Apportioning in the non-breeding season - Case study 1

UKCEH and BioSS

24 August 2023

Summary

This report presents the apportioning of common guillemot in the UK in the non-breeding season (August to February) based on the uploaded footprint. The footprint was in the UK North Sea waters and Channel BDMPS region and had an area of 158 km^2. The number of guillemots in the footprint was estimated to be 303.8 (147.2, 611) with numbers in brackets the lower and upper 95% confidence intervals. The total bird density within the footprint was estimated to be 1.93 (0.93, 3.87) km^{-2}. In total, 5 BDMPS colonies and 34 colonies that used geolocator-based utilisation distributions contributed to the apportioning calculations.

The accompanying User Guide to this tool describes the methods used to estimate bird metrics within the footprint, and a full description of the geolocator (GLS) data is available in the WP3 report associated with this project. Briefly, tracked colonies are defined as those colonies where guillemots were tracked using geolocator (GLS) tags and so a utilisation distribution could be estimated to characterise space use in the non-breeding season. Untracked colonies are defined as those colonies that were within the user-defined distance threshold of 270 km of at least one tracked colony, calculated using at-sea distance. Based on the assumption that colonies that are nearer are more similar, utilisation distributions for untracked colonies were derived using weightings based on distance from tracked colonies. Tracked colonies that were closer to an untracked colony have a higher weighting than tracked colonies that are further away. Finally, if no tracked colonies are within 270 km of an untracked colony, BDMPS is used to calculate apportioning for the untracked colony (defined as a BDMPS colony).

Table 1 shows all tracked colonies and the number of geolocator tags that were successfully retrieved over three seasons between 2018 and 2021.

Table 1: Geolocator tag sample sizes for tracked colonies

Colony	UK SPA code	Sample size
Buchan Ness to Collieston Coast	UK9002491	82
Canna and Sanday	UK9001431	69
East Caithness Cliffs	UK9001182	78
Fair Isle	UK9002091	20
Forth Islands	UK9004171	68
Foula	UK9002061	13
North Colonsay and Western Cliffs	UK9003171	52
Treshnish Isles	UK9003041	33
Ynys Seiriol / Puffin Island	UK9020285	6

User inputs

Table 2 shows the user-defined inputs to the analysis. If the uploaded footprint was located in more than one BDMPS region, the table shows the region chosen by the user. If the footprint was located only in one BDMPS region, this region is automatically chosen in the ANBS tool run.

Table 2: Input parameter values for ANBS tool run

Parameter description	Parameter value
Species	Guillemot
Mode	footprint
BDMPS uncertainty scalar	1.5
Distance threshold (km)	270
Season	non-breeding season (August to February)
Months	January, February, August, September, October, November, December
BDMPS Region	UK North Sea waters and Channel

Table 3 shows colonies that are defined from the BDMPS populations and the size (number of pairs of breeding adults) of each population, whether a UK SPA, aggregate of UK non-SPA colonies, or aggregate of overseas colonies. In the ANBS tool, the number of pairs of breeding adults can be

changed for any colony as part of the inputs so the table shows the population estimates used in the analysis.

Table 3: Input parameter values for ANBS tool run

Colony or population	Estimated pairs of breeding adults
Ailsa Craig SPA	5247
Buchan Ness to Collieston Coast SPA	12928
Calf of Eday SPA	6300
Canna and Sanday SPA	3913
Cape Wrath SPA	27359
Copinsay SPA	5607
East Caithness Cliffs SPA	106500
Fair Isle SPA	13066
Farne Islands SPA	33532
Faroe Islands	100000
Flamborough and Filey Coast SPA	39641
Flannan Isles SPA	9807
Forth Islands SPA	14674
Foula SPA	16615
Fowlsheugh SPA	30100
Germany and Denmark	5000
Handa SPA	37993
Hermaness; Saxavord and Valla Field SPA	4620
Hoy SPA	6300
Marwick Head SPA	11097
Mingulay and Berneray SPA	13527
North Caithness Cliffs SPA	47000
North Colonsay and western cliffs SPA	13500
North Rona and Sula Sgeir SPA	5000
North Sea UK non-SPA populations	147000
Norway	100000
Noss SPA	14783
Rathlin Island SPA	87398

Table 3: Input parameter values for ANBS tool run *(continued)*

Colony or population	Estimated pairs of breeding adults
Rousay SPA	6200
Rum SPA	1644
Shiant Isles SPA	5148
Skomer and Skokholm SPA	16300
St Abbs Head to Fast Castle SPA	22103
St Kilda SPA	15700
Sule Skerry and Sule Stack SPA	7633
Sumburgh SPA	4762
Troup; Pennan and Lions Heads SPS	10938
UK North Sea non-SPA populations	147000
UK West coast non-SPA populations	79000
West coast UK non-SPA populations	79000
West Westray SPA	33900

Results

Apportioning tables

Table 4 shows the colonies and populations used in the apportioning calculations for the area of the specified footprint (158 km^2).

Table 4: Colonies or populations used in the apportioning calculations, showing the number of adults, adults per sq. km, and proportion of adults from each colony or population, all with 95% CIs. (*) denotes a BDMPS colony or population. All other colonies are either GLS tracked or untracked

Colony or population	Number of adults (95% CIs)	Adults per sq. km (95% CIs)	Proportion of adults (95% CIs)
UK North Sea non-SPA populations*	124.6 (40, 316.2)	0.789 (0.254, 2.004)	0.383 (0.193, 0.614)

Table 4: Colonies or populations used in the apportioning calculations, showing the number of adults, adults per sq. km, and proportion of adults from each colony or population, all with 95% CIs. (*) denotes a BDMPS colony or population. All other colonies are either GLS tracked or un-tracked *(continued)*

Colony or population	Number of adults (95% CIs)	Adults per sq. km (95% CIs)	Proportion of adults (95% CIs)
East Caithness Cliffs SPA	29.9 (28.7, 31.1)	0.189 (0.182, 0.197)	0.104 (0.057, 0.137)
Flamborough and Filey Coast SPA	16.7 (12.8, 18.8)	0.106 (0.081, 0.119)	0.058 (0.032, 0.085)
Farne Islands SPA	12.8 (4.4, 16)	0.081 (0.028, 0.101)	0.044 (0.017, 0.071)
Rathlin Island SPA	11.8 (6.7, 27.1)	0.075 (0.043, 0.171)	0.039 (0.018, 0.102)
North Caithness Cliffs SPA	10.5 (3.9, 21.8)	0.067 (0.025, 0.138)	0.036 (0.012, 0.088)
Faroe Islands*	10.4 (3.5, 25.6)	0.066 (0.022, 0.162)	0.036 (0.012, 0.085)
Fowlsheugh SPA	9.1 (2.8, 14.2)	0.058 (0.018, 0.09)	0.031 (0.009, 0.058)
St Abbs Head to Fast Castle SPA	8.3 (3, 10.5)	0.053 (0.019, 0.066)	0.029 (0.011, 0.045)
Forth Islands SPA	6.8 (6.6, 7)	0.043 (0.042, 0.044)	0.024 (0.013, 0.032)
Handa SPA	6.6 (2.9, 13)	0.042 (0.018, 0.082)	0.023 (0.008, 0.05)
West Westray SPA	6.2 (3, 11.5)	0.039 (0.019, 0.073)	0.022 (0.009, 0.049)
Norway*	5.7 (1.7, 16.3)	0.036 (0.011, 0.103)	0.019 (0.006, 0.05)
Cape Wrath SPA	4.7 (2.2, 9.3)	0.03 (0.014, 0.059)	0.016 (0.005, 0.036)
Skomer and Skokholm SPA	4.6 (4, 5.1)	0.029 (0.026, 0.032)	0.016 (0.009, 0.023)
Buchan Ness to Collieston Coast SPA	4.3 (4.1, 4.4)	0.027 (0.026, 0.028)	0.015 (0.008, 0.02)
Troup; Pennan and Lions Heads SPS	2.8 (1, 5.1)	0.018 (0.007, 0.032)	0.01 (0.003, 0.02)
UK West coast non-SPA populations*	2.7 (0.6, 6.8)	0.017 (0.004, 0.043)	0.009 (0.002, 0.027)
Noss SPA	2.4 (1.6, 4.9)	0.015 (0.01, 0.031)	0.009 (0.004, 0.019)
Marwick Head SPA	2.2 (1, 4.5)	0.014 (0.006, 0.028)	0.008 (0.003, 0.016)
Foula SPA	1.9 (1.7, 2.1)	0.012 (0.011, 0.013)	0.007 (0.004, 0.009)

Table 4: Colonies or populations used in the apportioning calculations, showing the number of adults, adults per sq. km, and proportion of adults from each colony or population, all with 95% CIs. (*) denotes a BDMPS colony or population. All other colonies are either GLS tracked or un-tracked *(continued)*

Colony or population	Number of adults (95% CIs)	Adults per sq. km (95% CIs)	Proportion of adults (95% CIs)
Fair Isle SPA	1.7 (1.6, 1.9)	0.011 (0.01, 0.012)	0.006 (0.003, 0.008)
St Kilda SPA	1.5 (1.2, 4.3)	0.01 (0.007, 0.027)	0.005 (0.003, 0.015)
Mingulay and Berneray SPA	1.5 (1, 3.8)	0.009 (0.007, 0.024)	0.005 (0.002, 0.015)
Sule Skerry and Sule Stack SPA	1.4 (0.6, 2.6)	0.009 (0.004, 0.016)	0.005 (0.002, 0.011)
Hoy SPA	1.3 (0.5, 3)	0.008 (0.003, 0.019)	0.005 (0.001, 0.011)
Calf of Eday SPA	1.3 (0.6, 2.9)	0.008 (0.004, 0.019)	0.005 (0.001, 0.012)
Copinsay SPA	1.2 (0.5, 2.6)	0.008 (0.003, 0.016)	0.004 (0.002, 0.01)
Rousay SPA	1.2 (0.5, 2.9)	0.007 (0.003, 0.018)	0.004 (0.001, 0.009)
Germany and Denmark*	1.1 (0.3, 2.9)	0.007 (0.002, 0.018)	0.004 (0.001, 0.011)
North Colonsay and western cliffs SPA	1.1 (1, 1.1)	0.007 (0.006, 0.007)	0.004 (0.002, 0.005)
Flannan Isles SPA	1 (0.7, 2.8)	0.006 (0.005, 0.018)	0.003 (0.002, 0.01)
Sumburgh SPA	0.9 (0.4, 2.2)	0.006 (0.003, 0.014)	0.003 (0.001, 0.009)
North Rona and Sula Sgeir SPA	0.8 (0.4, 1.7)	0.005 (0.003, 0.01)	0.003 (0.001, 0.006)
Ailsa Craig SPA	0.8 (0.4, 1.6)	0.005 (0.003, 0.01)	0.003 (0.001, 0.006)
Hermaness; Saxavord and Valla Field SPA	0.7 (0.5, 1.5)	0.005 (0.003, 0.01)	0.003 (0.001, 0.006)
Shiant Isles SPA	0.7 (0.4, 1.6)	0.004 (0.003, 0.01)	0.002 (0.001, 0.006)
Canna and Sanday SPA	0.4 (0.3, 0.4)	0.002 (0.002, 0.002)	0.001 (0.001, 0.002)
Rum SPA	0.2 (0.1, 0.2)	0.001 (0.001, 0.001)	0.001 (0, 0.001)

Table 5 shows the colonies and populations used in the cumulative apportioning calculations for the area of the specified footprint (158 km^2).

Table 5: Colonies or populations used in the apportioning calculations, showing the cumulative number of adults (95% CIs), cumulative adults per sq. km (95% CIs), and cumulative proportion of adults. (*) denotes a BDMPS colony or population. All other colonies are either GLS tracked or untracked

Colony or population	Cumulative number of adults (95% CIs)	Cumulative adults per sq. km (95% CIs)	Cumulative proportion of adults
UK North Sea non-SPA populations*	124.6 (40, 316.2)	0.79 (0.25, 2)	0.38
East Caithness Cliffs SPA	154.5 (68.7, 347.2)	0.98 (0.44, 2.2)	0.49
Flamborough and Filey Coast SPA	171.1 (81.5, 366.1)	1.08 (0.52, 2.32)	0.54
Farne Islands SPA	184 (85.9, 382)	1.17 (0.54, 2.42)	0.59
Rathlin Island SPA	195.8 (92.6, 409.1)	1.24 (0.59, 2.59)	0.63
North Caithness Cliffs SPA	206.3 (96.5, 430.9)	1.31 (0.61, 2.73)	0.66
Faroe Islands*	216.7 (99.9, 456.5)	1.37 (0.63, 2.89)	0.70
Fowlsheugh SPA	225.8 (102.7, 470.6)	1.43 (0.65, 2.98)	0.73
St Abbs Head to Fast Castle SPA	234.1 (105.7, 481.1)	1.48 (0.67, 3.05)	0.76
Forth Islands SPA	240.9 (112.3, 488.1)	1.53 (0.71, 3.09)	0.78
Handa SPA	247.5 (115.1, 501.1)	1.57 (0.73, 3.18)	0.81
West Westray SPA	253.7 (118.1, 512.6)	1.61 (0.75, 3.25)	0.83
Norway*	259.5 (119.7, 528.9)	1.64 (0.76, 3.35)	0.85
Cape Wrath SPA	264.2 (121.9, 538.2)	1.67 (0.77, 3.41)	0.86
Skomer and Skokholm SPA	268.8 (125.9, 543.3)	1.7 (0.8, 3.44)	0.88
Buchan Ness to Collieston Coast SPA	273.1 (130, 547.7)	1.73 (0.82, 3.47)	0.89
Troup; Pennan and Lions Heads SPS	275.9 (131.1, 552.8)	1.75 (0.83, 3.5)	0.90
UK West coast non-SPA populations*	278.6 (131.7, 559.6)	1.77 (0.83, 3.55)	0.91
Noss SPA	281 (133.3, 564.5)	1.78 (0.84, 3.58)	0.92

