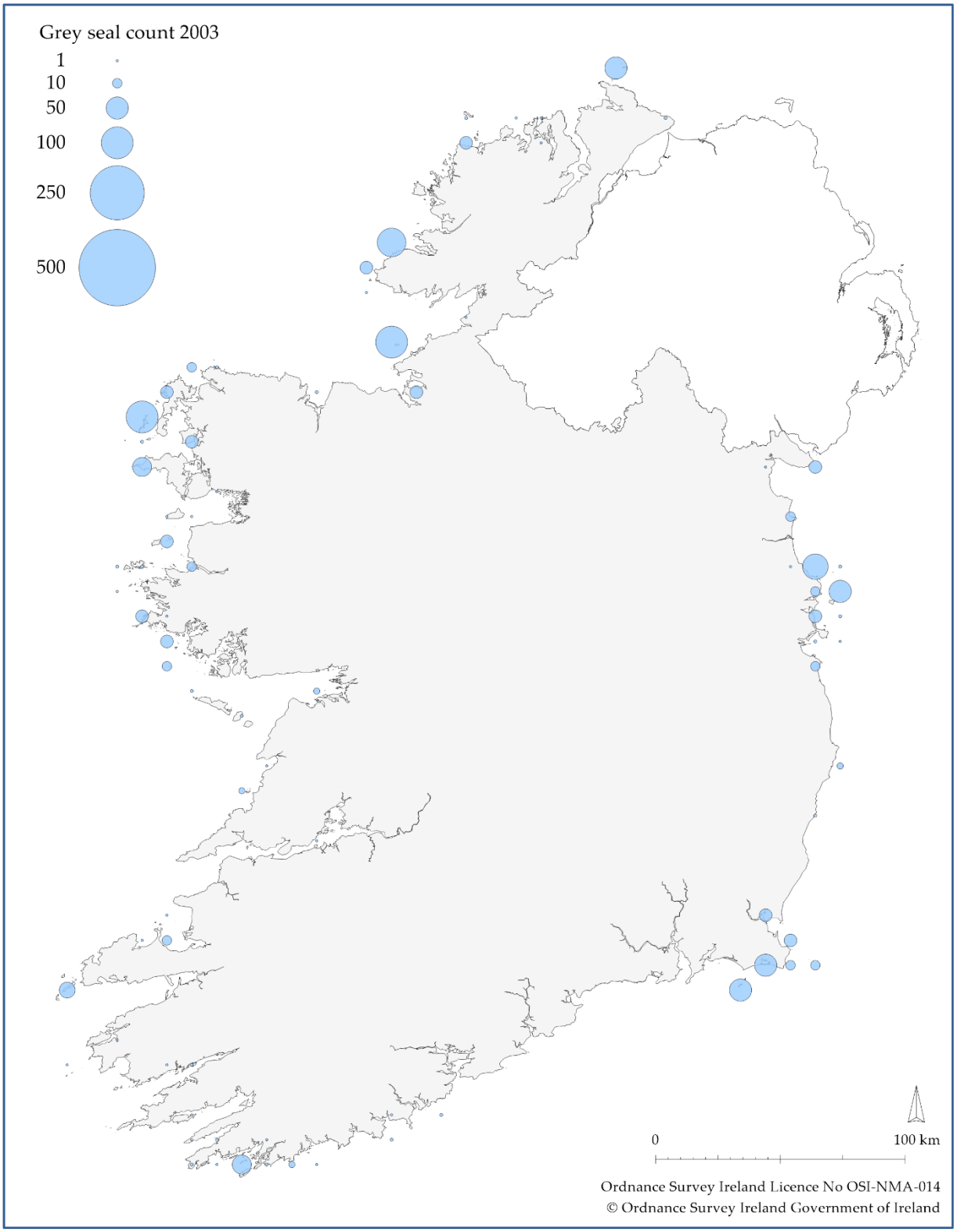

Figure 18 Distribution of Grey Seals in Ireland from aerial surveys carried out in August 2003. Counts are aggregated by 10 km grid squares. Symbol size is in proportion to numbers counted with size guides given in the Legend (top left).