Table 5: Colonies or populations used in the apportioning calculations, showing the cumulative number of adults (95% CIs), cumulative adults per sq. km (95% CIs), and cumulative proportion of adults. (*) denotes a BDMPS colony or population. All other colonies are either GLS tracked or untracked *(continued)*

Colony or population	Cumulative number of adults (95% CIs)	Cumulative adults per sq. km (95% CIs)	Cumulative proportion of adults
Marwick Head SPA	283.3 (134.3, 569)	1.8 (0.85, 3.61)	0.93
Foula SPA	285.1 (136, 571.1)	1.81 (0.86, 3.62)	0.94
Fair Isle SPA	286.9 (137.6, 572.9)	1.82 (0.87, 3.63)	0.94
St Kilda SPA	288.4 (138.8, 577.2)	1.83 (0.88, 3.66)	0.95
Mingulay and Berneray SPA	289.9 (139.8, 581)	1.84 (0.89, 3.68)	0.95
Sule Skerry and Sule Stack SPA	291.3 (140.4, 583.6)	1.85 (0.89, 3.7)	0.96
Hoy SPA	292.6 (141, 586.6)	1.85 (0.89, 3.72)	0.96
Calf of Eday SPA	293.9 (141.5, 589.5)	1.86 (0.9, 3.74)	0.97
Copinsay SPA	295.1 (142, 592.1)	1.87 (0.9, 3.75)	0.97
Rousay SPA	296.2 (142.6, 594.9)	1.88 (0.9, 3.77)	0.97
Germany and Denmark*	297.3 (142.9, 597.8)	1.88 (0.91, 3.79)	0.98
North Colonsay and western cliffs SPA	298.4 (143.9, 599)	1.89 (0.91, 3.8)	0.98
Flannan Isles SPA	299.4 (144.6, 601.8)	1.9 (0.92, 3.81)	0.98
Sumburgh SPA	300.3 (145, 604)	1.9 (0.92, 3.83)	0.99
North Rona and Sula Sgeir SPA	301.1 (145.4, 605.6)	1.91 (0.92, 3.84)	0.99
Ailsa Craig SPA	301.9 (145.8, 607.2)	1.91 (0.92, 3.85)	0.99
Hermaness; Saxavord and Valla Field SPA	302.6 (146.3, 608.8)	1.92 (0.93, 3.86)	1.00
Shiant Isles SPA	303.3 (146.7, 610.4)	1.92 (0.93, 3.87)	1.00
Canna and Sanday SPA	303.7 (147, 610.8)	1.92 (0.93, 3.87)	1.00
Rum SPA	303.8 (147.2, 611)	1.93 (0.93, 3.87)	1.00

RAG status

Fig. 1 shows colonies that contribute to the final apportioning in the analysis. Some colonies were further than the distance threshold (270 km) from any tracked colony. For these colonies, BDMPS apportioning was used (red circles). Colonies that were within the distance threshold (270 km) from one of more tracked colony had their utilisation distributions derived from those tracked colonies (amber). Tracked colonies were listed in the BDMPS data as UK SPAs contributed to the apportioning (green). Tracked colonies listed in the BDMPS data as UK non-SPAs for common guillemot were used in the apportioning through contributing to the utilisation distributions of untracked colonies (light green).
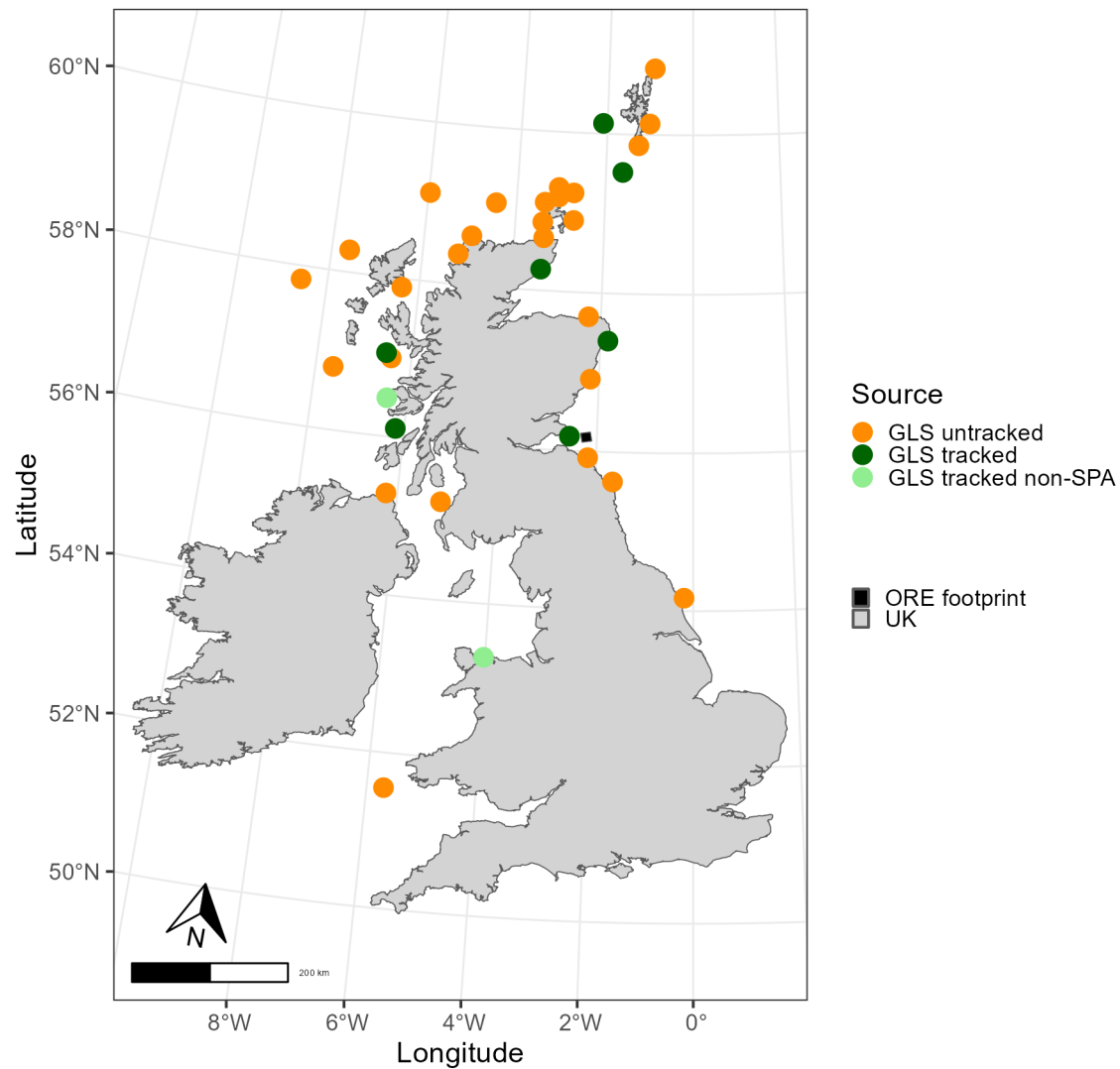
Figure 1: RAG status map showing colonies used in the analysis. Red = BDMPS, Amber = GLS untracked, Green = GLS tracked, Light Green = GLS tracked non-SPA

Apportioning maps

Colonies contributing most to apportioning

Figs. 2 and 3 show the two GLS colonies that contribute highest to the apportioning of guillemot in the non-breeding season (August to February) for the specified footprint. For the purposes of visualisation, the spatial extent of the bird density maps was slightly reduced.
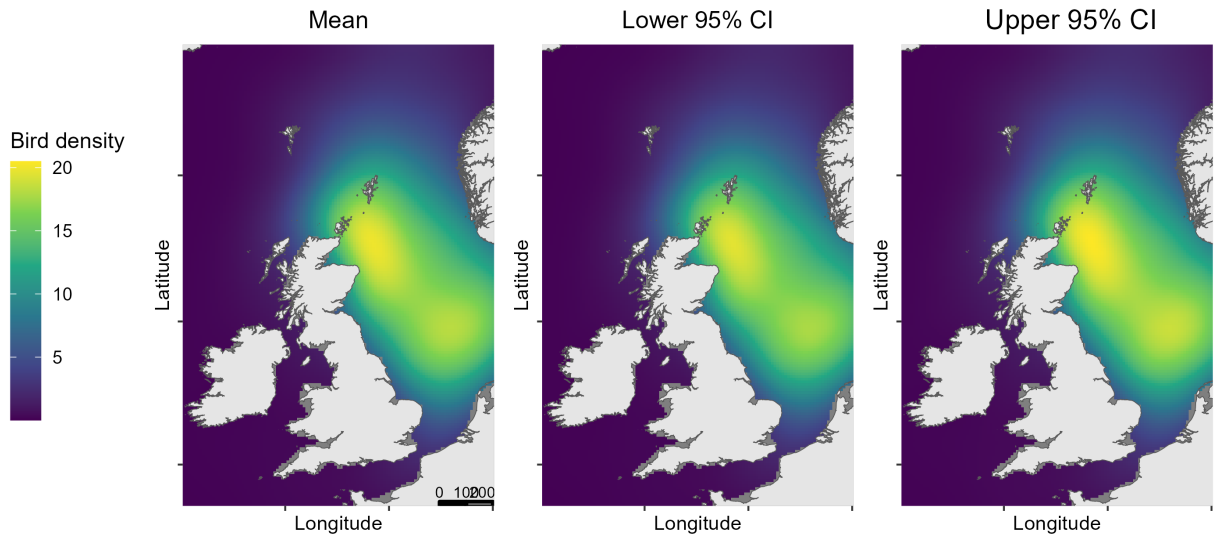
East Caithness Cliffs SPA

Figure 2: Maps showing colony East Caithness Cliffs SPA. The utilisation distributions are shown for estimated population mean (L), lower 95% CI (C), and upper 95% CI (R). Bird density can be interpreted as the expected number of adult breeding birds per 10 sq. km
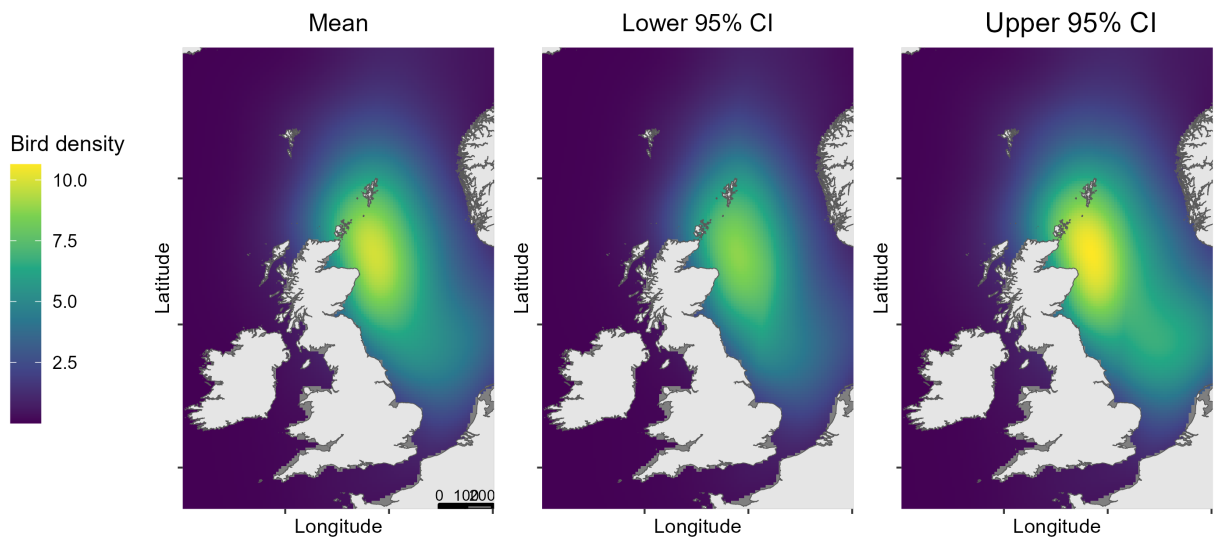
Flamborough and Filey Coast SPA

Figure 3: Maps showing colony Flamborough and Filey Coast SPA. The utilisation distributions are shown for estimated population mean (L), lower 95% CI (C), and upper 95% CI (R). Bird density can be interpreted as the expected number of adult breeding birds per 10 sq. km

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Caveats and limitations

- Currently, only adult breeding birds are considered within the apportioning calculation. Immature birds and non-breeding adults are not considered in this iteration of the ANBS tool.
- Tracked colonies that were not listed in the BDMPS data as UK SPAs for common guillemot (Fig. 1), were used in the apportioning calculations by contributing part of their utilisation distributions to untracked colonies within the distance threshold (270 km). However, those tracked colonies were not in themselves included in the apportioning calculations, in order to avoid double counting since they are assumed to be included within the aggregations of UK non-SPA colonies listed in BDMPS. Therefore, they do not appear in Tables 4 and 5.
- The specified footprint must be within the UK EEZ (and therefore, by default within the BDMPS regions).
- If the specified footprint was located within both BDMPS regions (UK Western Waters and UK North Sea Waters and Channel), the BDMPS region was selected by the user.

Apppendix

System information used in the analysis

The information below shows the system information used in the analysis including the version of R, platform, locale, and packages with version numbers.

R version 4.2.2 (2022-10-31 ucrt)

Platform: x86_64-w64-mingw32/x64 (64-bit)

locale: *LC_COLLATE=English_United Kingdom.1252, LC_CTYPE=English_United Kingdom.1252, LC_MONETARY=English_United Kingdom.1252, LC_NUMERIC=C* and *LC_TIME=English_United Kingdom.1252*

attached base packages: *grid, stats, graphics, grDevices, utils, datasets, methods* and *base*

other attached packages: *tictoc(v.1.1), pander(v.0.6.5), formatR(v.1.14), ggsn(v.0.5.0), ggspatial(v.1.1.7), svDialogs(v.1.1.0), patchwork(v.1.1.2), tinytex(v.0.44), kableExtra(v.1.3.4), stringr(v.1.5.0), devtools(v.2.4.5), usethis(v.2.1.6), ggplot2(v.3.4.1), rgeos(v.0.6-2), gdistance(v.1.6), Matrix(v.1.5-3), igraph(v.1.4.1), raster(v.3.6-20), sp(v.1.6-0), sf(v.1.0-12), terra(v.1.7-18), knitr(v.1.42), rmarkdown(v.2.21), rstudioapi(v.0.14)* and *pacman(v.0.5.1)*

loaded via a namespace (and not attached): *bitops(v.1.0-7), fs(v.1.6.1), webshot(v.0.5.4), httr(v.1.4.5), tools(v.4.2.2), profvis(v.0.3.7), bslib(v.0.4.2), rgdal(v.1.6-5), utf8(v.1.2.3), R6(v.2.5.1),*

KernSmooth(v.2.23-20), DBI(v.1.1.3), colorspace(v.2.1-0), urlchecker(v.1.0.1), withr(v.2.5.0), tidyselect(v.1.2.0), prettyunits(v.1.1.1), processx(v.3.8.0), compiler(v.4.2.2), textshaping(v.0.3.6), cli(v.3.6.1), rvest(v.1.0.3), xml2(v.1.3.3), labeling(v.0.4.2), svGUI(v.1.0.1), sass(v.0.4.5), scales(v.1.2.1), classInt(v.0.4-9), callr(v.3.7.3), proxy(v.0.4-27), systemfonts(v.1.0.4), digest(v.0.6.31), foreign(v.0.8-84), svglite(v.2.1.1), jpeg(v.0.1-10), pkgconfig(v.2.0.3), htmltools(v.0.5.5), sessioninfo(v.1.2.2), fastmap(v.1.1.1), htmlwidgets(v.1.6.2), rlang(v.1.1.0), shiny(v.1.7.4), farver(v.2.1.1), jquerylib(v.0.1.4), generics(v.0.1.3), jsonlite(v.1.8.4), dplyr(v.1.1.1), magrittr(v.2.0.3), Rcpp(v.1.0.10), munsell(v.0.5.0), fansi(v.1.0.4), lifecycle(v.1.0.3), stringi(v.1.7.12), yaml(v.2.3.7), pkgbuild(v.1.4.0), plyr(v.1.8.8), maptools(v.1.1-6), parallel(v.4.2.2), promises(v.1.2.0.1), crayon(v.1.5.2), miniUI(v.0.1.1.1), lattice(v.0.20-45), ps(v.1.7.3), pillar(v.1.9.0), codetools(v.0.2-19), pkgload(v.1.3.2), glue(v.1.6.2), evaluate(v.0.20), remotes(v.2.4.2), png(v.0.1-8), vctrs(v.0.6.1), httpuv(v.1.6.9), RgoogleMaps(v.1.4.5.3), gtable(v.0.3.3), purrr(v.1.0.1), tidyr(v.1.3.0), cachem(v.1.0.7), xfun(v.0.38), mime(v.0.12), xtable(v.1.8-4), e1071(v.1.7-13), later(v.1.3.0), ragg(v.1.2.5), viridisLite(v.0.4.1), class(v.7.3-21), tibble(v.3.2.1), memoise(v.2.0.1), units(v.0.8-1), ggmap(v.3.0.2) and *ellipsis(v.0.3.2)*

Apportioning in the non-breeding season - Case study 2

UKCEH and BioSS

24 August 2023

Summary

This report presents the apportioning of razorbill in the UK in the migration seasons (August to October; and January to March) based on the uploaded footprint. The footprint was in the UK North Sea waters and Channel BDMPS region and had an area of $329\,\text{km}^2$. The number of razorbills in the footprint was estimated to be 281.5 (174.1, 437.9) with numbers in brackets the lower and upper 95% confidence intervals. The total bird density within the footprint was estimated to be 0.85 (0.53, 1.33) km^{-2}. In total, 9 BDMPS colonies and 19 colonies that used geolocator-based utilisation distributions contributed to the apportioning calculations.

The accompanying User Guide to this tool describes the methods used to estimate bird metrics within the footprint, and a full description of the geolocator (GLS) data is available in the WP3 report associated with this project. Briefly, tracked colonies are defined as those colonies where razorbills were tracked using geolocator (GLS) tags and so a utilisation distribution could be estimated to characterise space use in the non-breeding season. Untracked colonies are defined as those colonies that were within the user-defined distance threshold of 150 km of at least one tracked colony, calculated using at-sea distance. Based on the assumption that colonies that are nearer are more similar, utilisation distributions for untracked colonies were derived using weightings based on distance from tracked colonies. Tracked colonies that were closer to an untracked colony have a higher weighting than tracked colonies that are further away. Finally, if no tracked colonies are within 150 km of an untracked colony, BDMPS is used to calculate apportioning for the untracked colony (defined as a BDMPS colony).

Table 1 shows all tracked colonies and the number of geolocator tags that were successfully retrieved over three seasons between 2018 and 2021.

Table 1: Geolocator tag sample sizes for tracked colonies

Colony	UK SPA code	Sample size
Buchan Ness to Collieston Coast	UK9002491	13
Canna and Sanday	UK9001431	22
East Caithness Cliffs	UK9001182	24
Fair Isle	UK9002091	13
Farne Islands	UK9006021	5
Forth Islands	UK9004171	21
Pentland Firth Islands	UK9001131	18
Shiant Isles	UK9001041	13
Treshnish Isles	UK9003041	13

User inputs

Table 2 shows the user-defined inputs to the analysis. If the uploaded footprint was located in more than one BDMPS region, the table shows the region chosen by the user. If the footprint was located only in one BDMPS region, this region is automatically chosen in the ANBS tool run.

Table 2: Input parameter values for ANBS tool run

Parameter description	Parameter value
Species	Razorbill
Mode	footprint
BDMPS uncertainty scalar	1.5
Distance threshold (km)	150
Season	migration seasons (August to October; and January to March)
Months	January, February, March, August, September, October
BDMPS Region	UK North Sea waters and Channel

Table 3 shows colonies that are defined from the BDMPS populations and the size (number of pairs of breeding adults) of each population, whether a UK SPA, aggregate of UK non-SPA colonies, or aggregate of overseas colonies. In the ANBS tool, the number of pairs of breeding adults can be

changed for any colony as part of the inputs so the table shows the population estimates used in the analysis.

Table 3: Input parameter values for ANBS tool run

Colony or population	Estimated pairs of breeding adults
Cape Wrath	2090
Denmark; Finland; Sweden	16000
East Caithness Cliffs	12500
Fair Isle	915
Faroe	4500
Flamborough and Filey	10001
Flannan Islands	1051
Forth Islands	2625
Foula	375
Fowlsheugh	3524
France	25
Handa	5165
Iceland	315400
Ireland	17000
Mingulay and Berneray	10111
North Caithness Cliffs	1700
North Rona and Sula Sgeir	1089
Norway	30300
Rathlin Island	15393
Russia	3500
Shiants	4248
Skomer and Skokholm	6001
St Abbs to Fast Castle	1219
St Kilda	1700
Troup; Pennan and Lions	1743
UK North Sea non-SPA colonies	10000
UK Western non-SPA colonies	10000

Results

Apportioning tables

Table 4 shows the colonies and populations used in the apportioning calculations for the area of the specified footprint (329 km^2).

Table 4: Colonies or populations used in the apportioning calculations, showing the number of adults, adults per sq. km, and proportion of adults from each colony or population, all with 95% CIs. (*) denotes a BDMPS colony or population. All other colonies are either GLS tracked or untracked

Colony or population	Number of adults (95% CIs)	Adults per sq. km (95% CIs)	Proportion of adults (95% CIs)
Iceland*	202.2 (121.6, 314.1)	0.614 (0.369, 0.953)	0.711 (0.609, 0.793)
UK North Sea non-SPA colonies*	20.3 (12.7, 33.7)	0.062 (0.039, 0.102)	0.074 (0.04, 0.138)
Norway*	11.6 (7.2, 19.6)	0.035 (0.022, 0.06)	0.042 (0.025, 0.069)
Flamborough and Filey	9.4 (6.5, 12.9)	0.028 (0.02, 0.039)	0.034 (0.022, 0.056)
East Caithness Cliffs	7.1 (6.4, 7.9)	0.022 (0.019, 0.024)	0.026 (0.019, 0.036)
Rathlin Island	4.7 (3.1, 9.9)	0.014 (0.009, 0.03)	0.017 (0.01, 0.034)
Faroe*	4.6 (2.6, 7.2)	0.014 (0.008, 0.022)	0.017 (0.009, 0.026)
Denmark; Finland; Sweden*	3.3 (1.7, 5.1)	0.01 (0.005, 0.015)	0.012 (0.007, 0.018)
Fowlsheugh	2.6 (1.8, 3.9)	0.008 (0.006, 0.012)	0.009 (0.006, 0.016)
Mingulay and Berneray	2.3 (1.1, 3.2)	0.007 (0.003, 0.01)	0.008 (0.004, 0.014)
Forth Islands	1.8 (1.6, 2.1)	0.005 (0.005, 0.006)	0.007 (0.005, 0.009)
Handa	1.6 (1, 3.5)	0.005 (0.003, 0.011)	0.006 (0.003, 0.013)
Skomer and Skokholm	1.3 (0.6, 1.8)	0.004 (0.002, 0.006)	0.005 (0.002, 0.008)
Shiants	1.1 (0.8, 1.5)	0.003 (0.002, 0.005)	0.004 (0.003, 0.007)

Table 4: Colonies or populations used in the apportioning calculations, showing the number of adults, adults per sq. km, and proportion of adults from each colony or population, all with 95% CIs. (*) denotes a BDMPS colony or population. All other colonies are either GLS tracked or untracked *(continued)*

Colony or population	Number of adults (95% CIs)	Adults per sq. km (95% CIs)	Proportion of adults (95% CIs)
Troup; Pennan and Lions	1.1 (0.9, 1.7)	0.003 (0.003, 0.005)	0.004 (0.003, 0.006)
St Abbs to Fast Castle	1 (0.7, 1.5)	0.003 (0.002, 0.004)	0.004 (0.002, 0.006)
North Caithness Cliffs	1 (0.9, 1.3)	0.003 (0.003, 0.004)	0.004 (0.002, 0.005)
Cape Wrath	0.8 (0.5, 1.6)	0.002 (0.001, 0.005)	0.003 (0.001, 0.007)
Ireland*	0.7 (0.4, 1.1)	0.002 (0.001, 0.003)	0.003 (0.001, 0.005)
Fair Isle	0.5 (0.4, 0.7)	0.002 (0.001, 0.002)	0.002 (0.001, 0.003)
St Kilda	0.4 (0.2, 0.5)	0.001 (0.001, 0.002)	0.002 (0.001, 0.003)
UK Western non-SPA colonies*	0.4 (0.2, 0.6)	0.001 (0.001, 0.002)	0.001 (0.001, 0.003)
Russia*	0.4 (0.2, 0.6)	0.001 (0.001, 0.002)	0.001 (0.001, 0.002)
West Westray	0.3 (0.2, 0.4)	0.001 (0.001, 0.001)	0.001 (0.001, 0.002)
North Rona and Sula Sgeir	0.3 (0.2, 0.7)	0.001 (0.001, 0.002)	0.001 (0.001, 0.002)
Flannan Islands	0.3 (0.2, 0.3)	0.001 (0.001, 0.001)	0.001 (0.001, 0.001)
Foula	0.2 (0.2, 0.3)	0.001 (0.001, 0.001)	0.001 (0.001, 0.001)
France*	0 (0, 0)	0 (0, 0)	0 (0, 0)

Table 5 shows the colonies and populations used in the cumulative apportioning calculations for the area of the specified footprint (329 km^2).

Table 5: Colonies or populations used in the apportioning calculations, showing the cumulative number of adults (95% CIs), cumulative adults per sq. km (95% CIs), and cumulative proportion of adults. (*) denotes a BDMPS colony or population. All other colonies are either GLS tracked or untracked

Colony or population	Cumulative number of adults (95% CIs)	Cumulative adults per sq. km (95% CIs)	Cumulative proportion of adults
Iceland*	202.2 (121.6, 314.1)	0.61 (0.37, 0.95)	0.71

Table 5: Colonies or populations used in the apportioning calculations, showing the cumulative number of adults (95% CIs), cumulative adults per sq. km (95% CIs), and cumulative proportion of adults. (*) denotes a BDMPS colony or population. All other colonies are either GLS tracked or untracked *(continued)*

Colony or population	Cumulative number of adults (95% CIs)	Cumulative adults per sq. km (95% CIs)	Cumulative proportion of adults
UK North Sea non-SPA colonies*	222.5 (134.4, 347.9)	0.68 (0.41, 1.06)	0.78
Norway*	234.1 (141.6, 367.5)	0.71 (0.43, 1.12)	0.83
Flamborough and Filey	243.5 (148.1, 380.4)	0.74 (0.45, 1.15)	0.86
East Caithness Cliffs	250.6 (154.5, 388.2)	0.76 (0.47, 1.18)	0.89
Rathlin Island	255.3 (157.6, 398.2)	0.77 (0.48, 1.21)	0.90
Faroe*	259.9 (160.2, 405.4)	0.79 (0.49, 1.23)	0.92
Denmark; Finland; Sweden*	263.2 (161.9, 410.5)	0.8 (0.49, 1.25)	0.93
Fowlsheugh	265.8 (163.8, 414.4)	0.81 (0.5, 1.26)	0.94
Mingulay and Berneray	268.1 (164.9, 417.6)	0.81 (0.5, 1.27)	0.95
Forth Islands	269.9 (166.4, 419.6)	0.82 (0.51, 1.27)	0.96
Handa	271.5 (167.5, 423.1)	0.82 (0.51, 1.28)	0.96
Skomer and Skokholm	272.8 (168.1, 424.9)	0.83 (0.51, 1.29)	0.97
Shiants	273.9 (168.9, 426.5)	0.83 (0.51, 1.29)	0.97
Troup; Pennan and Lions	275.1 (169.8, 428.1)	0.83 (0.52, 1.3)	0.98
St Abbs to Fast Castle	276.1 (170.5, 429.6)	0.84 (0.52, 1.3)	0.98
North Caithness Cliffs	277.1 (171.4, 430.9)	0.84 (0.52, 1.31)	0.98
Cape Wrath	277.9 (171.8, 432.5)	0.84 (0.52, 1.31)	0.99
Ireland*	278.6 (172.2, 433.7)	0.85 (0.52, 1.32)	0.99
Fair Isle	279.2 (172.6, 434.3)	0.85 (0.52, 1.32)	0.99
St Kilda	279.6 (172.8, 434.9)	0.85 (0.52, 1.32)	0.99
UK Western non-SPA colonies*	280 (173.1, 435.5)	0.85 (0.53, 1.32)	0.99
Russia*	280.3 (173.2, 436.1)	0.85 (0.53, 1.32)	1.00