3.2.1 National population trend analysis for Grey Seal

There were significant trends through the time series. The GAM, which was favoured by model selection, indicated that following rapid increases since the start of the time series (2003), the counts appear to have levelled off (Figure 19). Specifically, predicted abundance in 2024 was ~191% higher than in 2003 (95% CI: 156.6-228.7%). The estimated current (2023-2024) rate of change (-0.8% per annum) was not significant (95% CI: -2.2-0.8%).

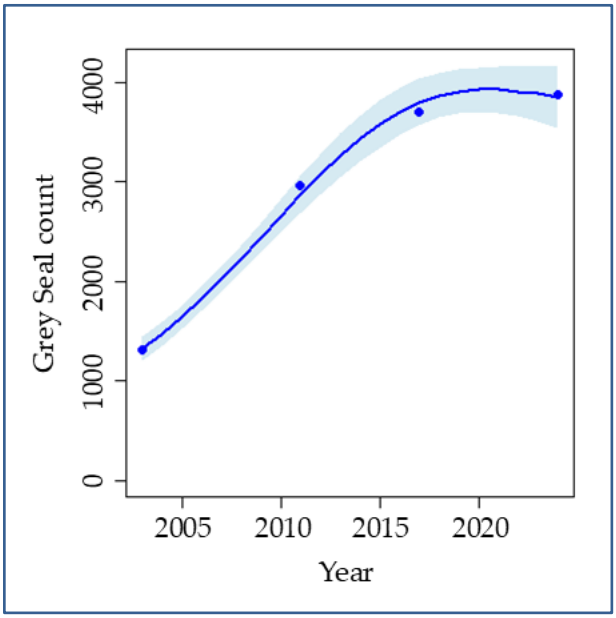

Figure 19 The predicted trend and associated 95% confidence intervals for Grey Seal August counts in Ireland estimated using a GAM. The points represent the values used to fit the trends.

4 Discussion

Harbour Seal haul-out counts conducted during the moult season are often used as a minimum population estimate, because the number of animals found on land tend to be higher and more consistent at this time of year (Thompson & Harwood, 1990; Russell *et al*., 2015). However, all animals are never onshore at the same time.

Day-to-day variability in haul-out numbers can be influenced by many different factors such as foraging conditions, tidal state and tidal range, wave action, and disturbance. In areas where suitable haul-out sites are accessible throughout the tidal cycle, local counts that underrepresent the true number of animals can also be due to seals choosing to haul out more during high water than low water. However, most haul-out sites are likely to be used mainly during low water, so this is not considered to be an issue for population monitoring at a large spatial scale.

Because most devices used to track the movements and behaviour of seals are glued to the animals' fur and drop off by or during the annual moult, data from such devices cannot be used to inform the proportion of the population available to count during the surveys. The estimated proportion of animals hauled-out during the August survey window, used here to scale the haul-out counts to population size, is based on data from flipper tags attached to 25 animals (Lonergan *et al*., 2013). Despite this relatively small sample size, the proportion of 0.72 (95% CI: 0.54-0.88) is within the range of estimates (0.65-0.81) produced by studies carried out in other countries (Harvey & Goley, 2011; Simpkins *et al*., 2003) and is a reasonable value to use for estimating total population size. Grey Seals are foraging during summer and often spend longer periods away from haul-out sites, which results in a much lower proportion of animals expected to be hauled-out during August surveys (0.252, 95% CI: 0.215-0.291; Russell & Carter, 2021). So even though more Harbour Seals were found onshore during the nationwide survey, the scaled counts suggest that around three times more Grey Seals than Harbour Seals used haul-out sites in Ireland in summer 2024.

For the nationwide trend analysis, the sample size available to fit the models was very small (n = 4). As such, the fitted trends likely encompass some day-to-day variation in counts rather than just the true trends in population abundance. This also means the day-to-day variability in counts is not being represented in the uncertainty estimates and thus confidence intervals are likely to be artificially tight. This is particularly pertinent for Grey Seals, for which the proportion of the population hauled out during the August survey windows is highly variable (Russell & Carter, 2021). The trends for both species should be considered in this context. For both species, the available data suggest that the national populations are currently stable, following increases that mainly occurred pre-2015. Adding new data points in future will increase robustness of the inferred trends and thus the confidence in the model outputs.