Table 5: Colonies or populations used in the apportioning calculations, showing the cumulative number of adults (95% CIs), cumulative adults per sq. km (95% CIs), and cumulative proportion of adults. (*) denotes a BDMPS colony or population. All other colonies are either GLS tracked or untracked *(continued)*

Colony or population	Cumulative number of adults (95% CIs)	Cumulative adults per sq. km (95% CIs)	Cumulative proportion of adults
West Westray	280.7 (173.5, 436.6)	0.85 (0.53, 1.32)	1.00
North Rona and Sula Sgeir	281 (173.7, 437.3)	0.85 (0.53, 1.33)	1.00
Flannan Islands	281.3 (173.9, 437.6)	0.85 (0.53, 1.33)	1.00
Foula	281.5 (174.1, 437.9)	0.85 (0.53, 1.33)	1.00
France*	281.5 (174.1, 437.9)	0.85 (0.53, 1.33)	1.00

RAG status

Fig. 1 shows colonies that contribute to the final apportioning in the analysis. Some colonies were further than the distance threshold (150 km) from any tracked colony. For these colonies, BDMPS apportioning was used (red circles). Colonies that were within the distance threshold (150 km) from one of more tracked colony had their utilisation distributions derived from those tracked colonies (amber). Tracked colonies were listed in the BDMPS data as UK SPAs contributed to the apportioning (green). Tracked colonies listed in the BDMPS data as UK non-SPAs for razorbill were used in the apportioning through contributing to the utilisation distributions of untracked colonies (light green).
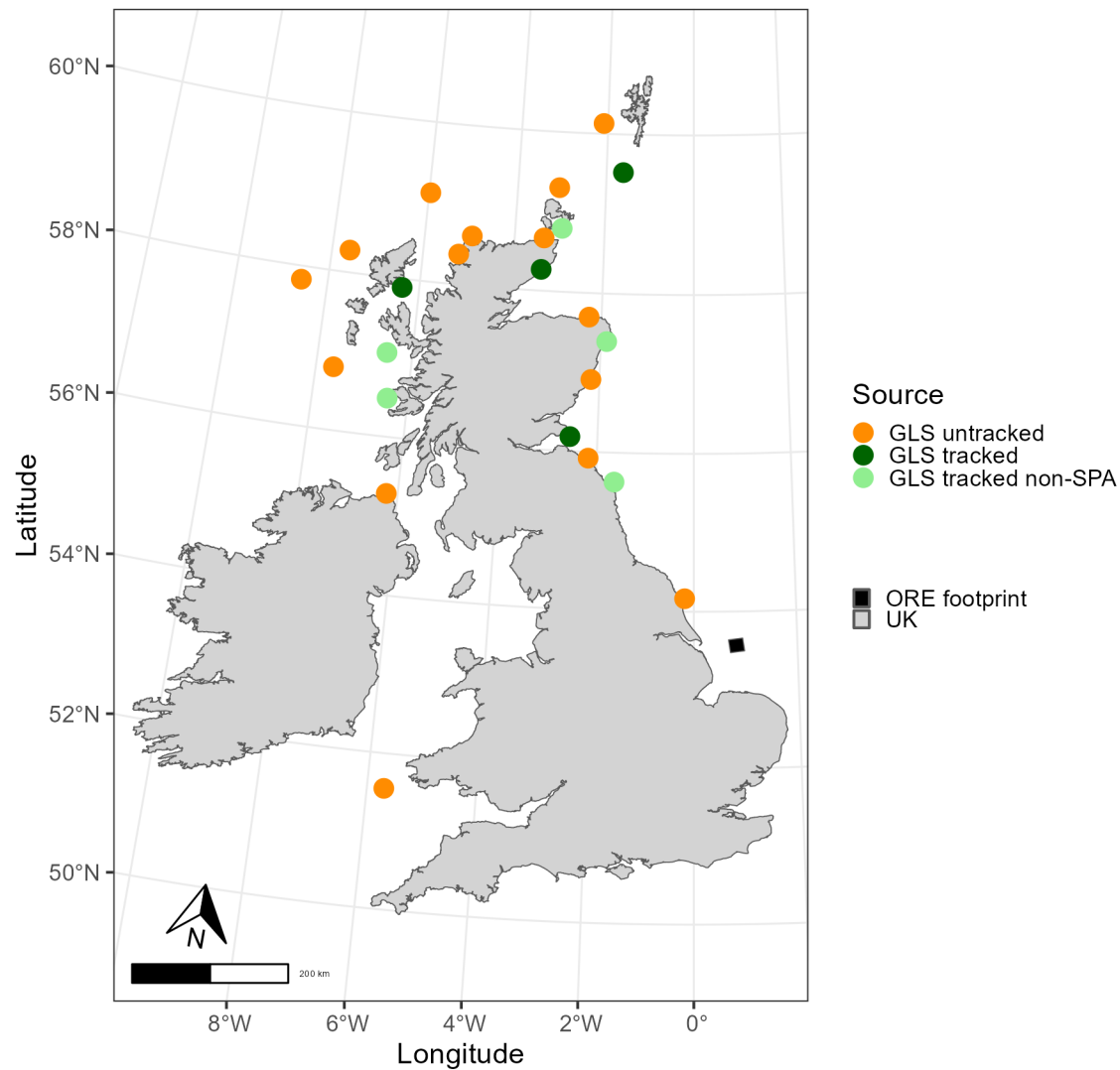
Figure 1: RAG status map showing colonies used in the analysis. Red = BDMPS, Amber = GLS untracked, Green = GLS tracked, Light Green = GLS tracked non-SPA

Apportioning maps

Colonies contributing most to apportioning

Figs. 2 and 3 show the two GLS colonies that contribute highest to the apportioning of razorbill in the migration seasons (August to October; and January to March) for the specified footprint. For the purposes of visualisation, the spatial extent of the bird density maps was slightly reduced.
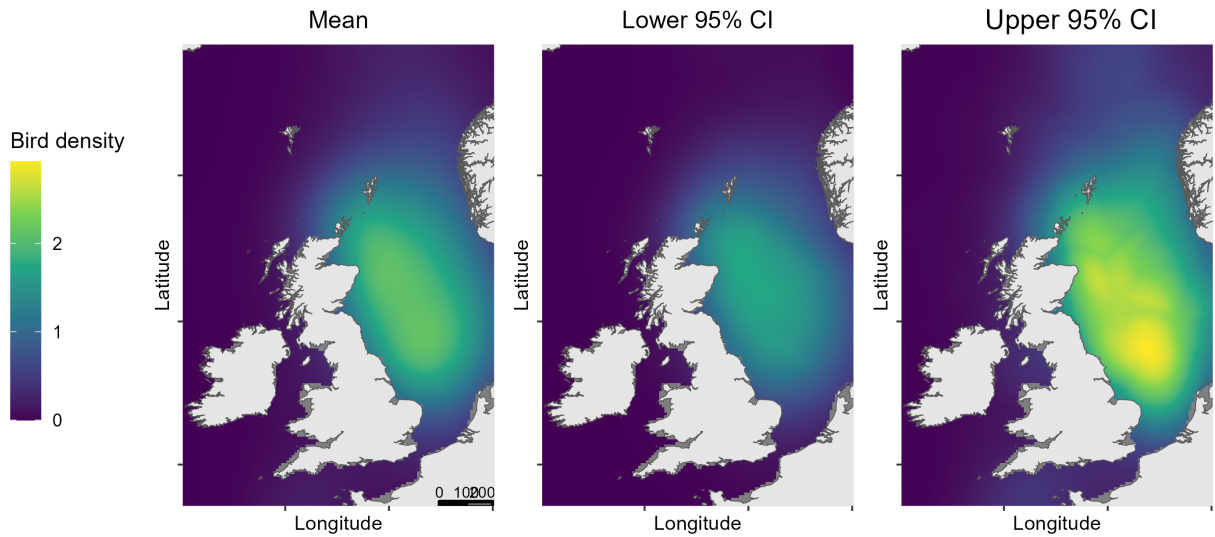
Figure 2: Maps showing colony Flamborough and Filey. The utilisation distributions are shown for estimated population mean (L), lower 95% CI (C), and upper 95% CI (R). Bird density can be interpreted as the expected number of adult breeding birds per 10 sq. km
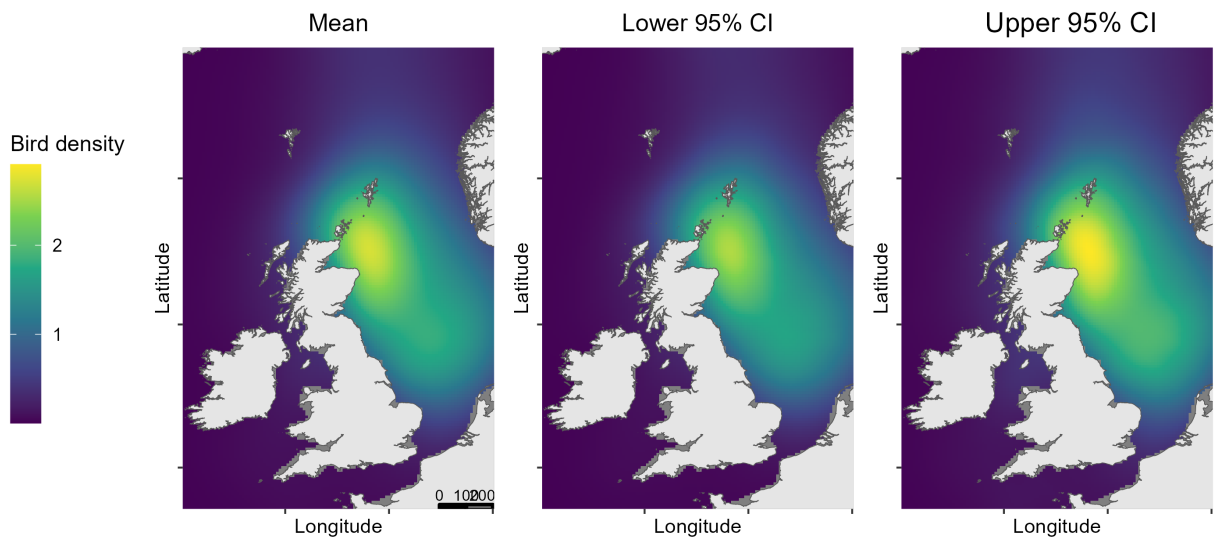
East Caithness Cliffs

Figure 3: Maps showing colony East Caithness Cliffs. The utilisation distributions are shown for estimated population mean (L), lower 95% CI (C), and upper 95% CI (R). Bird density can be interpreted as the expected number of adult breeding birds per 10 sq. km

Caveats and limitations

- Currently, only adult breeding birds are considered within the apportioning calculation. Immature birds and non-breeding adults are not considered in this iteration of the ANBS tool.
- Tracked colonies that were not listed in the BDMPS data as UK SPAs for razorbill (Fig. 1), were used in the apportioning calculations by contributing part of their utilisation distributions to untracked colonies within the distance threshold (150 km). However, those tracked colonies were not in themselves included in the apportioning calculations, in order to avoid double counting since they are assumed to be included within the aggregations of UK non-SPA colonies listed in BDMPS. Therefore, they do not appear in Tables 4 and 5.
- The specified footprint must be within the UK EEZ (and therefore, by default within the BDMPS regions).
- If the specified footprint was located within both BDMPS regions (UK Western Waters and UK North Sea Waters and Channel), the BDMPS region was selected by the user.

Apppendix

System information used in the analysis

The information below shows the system information used in the analysis including the version of R, platform, locale, and packages with version numbers.

R version 4.2.2 (2022-10-31 ucrt)

Platform: x86_64-w64-mingw32/x64 (64-bit)

locale: *LC_COLLATE=English_United Kingdom.1252, LC_CTYPE=English_United Kingdom.1252, LC_MONETARY=English_United Kingdom.1252, LC_NUMERIC=C* and *LC_TIME=English_United Kingdom.1252*

attached base packages: *grid, stats, graphics, grDevices, utils, datasets, methods* and *base*

other attached packages: *tictoc(v.1.1), pander(v.0.6.5), formatR(v.1.14), ggsn(v.0.5.0), ggspatial(v.1.1.7), svDialogs(v.1.1.0), patchwork(v.1.1.2), tinytex(v.0.44), kableExtra(v.1.3.4), stringr(v.1.5.0), devtools(v.2.4.5), usethis(v.2.1.6), ggplot2(v.3.4.1), rgeos(v.0.6-2), gdistance(v.1.6), Matrix(v.1.5-3), igraph(v.1.4.1), raster(v.3.6-20), sp(v.1.6-0), sf(v.1.0-12), terra(v.1.7-18), knitr(v.1.42), rmarkdown(v.2.21), rstudioapi(v.0.14)* and *pacman(v.0.5.1)*

loaded via a namespace (and not attached): *bitops(v.1.0-7), fs(v.1.6.1), webshot(v.0.5.4), httr(v.1.4.5), tools(v.4.2.2), profvis(v.0.3.7), bslib(v.0.4.2), rgdal(v.1.6-5), utf8(v.1.2.3), R6(v.2.5.1),*

KernSmooth(v.2.23-20), DBI(v.1.1.3), colorspace(v.2.1-0), urlchecker(v.1.0.1), withr(v.2.5.0), tidyselect(v.1.2.0), prettyunits(v.1.1.1), processx(v.3.8.0), compiler(v.4.2.2), textshaping(v.0.3.6), cli(v.3.6.1), rvest(v.1.0.3), xml2(v.1.3.3), labeling(v.0.4.2), svGUI(v.1.0.1), sass(v.0.4.5), scales(v.1.2.1), classInt(v.0.4-9), callr(v.3.7.3), proxy(v.0.4-27), systemfonts(v.1.0.4), digest(v.0.6.31), foreign(v.0.8-84), svglite(v.2.1.1), jpeg(v.0.1-10), pkgconfig(v.2.0.3), htmltools(v.0.5.5), sessioninfo(v.1.2.2), fastmap(v.1.1.1), htmlwidgets(v.1.6.2), rlang(v.1.1.0), shiny(v.1.7.4), farver(v.2.1.1), jquerylib(v.0.1.4), generics(v.0.1.3), jsonlite(v.1.8.4), dplyr(v.1.1.1), magrittr(v.2.0.3), Rcpp(v.1.0.10), munsell(v.0.5.0), fansi(v.1.0.4), lifecycle(v.1.0.3), stringi(v.1.7.12), yaml(v.2.3.7), pkgbuild(v.1.4.0), plyr(v.1.8.8), maptools(v.1.1-6), parallel(v.4.2.2), promises(v.1.2.0.1), crayon(v.1.5.2), miniUI(v.0.1.1.1), lattice(v.0.20-45), ps(v.1.7.3), pillar(v.1.9.0), codetools(v.0.2-19), pkgload(v.1.3.2), glue(v.1.6.2), evaluate(v.0.20), remotes(v.2.4.2), png(v.0.1-8), vctrs(v.0.6.1), httpuv(v.1.6.9), RgoogleMaps(v.1.4.5.3), gtable(v.0.3.3), purrr(v.1.0.1), tidyr(v.1.3.0), cachem(v.1.0.7), xfun(v.0.38), mime(v.0.12), xtable(v.1.8-4), e1071(v.1.7-13), later(v.1.3.0), ragg(v.1.2.5), viridisLite(v.0.4.1), class(v.7.3-21), tibble(v.3.2.1), memoise(v.2.0.1), units(v.0.8-1), ggmap(v.3.0.2) and *ellipsis(v.0.3.2)*

Apportioning in the non-breeding season - Case study 3

UKCEH and BioSS

24 August 2023

Summary

This report presents the apportioning of common guillemot in the UK in the non-breeding season (August to February) based on the uploaded footprint. The footprint was in the UK Western waters BDMPS region and had an area of $74\,\text{km}^2$. The number of guillemots in the footprint was estimated to be 124. The total bird density within the footprint was estimated to be 1.68 km^{-2}. In total, 30 BDMPS colonies contributed to the apportioning calculations.

The accompanying User Guide to this tool describes the methods used to estimate bird metrics within the footprint. For this model run, only BDMPS is used to estimate apportioning and no levels of uncertainty are included in the estimates of apportioning.

User inputs

Table 1 shows the user-defined inputs to the analysis. If the uploaded footprint was located in more than one BDMPS region, the table shows the region chosen by the user. If the footprint was located only in one BDMPS region, this region is automatically chosen in the ANBS tool run.

Table 1: Input parameter values for ANBS tool run

Parameter description	Parameter value
Species	Common guillemot (Uria aalge)
Mode	footprint
BDMPS uncertainty scalar	0
Distance threshold (km)	0

1

Table 1: Input parameter values for ANBS tool run *(continued)*

Parameter description	Parameter value
Season	non-breeding season (August to February)
BDMPS Region	UK Western waters

Table 2 shows colonies that are defined from the BDMPS populations and the size (number of pairs of breeding adults) of each population, whether a UK SPA, aggregate of UK non-SPA colonies, or aggregate of overseas colonies. In the ANBS tool, the number of pairs of breeding adults can be changed for any colony as part of the inputs so the table shows the population estimates used in the analysis.

Table 2: Input parameter values for ANBS tool run

Colony or population	Estimated pairs of breeding adults
Ailsa Craig SPA	5247
Buchan Ness to Collieston Coast SPA	12928
Calf of Eday SPA	6300
Canna and Sanday SPA	3913
Cape Wrath SPA	27359
Copinsay SPA	5607
East Caithness Cliffs SPA	106500
Fair Isle SPA	13066
Farne Islands SPA	33532
Faroe Islands	100000
Flamborough and Filey Coast SPA	39641
Flannan Isles SPA	9807
Forth Islands SPA	14674
Foula SPA	16615
Fowlsheugh SPA	30100
Germany and Denmark	5000
Handa SPA	37993
Hermaness; Saxavord and Valla Field SPA	4620

Table 2: Input parameter values for ANBS tool run *(continued)*

Colony or population	Estimated pairs of breeding adults
Hoy SPA	6300
Marwick Head SPA	11097
Mingulay and Berneray SPA	13527
North Caithness Cliffs SPA	47000
North Colonsay and western cliffs SPA	13500
North Rona and Sula Sgeir SPA	5000
North Sea UK non-SPA populations	147000
Norway	100000
Noss SPA	14783
Rathlin Island SPA	87398
Rousay SPA	6200
Rum SPA	1644
Shiant Isles SPA	5148
Skomer and Skokholm SPA	16300
St Abbs Head to Fast Castle SPA	22103
St Kilda SPA	15700
Sule Skerry and Sule Stack SPA	7633
Sumburgh SPA	4762
Troup; Pennan and Lions Heads SPS	10938
UK North Sea non-SPA populations	147000
UK West coast non-SPA populations	79000
West coast UK non-SPA populations	79000
West Westray SPA	33900

Results

Apportioning tables

Table 3 shows the colonies and populations used in the apportioning calculations for the area of the specified footprint (74 km^2).

Table 3: Colonies or populations used in the apportioning calculations, showing the number of adults, adults per sq. km, and proportion of adults from each BDMPS colony or population.

Colony or population	Number of adults	Adults per sq. km	Proportion of adults
Rathlin Island SPA	33.1	0.449	0.266
West coast UK non-SPA populations	28.4	0.385	0.229
Handa SPA	13.7	0.185	0.110
Cape Wrath SPA	9.8	0.133	0.079
St Kilda SPA	5.6	0.077	0.045
Skomer and Skokholm SPA	5.6	0.075	0.045
North Colonsay and western cliffs SPA	5.1	0.069	0.041
Mingulay and Berneray SPA	4.9	0.066	0.039
Flannan Isles SPA	3.5	0.048	0.028
Sule Skerry and Sule Stack SPA	2.7	0.037	0.022
Ailsa Craig SPA	2.0	0.027	0.016
Faroe Islands	1.9	0.026	0.015
Shiant Isles SPA	1.9	0.025	0.015
North Rona and Sula Sgeir SPA	1.8	0.024	0.014
Canna and Sanday SPA	1.4	0.019	0.011
Rum SPA	0.6	0.008	0.005
North Sea UK non-SPA populations	0.6	0.008	0.004

Table 3: Colonies or populations used in the apportioning calculations, showing the number of adults, adults per sq. km, and proportion of adults from each BDMPS colony or population. *(continued)*

Colony or population	Number of adults	Adults per sq. km	Proportion of adults
Norway	0.4	0.005	0.003
North Caithness Cliffs SPA	0.4	0.005	0.003
West Westray SPA	0.3	0.003	0.002
Foula SPA	0.1	0.002	0.001
Noss SPA	0.1	0.002	0.001
Fair Isle SPA	0.1	0.001	0.001
Marwick Head SPA	0.1	0.001	0.001
Calf of Eday SPA	0.0	0.001	0.000
Hoy SPA	0.0	0.001	0.000
Rousay SPA	0.0	0.001	0.000
Copinsay SPA	0.0	0.001	0.000
Sumburgh SPA	0.0	0.000	0.000
Hermaness; Saxavord and Valla Field SPA	0.0	0.000	0.000

Table 4 shows the colonies and populations used in the cumulative apportioning calculations for the area of the specified footprint (74 km^2).

Table 4: Colonies or populations used in the apportioning calculations, showing the cumulative number of adults, cumulative adults per sq. km, and cumulative proportion of adults from each BDMPS colony or population.

Colony or population	Cumulative number of adults	Cumulative adults per sq. km	Cumulative proportion of adults
Rathlin Island SPA	33.1	0.45	0.27
West coast UK non-SPA populations	61.5	0.83	0.50
Handa SPA	75.2	1.02	0.61
Cape Wrath SPA	85.0	1.15	0.68
St Kilda SPA	90.7	1.23	0.73

Table 4: Colonies or populations used in the apportioning calculations, showing the cumulative number of adults, cumulative adults per sq. km, and cumulative proportion of adults from each BDMPS colony or population. *(continued)*

Colony or population	Cumulative number of adults	Cumulative adults per sq. km	Cumulative proportion of adults
Skomer and Skokholm SPA	96.2	1.30	0.77
North Colonsay and western cliffs SPA	101.3	1.37	0.82
Mingulay and Berneray SPA	106.2	1.44	0.85
Flannan Isles SPA	109.7	1.49	0.88
Sule Skerry and Sule Stack SPA	112.5	1.52	0.91
Ailsa Craig SPA	114.5	1.55	0.92
Faroe Islands	116.4	1.58	0.94
Shiant Isles SPA	118.2	1.60	0.95
North Rona and Sula Sgeir SPA	120.0	1.63	0.97
Canna and Sanday SPA	121.4	1.65	0.98
Rum SPA	122.0	1.65	0.98
North Sea UK non-SPA populations	122.6	1.66	0.99
Norway	122.9	1.67	0.99
North Caithness Cliffs SPA	123.3	1.67	0.99
West Westray SPA	123.6	1.67	0.99
Foula SPA	123.7	1.68	1.00
Noss SPA	123.8	1.68	1.00
Fair Isle SPA	123.9	1.68	1.00
Marwick Head SPA	124.0	1.68	1.00
Calf of Eday SPA	124.0	1.68	1.00
Hoy SPA	124.1	1.68	1.00

Table 4: Colonies or populations used in the apportioning calculations, showing the cumulative number of adults, cumulative adults per sq. km, and cumulative proportion of adults from each BDMPS colony or population. *(continued)*

Colony or population	Cumulative number of adults	Cumulative adults per sq. km	Cumulative proportion of adults
Rousay SPA	124.1	1.68	1.00
Copinsay SPA	124.2	1.68	1.00
Sumburgh SPA	124.2	1.68	1.00
Hermaness; Saxavord and Valla Field SPA	124.2	1.68	1.00

RAG status

Fig. 1 shows the BDMPS colonies that contribute to the final apportioning in the analysis (red circles).
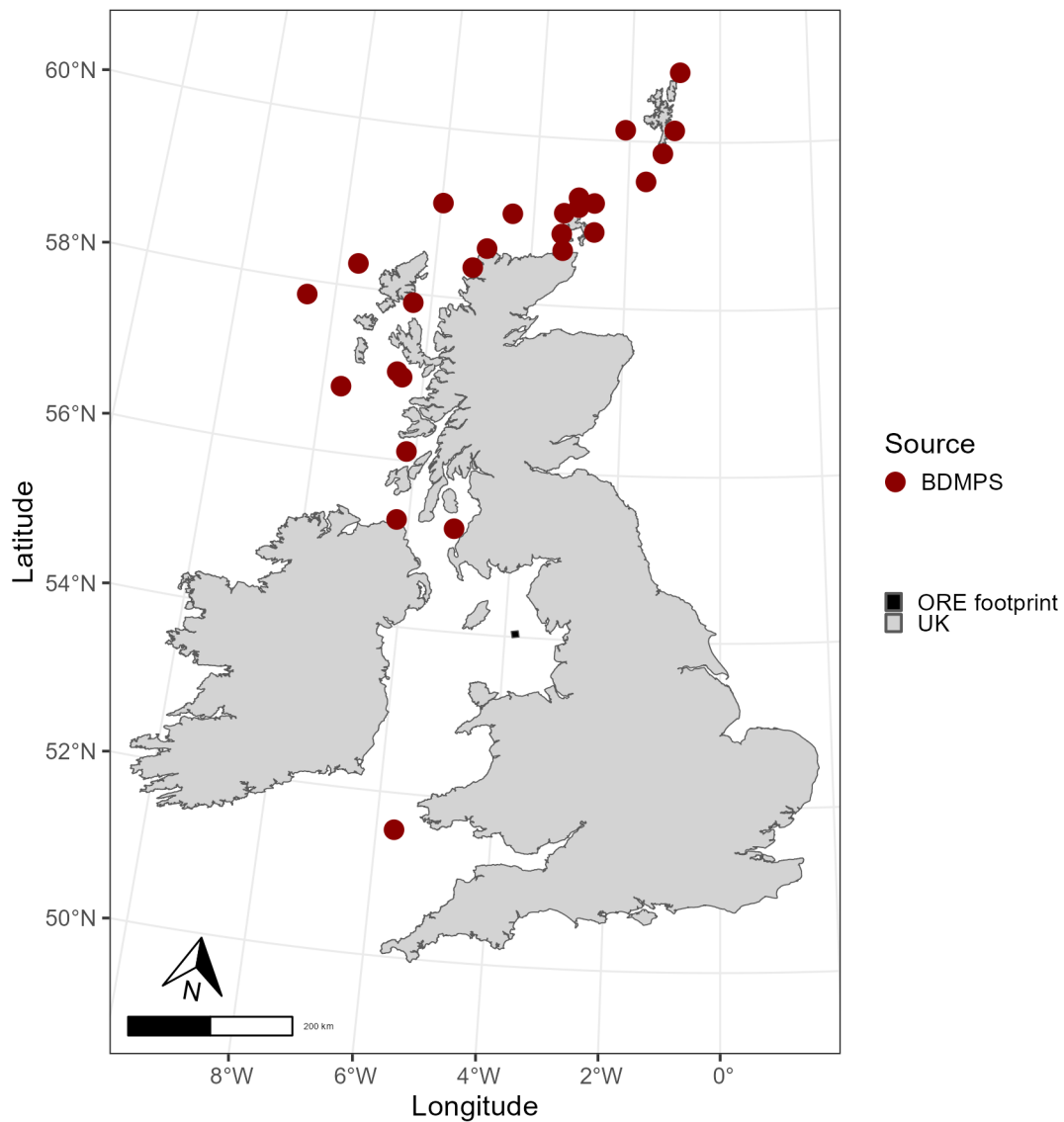
Figure 1: RAG status map showing colonies used in the analysis. Red = BDMPS

Caveats and limitations

- Currently, only adult breeding birds are considered within the apportioning calculation. Immature birds and non-breeding adults are not considered in this iteration of the ANBS tool.
- The specified footprint must be within the UK EEZ (and therefore, by default within the BDMPS regions).
- If the specified footprint was located within both BDMPS regions (UK Western Waters and UK North Sea Waters and Channel), the BDMPS region was selected by the user.