Genetic studies using Harbour Seal skin samples, collected in many different locations around the UK and along the European mainland, revealed the existence of two distinct Harbour Seal metapopulations, one in the southern North Sea (southeast England, France, The Wadden Sea) and one centred on Scotland. There were no data for Ireland in the study, but limited data from Northern Ireland, and the absence of Harbour Seals in Wales and South-west England indicated that Ireland was likely part of the latter metapopulation (Olsen *et al*., 2017; Carroll *et al*., 2020). However, a more recent study by Steinmetz *et al*. (2023) that focussed on Ireland concluded that some level of connectivity existed to both metapopulations. The same study confirmed Carroll *et al*.'s (2020) findings that the west of Scotland acts as a source population for the north of the island of Ireland (mainly based on samples from Northern Ireland). It also included a migration analysis indicating that the local Harbour Seal population in the north of Ireland and in Northern Ireland is a source population for both Southwest Ireland and East Ireland.

The five Irish regions used in the reporting of the nationwide surveys since 2017/2018 can be considered as monitoring units. Monitoring units are often subdivisions which are arbitrarily drawn based on natural breaks in a species distribution and can generally be covered within

the same survey session/day/month/year. However, even though most of the Harbour Seals found in different monitoring units are separated by significant distances (at least 65 km), and telemetry data from Southwest Ireland show that Harbour Seals generally tend to forage within 20 km of their haul-out site (Cronin & McConnell, 2008), this does not mean that these regions represent genetically distinct populations; individuals may move between regions, and pups tend to disperse more widely (Hanson *et al.*, 2013). Genetic analysis has revealed the presence of at least three genetically distinct local populations in Ireland (Steinmetz *et al*., 2023). The small local population encompassing the East and Southeast regions appears to have increased since the beginning of the time series. The local population encompassing the Southwest region and (parts of) the West region appears to be stable. The local population represented by the North region shows no clear trend over the time series though the last two surveys were higher than the first two.

In addition to the uncertainty around the proportion of animals onshore and available to count during a survey, it is also likely that an unknown number of hauled-out seals are missed during surveys. Even from an aerial view, a small number of animals can be hidden from sight, especially along complex coastlines characterised by sea cliffs, gullies, and rock formations of different shapes and sizes. Such locations are even harder to access and survey efficiently on foot or by boat. But large open areas can also pose challenges for obtaining reliable counts from ground or sea level, *e.g*. if a vantage point is far from the seals and at a similar elevation. A small number of ground counts conducted at the same time as the 2024 helicopter surveys produced markedly lower totals (NPWS, pers. comm., 13 Sep 2024). Although seals repeatedly haul out in very similar locations, they can (and often do) choose slightly different sites dependant on tidal state, weather conditions, disturbance events, or other unknown factors. This means that robust population monitoring relies on comprehensive surveys where most of the coast is actively searched. Although ground or boat-based counts and drone surveys can be ideal for monitoring seals in certain areas, conducting seal haul-out counts over larger regional or national spatial scales within an appropriate time frame still requires manned aerial surveys. Unless most seals in a study area are known to be found on sandbanks where they are less well camouflaged and more easily spotted by eye, such surveys should ideally be carried out using a highly manoeuvrable helicopter equipped with a camera system that has thermal imaging capabilities.

5 Bibliography & Relevant Literature

Banga, R., Russell, D.J.F., Carter, M.I.D., Chaudry, F., Gilles, A., Abel, C., Ahola, M., Authier, M., Bjørge, A., Brasseur, S., Carlsson, A., Carlstrom, J., Christensen, A.H., Dinis, A., Engene, N., Galatius, A., Geelhoed, S., Granquist, S., Haelters, J., Jess, A., Morris, C., Murphy, S., Ó Cadhla, O., Persson, S., Pierce, G., Poncet, S., Rosing-Asvid, A., Saavedra, C., Taylor, N., Teixeira, A., van Neer, A., Vasconcelos, R. & Vincent, C. (2022). Seal Abundance and Distribution. In: OSPAR, 2023: The 2023 Quality Status Report for the Northeast Atlantic. OSPAR Commission, London. Available at: https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/indicator-assessments/seal-abundance-and-distribution