Apppendix

System information used in the analysis

The information below shows the system information used in the analysis including the version of R, platform, locale, and packages with version numbers.

R version 4.2.2 (2022-10-31 ucrt)

Platform: x86_64-w64-mingw32/x64 (64-bit)

locale: *LC_COLLATE=English_United Kingdom.1252*, *LC_CTYPE=English_United Kingdom.1252*, *LC_MONETARY=English_United Kingdom.1252*, *LC_NUMERIC=C* and *LC_TIME=English_United Kingdom.1252*

attached base packages: *grid, stats, graphics, grDevices, utils, datasets, methods* and *base*

other attached packages: *tictoc(v.1.1), pander(v.0.6.5), formatR(v.1.14), ggsn(v.0.5.0), ggspatial(v.1.1.7), svDialogs(v.1.1.0), patchwork(v.1.1.2), tinytex(v.0.44), kableExtra(v.1.3.4), stringr(v.1.5.0), devtools(v.2.4.5), usethis(v.2.1.6), ggplot2(v.3.4.1), rgeos(v.0.6-2), gdistance(v.1.6), Matrix(v.1.5-3), igraph(v.1.4.1), raster(v.3.6-20), sp(v.1.6-0), sf(v.1.0-12), terra(v.1.7-18), knitr(v.1.42), rmarkdown(v.2.21), rstudioapi(v.0.14)* and *pacman(v.0.5.1)*

loaded via a namespace (and not attached): *bitops(v.1.0-7), fs(v.1.6.1), webshot(v.0.5.4), httr(v.1.4.5), tools(v.4.2.2), profvis(v.0.3.7), bslib(v.0.4.2), rgdal(v.1.6-5), utf8(v.1.2.3), R6(v.2.5.1), KernSmooth(v.2.23-20), DBI(v.1.1.3), colorspace(v.2.1-0), urlchecker(v.1.0.1), withr(v.2.5.0), tidyselect(v.1.2.0), prettyunits(v.1.1.1), processx(v.3.8.0), compiler(v.4.2.2), textshaping(v.0.3.6), cli(v.3.6.1), rvest(v.1.0.3), xml2(v.1.3.3), labeling(v.0.4.2), svGUI(v.1.0.1), sass(v.0.4.5), scales(v.1.2.1), classInt(v.0.4-9), callr(v.3.7.3), proxy(v.0.4-27), systemfonts(v.1.0.4), digest(v.0.6.31), foreign(v.0.8-84), svglite(v.2.1.1), jpeg(v.0.1-10), pkgconfig(v.2.0.3), htmltools(v.0.5.5), sessioninfo(v.1.2.2), fastmap(v.1.1.1), htmlwidgets(v.1.6.2), rlang(v.1.1.0), shiny(v.1.7.4), farver(v.2.1.1), jquerylib(v.0.1.4), generics(v.0.1.3), jsonlite(v.1.8.4), dplyr(v.1.1.1), magrittr(v.2.0.3), Rcpp(v.1.0.10), munsell(v.0.5.0), fansi(v.1.0.4), lifecycle(v.1.0.3), stringi(v.1.7.12), yaml(v.2.3.7), pkgbuild(v.1.4.0), plyr(v.1.8.8), maptools(v.1.1-6), parallel(v.4.2.2), promises(v.1.2.0.1), crayon(v.1.5.2), miniUI(v.0.1.1.1), lattice(v.0.20-45), ps(v.1.7.3), pillar(v.1.9.0), codetools(v.0.2-19), pkgload(v.1.3.2), glue(v.1.6.2), evaluate(v.0.20), remotes(v.2.4.2), png(v.0.1-8), vctrs(v.0.6.1), httpuv(v.1.6.9), RgoogleMaps(v.1.4.5.3), gtable(v.0.3.3), purrr(v.1.0.1), tidyr(v.1.3.0), cachem(v.1.0.7), xfun(v.0.38), mime(v.0.12), xtable(v.1.8-4), e1071(v.1.7-13), later(v.1.3.0), ragg(v.1.2.5), viridisLite(v.0.4.1), class(v.7.3-21), tibble(v.3.2.1), memoise(v.2.0.1), units(v.0.8-1), ggmap(v.3.0.2)* and *ellipsis(v.0.3.2)*

Apportioning in the non-breeding season - Case study 4

UKCEH and BioSS

24 August 2023

Summary

This report presents the apportioning of razorbill in the UK in the winter (November and December) for the UK Western waters BDMPS region. The number of razorbills was estimated to be 205043.1 (12590.6, 684809.3) with numbers in brackets the lower and upper 95% confidence intervals. The total bird density within the BDMPS region was estimated to be 0.53 (0.03, 1.76) km^{-2}. In total, 9 BDMPS colonies and 19 colonies that used geolocator-based utilisation distributions contributed to the apportioning calculations.

The accompanying User Guide to this tool describes the methods used to estimate bird metrics within the footprint, and a full description of the geolocator (GLS) data is available in the WP3 report associated with this project. Briefly, tracked colonies are defined as those colonies where rtolower(inputs$species)'s were tracked using geolocator (GLS) tags and so a utilisation distribution could be estimated to characterise space use in the non-breeding season. Untracked colonies are defined as those colonies that were within the user-defined distance threshold of 270 km of at least one tracked colony, calculated using at-sea distance. Based on the assumption that colonies that are nearer are more similar, utilisation distributions for untracked colonies were derived using weightings based on distance from tracked colonies. Tracked colonies that were closer to an untracked colony have a higher weighting than tracked colonies that are further away. Finally, if no tracked colonies are within 270 km of an untracked colony, BDMPS is used to calculate apportioning for the untracked colony (defined as a BDMPS colony).

Table 1 shows all tracked colonies and the number of geolocator tags that were successfully retrieved over three seasons between 2018 and 2021.

Table 1: Geolocator tag sample sizes for tracked colonies

Colony	UK SPA code	Sample size
Buchan Ness to Collieston Coast	UK9002491	13
Canna and Sanday	UK9001431	22
East Caithness Cliffs	UK9001182	24
Fair Isle	UK9002091	13
Farne Islands	UK9006021	5
Forth Islands	UK9004171	21
Pentland Firth Islands	UK9001131	18
Shiant Isles	UK9001041	13
Treshnish Isles	UK9003041	13

User inputs

Table 2 shows the user-defined inputs to the analysis.

Table 2: Input parameter values for ANBS tool run

Parameter description	Parameter value
Species	Razorbill
Mode	map
BDMPS uncertainty scalar	1.5
Distance threshold (km)	270
Season	winter (November and December)
Months	November, December
BDMPS Region	UK Western waters

Table 3 shows colonies that are defined from the BDMPS populations and the size (number of pairs of breeding adults) of each population, whether a UK SPA, aggregate of UK non-SPA colonies, or aggregate of overseas colonies. In the ANBS tool, the number of pairs of breeding adults can be changed for any colony as part of the inputs so the table shows the population estimates used in the analysis.

Table 3: Input parameter values for ANBS tool run

Colony or population	Estimated pairs of breeding adults
Cape Wrath	2090
Denmark; Finland; Sweden	16000
East Caithness Cliffs	12500
Fair Isle	915
Faroe	4500
Flamborough and Filey	10001
Flannan Islands	1051
Forth Islands	2625
Foula	375
Fowlsheugh	3524
France	25
Handa	5165
Iceland	315400
Ireland	17000
Mingulay and Berneray	10111
North Caithness Cliffs	1700
North Rona and Sula Sgeir	1089
Norway	30300
Rathlin Island	15393
Russia	3500
Shiants	4248
Skomer and Skokholm	6001
St Abbs to Fast Castle	1219
St Kilda	1700
Troup; Pennan and Lions	1743
UK North Sea non-SPA colonies	10000
UK Western non-SPA colonies	10000
West Westray	550

Results

Apportioning tables

Table 4 shows the colonies and populations used in the apportioning calculations for the area of the UK Western waters BDMPS region.

Table 4: Colonies or populations used in the apportioning calculations, showing the number of adults, adults per sq. km, and proportion of adults from each colony or population, all with 95% CIs. (*) denotes a BDMPS colony or population. All other colonies are either GLS tracked or untracked

Colony or population	Number of adults (95% CIs)	Adults per sq. km (95% CIs)	Proportion of adults (95% CIs)
Iceland*	160056.2 (5698.9, 547542.9)	0.411 (0.015, 1.405)	0.615 (0.097, 0.94)
UK Western non-SPA colonies*	7527.9 (633.3, 17969.5)	0.019 (0.002, 0.046)	0.067 (0.003, 0.269)
Norway*	7034.8 (70.6, 33921.7)	0.018 (0, 0.087)	0.059 (0, 0.334)
Ireland*	5498 (166.7, 25397.7)	0.014 (0, 0.065)	0.043 (0.001, 0.204)
Rathlin Island	4641.8 (329.3, 10756.8)	0.012 (0.001, 0.028)	0.04 (0.001, 0.164)
Mingulay and Berneray	4213.1 (390, 7018.2)	0.011 (0.001, 0.018)	0.037 (0.004, 0.114)
Faroe*	3511.9 (428.2, 8113.8)	0.009 (0.001, 0.021)	0.031 (0.002, 0.109)
Skomer and Skokholm	2891.3 (1879.8, 4238.4)	0.007 (0.005, 0.011)	0.025 (0.004, 0.068)
Shiants	2128 (1952.7, 2343)	0.005 (0.005, 0.006)	0.019 (0.004, 0.048)
Denmark; Finland; Sweden*	1512.3 (24.7, 9958.2)	0.004 (0, 0.026)	0.013 (0, 0.081)
Handa	1475.4 (120.8, 3620.6)	0.004 (0, 0.009)	0.012 (0, 0.043)
St Kilda	795.2 (266.4, 1191.9)	0.002 (0.001, 0.003)	0.007 (0.001, 0.022)

Table 4: Colonies or populations used in the apportioning calculations, showing the number of adults, adults per sq. km, and proportion of adults from each colony or population, all with 95% CIs. (*) denotes a BDMPS colony or population. All other colonies are either GLS tracked or untracked *(continued)*

Colony or population	Number of adults (95% CIs)	Adults per sq. km (95% CIs)	Proportion of adults (95% CIs)
UK North Sea non-SPA colonies*	665.6 (9.3, 4159)	0.002 (0, 0.011)	0.005 (0, 0.032)
Cape Wrath	468.3 (10.1, 1389.5)	0.001 (0, 0.004)	0.004 (0, 0.022)
East Caithness Cliffs	476.6 (385.7, 616.2)	0.001 (0.001, 0.002)	0.004 (0.001, 0.011)
Flannan Islands	399.3 (36.1, 748.6)	0.001 (0, 0.002)	0.004 (0, 0.014)
North Rona and Sula Sgeir	328.4 (23.3, 761)	0.001 (0, 0.002)	0.003 (0, 0.012)
North Caithness Cliffs	304.8 (10.7, 1146.4)	0.001 (0, 0.003)	0.003 (0, 0.017)
Fowlsheugh	208.4 (10.2, 637.8)	0.001 (0, 0.002)	0.002 (0, 0.013)
Flamborough and Filey	194.5 (11.8, 411.6)	0 (0, 0.001)	0.002 (0, 0.007)
Troup; Pennan and Lions	204.2 (6.8, 855.4)	0.001 (0, 0.002)	0.002 (0, 0.008)
Russia*	178.5 (4.5, 1119.8)	0 (0, 0.003)	0.001 (0, 0.009)
West Westray	92.7 (5.2, 292.2)	0 (0, 0.001)	0.001 (0, 0.004)
Forth Islands	93.5 (78, 113.8)	0 (0, 0)	0.001 (0, 0.002)
Fair Isle	51.6 (31.2, 71.9)	0 (0, 0)	0 (0, 0.001)
Foula	46.6 (4.2, 186.4)	0 (0, 0)	0 (0, 0.002)
St Abbs to Fast Castle	38.5 (1.6, 202.1)	0 (0, 0.001)	0 (0, 0.002)
France*	5.6 (0.3, 25)	0 (0, 0)	0 (0, 0)

Table 5 shows the colonies and populations used in the cumulative apportioning calculations for the area of the UK Western waters BDMPS region.

Table 5: Colonies or populations used in the apportioning calculations, showing the cumulative number of adults (95% CIs), cumulative adults per sq. km (95% CIs), and cumulative proprtion of adults. (*) denotes a BDMPS colony or population. All other colonies are either GLS tracked or untracked

Colony or population	Cumulative number of adults (95% CIs)	Cumulative adults per sq. km (95% CIs)	Cumulative proportion of adults
Iceland*	160056.2 (5698.9, 547542.9)	0.41 (0.01, 1.41)	0.61
UK Western non-SPA colonies*	167584 (6332.2, 565512.4)	0.43 (0.02, 1.45)	0.68
Norway*	174618.8 (6402.8, 599434.1)	0.45 (0.02, 1.54)	0.74
Ireland*	180116.8 (6569.6, 624831.8)	0.46 (0.02, 1.6)	0.78
Rathlin Island	184758.6 (6898.9, 635588.6)	0.47 (0.02, 1.63)	0.82
Mingulay and Berneray	188971.8 (7288.9, 642606.9)	0.48 (0.02, 1.65)	0.86
Faroe*	192483.7 (7717.1, 650720.7)	0.49 (0.02, 1.67)	0.89
Skomer and Skokholm	195375 (9596.8, 654959.1)	0.5 (0.02, 1.68)	0.92
Shiants	197503 (11549.5, 657302)	0.51 (0.03, 1.69)	0.94
Denmark; Finland; Sweden*	199015.3 (11574.2, 667260.3)	0.51 (0.03, 1.71)	0.95
Handa	200490.8 (11695, 670880.8)	0.51 (0.03, 1.72)	0.96
St Kilda	201286 (11961.5, 672072.8)	0.52 (0.03, 1.72)	0.97
UK North Sea non-SPA colonies*	201951.6 (11970.8, 676231.7)	0.52 (0.03, 1.74)	0.97
Cape Wrath	202419.9 (11980.9, 677621.2)	0.52 (0.03, 1.74)	0.98

Table 5: Colonies or populations used in the apportioning calculations, showing the cumulative number of adults (95% CIs), cumulative adults per sq. km (95% CIs), and cumulative proprtion of adults. (*) denotes a BDMPS colony or population. All other colonies are either GLS tracked or untracked *(continued)*

Colony or population	Cumulative number of adults (95% CIs)	Cumulative adults per sq. km (95% CIs)	Cumulative proportion of adults
East Caithness Cliffs	202896.5 (12366.6, 678237.4)	0.52 (0.03, 1.74)	0.98
Flannan Islands	203295.8 (12402.7, 678986)	0.52 (0.03, 1.74)	0.98
North Rona and Sula Sgeir	203624.2 (12426, 679747)	0.52 (0.03, 1.74)	0.99
North Caithness Cliffs	203929 (12436.8, 680893.4)	0.52 (0.03, 1.75)	0.99
Fowlsheugh	204137.4 (12447, 681531.3)	0.52 (0.03, 1.75)	0.99
Flamborough and Filey	204331.9 (12458.8, 681942.9)	0.52 (0.03, 1.75)	0.99
Troup; Pennan and Lions	204536.1 (12465.5, 682798.2)	0.52 (0.03, 1.75)	1.00
Russia*	204714.6 (12470.1, 683918)	0.53 (0.03, 1.76)	1.00
West Westray	204807.3 (12475.3, 684210.1)	0.53 (0.03, 1.76)	1.00
Forth Islands	204900.8 (12553.3, 684323.9)	0.53 (0.03, 1.76)	1.00
Fair Isle	204952.4 (12584.5, 684395.8)	0.53 (0.03, 1.76)	1.00
Foula	204999 (12588.7, 684582.2)	0.53 (0.03, 1.76)	1.00
St Abbs to Fast Castle	205037.5 (12590.3, 684784.2)	0.53 (0.03, 1.76)	1.00
France*	205043.1 (12590.6, 684809.3)	0.53 (0.03, 1.76)	1.00

RAG status

Fig. 1 shows colonies that contribute to the final apportioning in the analysis. Some colonies were further than the distance threshold (270 km) from any tracked colony. For these colonies, BDMPS apportioning was used (red circles). Colonies that were within the distance threshold (270 km) from one of more tracked colony had their utilisation distributions derived from those tracked colonies (amber). Tracked colonies were listed in the BDMPS data as UK SPAs contributing to the apportioning (green). Tracked colonies listed in the BDMPS data as UK non-SPAs for razorbill were used in the apportioning through contributing to the utilisation distributions of untracked colonies (light green).
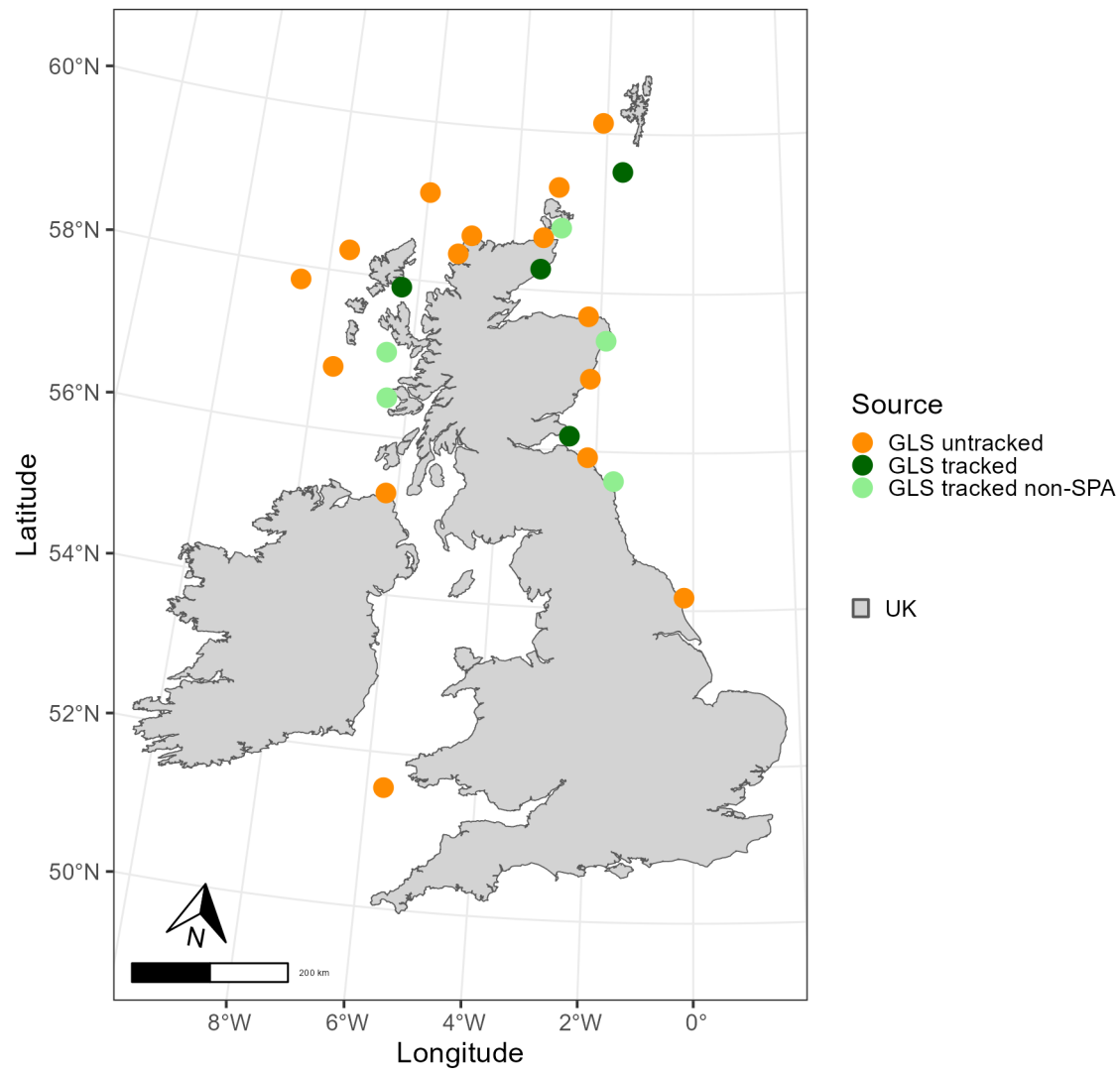
Figure 1: RAG status map showing colonies used in the analysis. Red = BDMPS, Amber = GLS untracked, Green = GLS tracked, Light Green = GLS tracked non-SPA

Apportioning maps

Fig. **??** shows the user-defined selected GLS colonies Shiants , West Westray that contribute to the apportioning of razorbill in the winter (November and December) for the UK Western waters BDMPS region. For the purposes of visualisation, the spatial extent of the bird density maps was slightly reduced.

Caveats and limitations

- Currently, only adult breeding birds are considered within the apportioning calculation. Immature birds and non-breeding adults are not considered in this iteration of the ANBS tool.
- Tracked colonies that were not listed in the BDMPS data as UK SPAs for razorbill (Fig. 1), were used in the apportioning calculations by contributing part of their utilisation distributions to untracked colonies within the distance threshold (270 km). However, those tracked colonies were not in themselves included in the apportioning calculations, in order to avoid double counting since they are assumed to be included within the aggregations of UK non-SPA colonies listed in BDMPS. Therefore, they do not appear in Tables 4 and 5.

Apppendix

System information used in the analysis

The information below shows the system information used in the analysis including the version of R, platform, locale, and packages with version numbers.

R version 4.2.2 (2022-10-31 ucrt)

Platform: x86_64-w64-mingw32/x64 (64-bit)

locale: *LC_COLLATE=English_United Kingdom.1252*, *LC_CTYPE=English_United Kingdom.1252*, *LC_MONETARY=English_United Kingdom.1252*, *LC_NUMERIC=C* and *LC_TIME=English_United Kingdom.1252*

attached base packages: *grid*, *stats*, *graphics*, *grDevices*, *utils*, *datasets*, *methods* and *base*

other attached packages: *tictoc(v.1.1)*, *pander(v.0.6.5)*, *formatR(v.1.14)*, *ggsn(v.0.5.0)*, *ggspatial(v.1.1.7)*, *svDialogs(v.1.1.0)*, *patchwork(v.1.1.2)*, *tinytex(v.0.44)*, *kableExtra(v.1.3.4)*, *stringr(v.1.5.0)*, *devtools(v.2.4.5)*, *usethis(v.2.1.6)*, *ggplot2(v.3.4.1)*, *rgeos(v.0.6-2)*, *gdistance(v.1.6)*, *Matrix(v.1.5-3)*, *igraph(v.1.4.1)*, *raster(v.3.6-20)*, *sp(v.1.6-0)*, *sf(v.1.0-12)*, *terra(v.1.7-18)*, *knitr(v.1.42)*, *rmarkdown(v.2.21)*, *rstudioapi(v.0.14)* and *pacman(v.0.5.1)*

loaded via a namespace (and not attached): *bitops(v.1.0-7)*, *fs(v.1.6.1)*, *webshot(v.0.5.4)*, *httr(v.1.4.5)*, *tools(v.4.2.2)*, *profvis(v.0.3.7)*, *bslib(v.0.4.2)*, *rgdal(v.1.6-5)*, *utf8(v.1.2.3)*, *R6(v.2.5.1)*, *KernSmooth(v.2.23-20)*, *DBI(v.1.1.3)*, *colorspace(v.2.1-0)*, *urlchecker(v.1.0.1)*, *withr(v.2.5.0)*, *tidyselect(v.1.2.0)*, *prettyunits(v.1.1.1)*, *processx(v.3.8.0)*, *compiler(v.4.2.2)*, *textshaping(v.0.3.6)*, *cli(v.3.6.1)*, *rvest(v.1.0.3)*, *xml2(v.1.3.3)*, *labeling(v.0.4.2)*, *svGUI(v.1.0.1)*, *sass(v.0.4.5)*, *scales(v.1.2.1)*,

classInt(v.0.4-9), callr(v.3.7.3), proxy(v.0.4-27), systemfonts(v.1.0.4), digest(v.0.6.31), foreign(v.0.8-84), svglite(v.2.1.1), jpeg(v.0.1-10), pkgconfig(v.2.0.3), htmltools(v.0.5.5), sessioninfo(v.1.2.2), fastmap(v.1.1.1), htmlwidgets(v.1.6.2), rlang(v.1.1.0), shiny(v.1.7.4), farver(v.2.1.1), jquerylib(v.0.1.4), generics(v.0.1.3), jsonlite(v.1.8.4), dplyr(v.1.1.1), magrittr(v.2.0.3), Rcpp(v.1.0.10), munsell(v.0.5.0), fansi(v.1.0.4), lifecycle(v.1.0.3), stringi(v.1.7.12), yaml(v.2.3.7), pkgbuild(v.1.4.0), plyr(v.1.8.8), maptools(v.1.1-6), parallel(v.4.2.2), promises(v.1.2.0.1), crayon(v.1.5.2), miniUI(v.0.1.1.1), lattice(v.0.20-45), ps(v.1.7.3), pillar(v.1.9.0), codetools(v.0.2-19), pkgload(v.1.3.2), glue(v.1.6.2), evaluate(v.0.20), remotes(v.2.4.2), png(v.0.1-8), vctrs(v.0.6.1), httpuv(v.1.6.9), RgoogleMaps(v.1.4.5.3), gtable(v.0.3.3), purrr(v.1.0.1), tidyr(v.1.3.0), cachem(v.1.0.7), xfun(v.0.38), mime(v.0.12), xtable(v.1.8-4), e1071(v.1.7-13), later(v.1.3.0), ragg(v.1.2.5), viridisLite(v.0.4.1), class(v.7.3-21), tibble(v.3.2.1), memoise(v.2.0.1), units(v.0.8-1), ggmap(v.3.0.2) and *ellipsis(v.0.3.2)*

Apportioning in the non-breeding season - Case study 5

UKCEH and BioSS

24 August 2023

Summary

This report presents the apportioning of razorbill in the UK in the migration seasons (August to October; and January to March) for the UK North Sea and Channel waters BDMPS region. The number of razorbills was estimated to be 302313.6. The total bird density within the BDMPS region was estimated to be 0.89 km^{-2}. In total, 28 BDMPS colonies contributed to the apportioning calculations.

The accompanying User Guide to this tool describes the methods used to estimate bird metrics within the footprint. For this model run, only BDMPS is used to estimate apportioning and no levels of uncertainty are included in the estimates of apportioning.

User inputs

Table 1 shows the user-defined inputs to the analysis.