Carroll, E.L., Hall, A., Olsen, M.T., Onoufriou, A.B., Gaggiotti, O.E. & Russell, D.J.F. (2020). Perturbation drives changing metapopulation dynamics in a top marine predator. *Proceedings of the Royal Society of London Series B: Biological Sciences,* vol. **287**, no. 1928, 20200318 . https://doi.org/10.1098/rspb.2020.0318

Carter, M. I. D., Boehme, L., Cronin, M. A., Duck, C. D., Grecian, W. J., Hastie, G. D., Jessopp, M., Matthiopoulos, J., McConnell, B. J., Miller, D. L., Morris, C. D., Moss, S. E. W., Thompson, D., Thompson, P. M., & Russell, D. J. F. (2022). Sympatric seals, satellite tracking and protected areas: habitat-based distribution estimates for conservation and management. Frontiers in Marine Science, **9**, [875869]. https://doi.org/10.3389/fmars.2022.875869

Council Directive 92/43/EEC (1992). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:31992L0043

Cronin, M., Duck, C.D., Ó Cadhla, O., Nairn, R., Strong, D., & O'Keeffe, C. (2004). An assessment of population size and distribution of harbour seals in the Republic of Ireland during the moult season in August 2003. *Irish Wildlife Manuals*, No. **11**. 34pp. National Parks & Wildlife Service, Department of Arts, Heritage & the Gaeltacht, Dublin.

Cronin, M., Duck, C.D, Ó Cadhla, O., Nairn, R., Strong, D., & O'Keeffe, C. (2007). An assessment of population size and distribution of harbour seals in the Republic of Ireland during the moult season in August 2003. *Journal of Zoology, London* **273**:131-139.

Cronin, M. & McConnell, B.J. (2008). SMS Seal: a new technique to measure haul-out behaviour in marine vertebrates. *Journal of Experimental Marine Biology and Ecology* **362**:43-48

Duck, C.D. & Morris, C.D. (2012). An aerial survey of harbour seals in Ireland: Part 1: Lough Foyle to Galway Bay. August 2011. Unpublished report to the National Parks & Wildlife Service, Department of Arts, Heritage & the Gaeltacht, Dublin.

Duck, C.D. & Morris, C.D. (2013). An aerial survey of harbour seals in Ireland: Part 2: Galway Bay to Carlingford Lough. August-September 2012. Unpublished report to the National Parks & Wildlife Service, Department of Arts, Heritage & the Gaeltacht, Dublin.

Ersts, P.J. [Internet] DotDotGoose (version 1.7.0). American Museum of Natural History, Center for Biodiversity and Conservation. Available from https://biodiversityinformatics.amnh.org/open_source/dotdotgoose. Accessed on 2024-05-24.

Hanson, N., Thompson, D., Duck, C., Moss, S. & Lonergan, M. (2013). Pup Mortality in a Rapidly Declining Harbour Seal (Phoca vitulina) Population. PLoS ONE **8**(11): e80727. doi:10.1371/journal.pone.0080727

Harvey, J.T. & Goley, D. (2011). Determining a correction factor for aerial surveys of harbor seals in California. *Marine Mammal Science*, **27**, 719-735.

Lonergan, M., Duck, C.D., Moss, S., Morris, C.D. & Thompson, D. (2013). Rescaling of aerial survey data with information from small numbers of telemetry tags to estimate the six of a declining harbour seal population. *Marine and Freshwater Ecosystems* **23**:135-144.

Minto, C., & Rakka, M. (2015). Power analysis to detect trends in haul-out counts of Harbour seals (*Phoca vitulina vitulina*) in Ireland. Statistical modelling and power analysis of NPWS Harbour seal monitoring data - Phase 2. Report to the National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin. Marine and Freshwater Research Centre, Galway-Mayo Institute of Technology, Galway.

Morris, C.D., & Duck, C.D. (2019). Aerial thermal-imaging survey of seals in Ireland, 2017 to 2018. *Irish Wildlife Manuals*, No. **111** National Parks and Wildlife Service, Department of Culture, Heritage and the Gaeltacht, Ireland.