Table 1: Input parameter values for ANBS tool run

Parameter description	Parameter value
Species	Razorbill
Mode	map
BDMPS uncertainty scalar	0
Distance threshold (km)	0
Season	migration seasons (August to October; and January to March)

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Table 1: Input parameter values for ANBS tool run *(continued)*

Parameter description	Parameter value
BDMPS Region	UK North Sea and Channel waters

Table 2 shows colonies that are defined from the BDMPS populations and the size (number of pairs of breeding adults) of each population, whether a UK SPA, aggregate of UK non-SPA colonies, or aggregate of overseas colonies. In the ANBS tool, the number of pairs of breeding adults can be changed for any colony as part of the inputs so the table shows the population estimates used in the analysis.

Table 2: Input parameter values for ANBS tool run

Colony or population	Estimated pairs of breeding adults
Cape Wrath	2090
Denmark; Finland; Sweden	16000
East Caithness Cliffs	12500
Fair Isle	915
Faroe	4500
Flamborough and Filey	10001
Flannan Islands	1051
Forth Islands	2625
Foula	375
Fowlsheugh	3524
France	25
Handa	5165
Iceland	315400
Ireland	17000
Mingulay and Berneray	10111
North Caithness Cliffs	1700
North Rona and Sula Sgeir	1089
Norway	30300
Rathlin Island	15393

Table 2: Input parameter values for ANBS tool run *(continued)*

Colony or population	Estimated pairs of breeding adults
Russia	3500
Shiants	4248
Skomer and Skokholm	6001
St Abbs to Fast Castle	1219
St Kilda	1700
Troup; Pennan and Lions	1743
UK North Sea non-SPA colonies	10000
UK Western non-SPA colonies	10000
West Westray	550

Results

Apportioning tables

Table 3 shows the colonies and populations used in the apportioning calculations for the area of the UK North Sea and Channel waters BDMPS region.

Table 3: Colonies or populations used in the apportioning calculations, showing the number of adults, adults per sq. km, and proportion of adults from each BDMPS colony or population.

Colony or population	Number of adults	Adults per sq. km	Proportion of adults
Iceland	189240.0	0.554	0.626
East Caithness Cliffs	24999.8	0.073	0.083
Flamborough and Filey	20001.8	0.059	0.066
UK North Sea non-SPA colonies	19999.8	0.059	0.066
Norway	12120.0	0.035	0.040
Fowlsheugh	7047.9	0.021	0.023
Forth Islands	5249.9	0.015	0.017

Table 3: Colonies or populations used in the apportioning calculations, showing the number of adults, adults per sq. km, and proportion of adults from each BDMPS colony or population. *(continued)*

Colony or population	Number of adults	Adults per sq. km	Proportion of adults
Faroe	4500.0	0.013	0.015
Troup; Pennan and Lions	3486.0	0.010	0.012
North Caithness Cliffs	3230.0	0.009	0.011
Denmark; Finland; Sweden	3200.0	0.009	0.011
St Abbs to Fast Castle	2438.0	0.007	0.008
Fair Isle	1738.5	0.005	0.006
West Westray	1045.0	0.003	0.003
Foula	712.5	0.002	0.002
Ireland	680.0	0.002	0.002
Rathlin Island	615.7	0.002	0.002
Mingulay and Berneray	404.4	0.001	0.001
UK Western non-SPA colonies	400.0	0.001	0.001
Russia	350.0	0.001	0.001
Skomer and Skokholm	240.0	0.001	0.001
Handa	206.6	0.001	0.001
Shiants	169.9	0.000	0.001
Cape Wrath	83.6	0.000	0.000
St Kilda	68.0	0.000	0.000
North Rona and Sula Sgeir	43.6	0.000	0.000
Flannan Islands	42.0	0.000	0.000
France	0.5	0.000	0.000

Table 4 shows the colonies and populations used in the cumulative apportioning calculations for the area of the UK North Sea and Channel waters BDMPS region.

Table 4: Colonies or populations used in the apportioning calculations, showing the cumulative number of adults, cumulative adults per sq. km, and cumulative proportion of adults from each BDMPS colony or population.

Colony or population	Cumulative number of adults	Cumulative adults per sq. km	Cumulative proportion of adults
Iceland	189240.0	0.55	0.63
East Caithness Cliffs	214239.8	0.63	0.71
Flamborough and Filey	234241.5	0.69	0.77
UK North Sea non-SPA colonies	254241.3	0.74	0.84
Norway	266361.3	0.78	0.88
Fowlsheugh	273409.3	0.80	0.90
Forth Islands	278659.2	0.82	0.92
Faroe	283159.2	0.83	0.94
Troup; Pennan and Lions	286645.2	0.84	0.95
North Caithness Cliffs	289875.2	0.85	0.96
Denmark; Finland; Sweden	293075.2	0.86	0.97
St Abbs to Fast Castle	295513.2	0.87	0.98
Fair Isle	297251.7	0.87	0.98
West Westray	298296.7	0.87	0.99
Foula	299009.2	0.88	0.99
Ireland	299689.2	0.88	0.99
Rathlin Island	300304.9	0.88	0.99
Mingulay and Berneray	300709.3	0.88	0.99
UK Western non-SPA colonies	301109.3	0.88	1.00
Russia	301459.3	0.88	1.00
Skomer and Skokholm	301699.4	0.88	1.00
Handa	301906.0	0.88	1.00
Shiants	302075.9	0.88	1.00

Table 4: Colonies or populations used in the apportioning calculations, showing the cumulative number of adults, cumulative adults per sq. km, and cumulative proportion of adults from each BDMPS colony or population. *(continued)*

Colony or population	Cumulative number of adults	Cumulative adults per sq. km	Cumulative proportion of adults
Cape Wrath	302159.5	0.88	1.00
St Kilda	302227.5	0.89	1.00
North Rona and Sula Sgeir	302271.0	0.89	1.00
Flannan Islands	302313.1	0.89	1.00
France	302313.6	0.89	1.00

RAG status

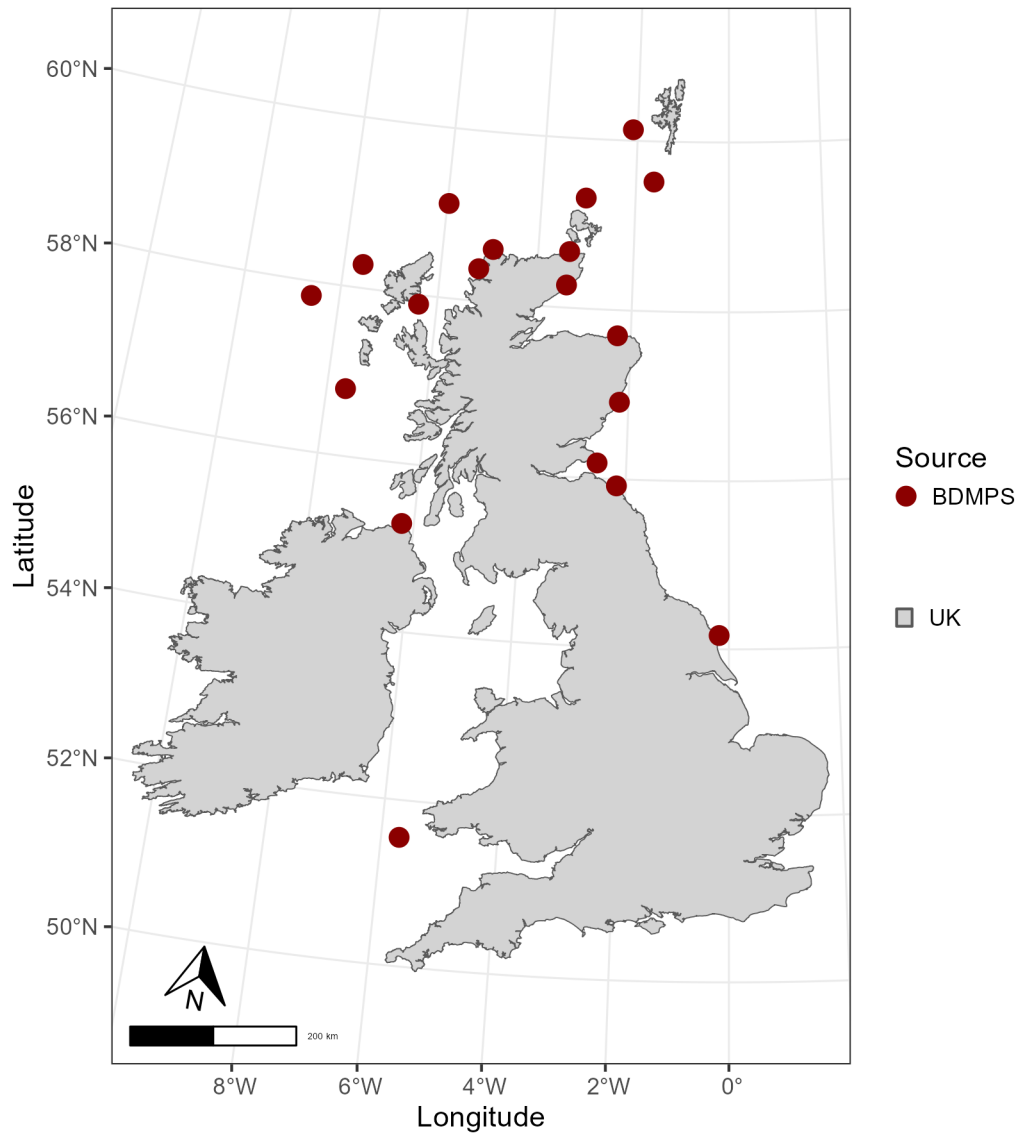Fig. 1 shows the BDMPS colonies that contribute to the final apportioning in the analysis (red circles).

Figure 1: RAG status map showing colonies used in the analysis. Red = BDMPS

Caveats and limitations

- Currently, only adult breeding birds are considered within the apportioning calculation. Immature birds and non-breeding adults are not considered in this iteration of the ANBS tool.

Apppendix

System information used in the analysis

The information below shows the system information used in the analysis including the version of R, platform, locale, and packages with version numbers.

R version 4.2.2 (2022-10-31 ucrt)

Platform: x86_64-w64-mingw32/x64 (64-bit)

locale: *LC_COLLATE=English_United Kingdom.1252*, *LC_CTYPE=English_United Kingdom.1252*, *LC_MONETARY=English_United Kingdom.1252*, *LC_NUMERIC=C* and *LC_TIME=English_United Kingdom.1252*

attached base packages: *grid, stats, graphics, grDevices, utils, datasets, methods* and *base*

other attached packages: *tictoc(v.1.1), pander(v.0.6.5), formatR(v.1.14), ggsn(v.0.5.0), ggspatial(v.1.1.7), svDialogs(v.1.1.0), patchwork(v.1.1.2), tinytex(v.0.44), kableExtra(v.1.3.4), stringr(v.1.5.0), devtools(v.2.4.5), usethis(v.2.1.6), ggplot2(v.3.4.1), rgeos(v.0.6-2), gdistance(v.1.6), Matrix(v.1.5-3), igraph(v.1.4.1), raster(v.3.6-20), sp(v.1.6-0), sf(v.1.0-12), terra(v.1.7-18), knitr(v.1.42), rmarkdown(v.2.21), rstudioapi(v.0.14)* and *pacman(v.0.5.1)*

loaded via a namespace (and not attached): *bitops(v.1.0-7), fs(v.1.6.1), webshot(v.0.5.4), httr(v.1.4.5), tools(v.4.2.2), profvis(v.0.3.7), bslib(v.0.4.2), rgdal(v.1.6-5), utf8(v.1.2.3), R6(v.2.5.1), KernSmooth(v.2.23-20), DBI(v.1.1.3), colorspace(v.2.1-0), urlchecker(v.1.0.1), withr(v.2.5.0), tidyselect(v.1.2.0), prettyunits(v.1.1.1), processx(v.3.8.0), compiler(v.4.2.2), textshaping(v.0.3.6), cli(v.3.6.1), rvest(v.1.0.3), xml2(v.1.3.3), labeling(v.0.4.2), svGUI(v.1.0.1), sass(v.0.4.5), scales(v.1.2.1), classInt(v.0.4-9), callr(v.3.7.3), proxy(v.0.4-27), systemfonts(v.1.0.4), digest(v.0.6.31), foreign(v.0.8-84), svglite(v.2.1.1), jpeg(v.0.1-10), pkgconfig(v.2.0.3), htmltools(v.0.5.5), sessioninfo(v.1.2.2), fastmap(v.1.1.1), htmlwidgets(v.1.6.2), rlang(v.1.1.0), shiny(v.1.7.4), farver(v.2.1.1), jquerylib(v.0.1.4), generics(v.0.1.3), jsonlite(v.1.8.4), dplyr(v.1.1.1), magrittr(v.2.0.3), Rcpp(v.1.0.10), munsell(v.0.5.0), fansi(v.1.0.4), lifecycle(v.1.0.3), stringi(v.1.7.12), yaml(v.2.3.7), pkgbuild(v.1.4.0), plyr(v.1.8.8), maptools(v.1.1-6), parallel(v.4.2.2), promises(v.1.2.0.1), crayon(v.1.5.2), miniUI(v.0.1.1.1), lattice(v.0.20-45), ps(v.1.7.3), pillar(v.1.9.0), codetools(v.0.2-19), pkgload(v.1.3.2), glue(v.1.6.2), evaluate(v.0.20), remotes(v.2.4.2), png(v.0.1-8), vctrs(v.0.6.1), httpuv(v.1.6.9), RgoogleMaps(v.1.4.5.3), gtable(v.0.3.3), purrr(v.1.0.1), tidyr(v.1.3.0), cachem(v.1.0.7), xfun(v.0.38), mime(v.0.12), xtable(v.1.8-4), e1071(v.1.7-13), later(v.1.3.0), ragg(v.1.2.5), viridisLite(v.0.4.1), class(v.7.3-21), tibble(v.3.2.1), memoise(v.2.0.1), units(v.0.8-1), ggmap(v.3.0.2)* and *ellipsis(v.0.3.2)*