NPWS (2012). Harbour seal pilot monitoring project, 2011. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin.

Ó Cadhla, O. & Strong, D. (2007). Grey seal moult population survey in the Republic of Ireland, 2007. Report to the National Parks & Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland. 22pp.

Ó Cadhla, O., Strong, D., O'Keeffe, C., Coleman, M., Cronin, M., Duck, C., Murray, T., Dower, P., Nairn, R., Murphy, P., Smiddy, P., Saich, C.,

Lyons, D. & Hiby, A.R. (2007). An assessment of the breeding population of grey seals in the Republic of Ireland, 2005. *Irish Wildlife Manuals*, No. **34**. National Parks & Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin. 60pp.

Ó Cadhla, O., Keena, T., Strong, D., Duck, C. & Hiby, L. (2013) Monitoring of the breeding population of grey seals in Ireland, 2009 - 2012. *Irish Wildlife Manuals*, No. **74**. National Parks and Wildlife Service, Department of the Arts, Heritage and the Gaeltacht, Dublin, Ireland.

Olsen, M.T., Islas, V., Graves, J.A., Onoufriou, A., Vincent, C., Brasseur, S., Frie, A.K. & Hall, A.J. (2017). Genetic population structure of harbour seals in the United Kingdom and neighbouring waters. *Aquatic Conservation: Marine and Freshwater Ecosystems*, **27**, 839-845.

Rakka, M. & Minto, C. (2015). An investigation of the effects of environmental and observational variables on haul-out counts of Harbour seals (*Phoca vitulina vitulina*) in Ireland. Unpublished report to the National Parks & Wildlife Service, Department of Arts, Heritage & the Gaeltacht, Dublin.

Russell, D.J.F., McClintock, B.T., Matthiopoulos, J., Thompson, P.M., Thompson, D., Hammond, P.S., Jones, E.L., MacKenzie, M.L., Moss, S. & McConnell, B.J. (2015). Intrinsic and extrinsic drivers of activity budgets in sympatric grey and harbour seals. *Oikos*, **124**, 1462-1472.

Russell, D.J.F. & Carter, M. (2021). Grey seal independent estimate scalar: converting counts to population estimates. SCOS Briefing Paper 2021/02. Available at: http://www.smru.st-andrews.ac.uk/files/2022/08/SCOS-2021.pdf pp 186-195.

Russell, D.J.F., Duck, C.D., Morris, C.D., Riddoch N.G. & Thompson, D. (2024). Trends in seal abundance and grey seal pup production. Sea Mammal Research Unit, SCOS BP 24/03.

SCOS (2024) Scientific advice on matters related to the management of seal populations: 2024. Natural Environmental Research Council, Sea Mammal Research Unit. University of St Andrews, St Andrews.

Simpkins, M.A., Withrow, D.E., Cesarone, J.C. & Boveng, P.L. (2003). Stability in The Proportion of Harbor Seals Hauled Out Under Locally Ideal Conditions. *Marine Mammal Science*, **19**, 791-805.

Steinmetz, K., Murphy, S., Cadhla, O.Ó., Carroll, E.L., Onoufriou, A.B., Russell, D.J.F., Cronin, M. & Mirimin, L. (2023). Population structure and genetic connectivity reveals distinctiveness of Irish harbour seals (*Phoca vitulina*) and implications for conservation management. *Aquatic Conservation: Marine and Freshwater Ecosystems*, **33**(2), 160–178. https://doi.org/10.1002/aqc.3909

Thompson, D., Duck, C.D., Morris, C.D. & Russell, D.J.F. (2019). The status of harbour seals (*Phoca vitulina*) in the UK. *Aquatic Conservation: Marine and Freshwater Ecosystems* **29**(S1):40–60.

Thompson, P. & Rothery, P. (1987). Age and sex differences in the timing of moult in the common seal, *Phoca vitulina*. *Journal of Zoology*, **212**: 597-603.

Thompson, P.M. & Harwood, J. (1990). Methods for estimating the population size of common seals, *Phoca vitulina*. *Journal of Applied Ecology*, **27**, 924-938.

npws.ie

National Parks and Wildlife Service

Rialtas na hÉireann
Government of Ireland