



Short-Term Behavioural Responses of Wintering Waterbirds to Marine Activity: Appendix 3

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Appendix 3

Existing Survey Data for Wintering Inshore Seabirds and Licensed Activities in Orkney and the Western Isles

Quantifying the Sensitivity of Waterbird Species during the Non-Breeding Season to Marine Activities in Orkney and the Western Isles

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1. Introduction

The purpose of this short report is to present the existing data sources on the distribution and abundance of the target species of waterbirds and the location of licensed marine activities within the regions of interest: Orkney and the Western Isles. In addition these data will be used to inform the selection of the most suitable study sites for field work in the winter of 2016/2017 as part of WP3.

In terms of carrying out shore based observations of interactions between birds and marine licenced activities, areas with the highest levels of marine activities should be targeted in order to maximise the chances of recording interactions with the target species. Although areas of low activity could also be included, there is a risk of insufficient data on number of interactions been collected. However, it will be important to select sites that represent both high and low densities (and medium, if possible) of wintering inshore species so that any interactions observed are representative of how birds are likely to respond based on numbers of birds/flock size. Significant gaps in survey coverage of the target species of wintering waterbirds can also be used inform the selection of appropriate sites for potential additional survey effort.

2. Methods

2.1 Bird Data

Relevant aerial and land based surveys for Orkney and the Western Isles (Figure 1) were identified during the project initiation meeting. European Seabirds at Sea (ESAS) data were not included because the focal species are prone to disturbance and such surveys are likely to underestimate total numbers (Schwemmer et al. 2011). ESAS surveys are also largely conducted further offshore, outside the typical spatial range of sea ducks, divers and grebes (*pers. comm.* Mark Lewis, JNCC). WWT aerial surveys conducted in the Western Isles were during the summer months and therefore also excluded, and poor resolution of digital aerial data collected for the Pentland Firth prevented the inclusion of these data (individual species of ducks and divers could not be differentiated between).

Land based counts for Orkney and the Western Isles were available from the BTO Wetland Bird Survey (WeBS) (<http://www.bto.org/volunteer-surveys/webs/data>) and the BTO Non-Estuarine Waterbird Survey (NEWS) (<https://www.bto.org/volunteer-surveys/webs/taking-part/non-estuarine-waterbird-survey-iii>). WeBS data are

collected monthly and we only included winter surveys (October-March) between 2000-2016 which had been conducted in coastal habitats (as opposed to all wetland habitats covered by the scheme). NEWS is conducted during December/January approximately every nine years and we included data collected during the last survey, completed 2015/16. Land-based counts (based on Vantage Points) of the focal species conducted between October and March were also available for the west coast of Lewis (Hall et al. 2014), Scapa Flow (EMEC 2011a) and Shapinsay Sound (EMEC 2011b), and all land-based surveys are presented as the peak sightings per species. Lawson et al. (2015) also used distance sampling to generate estimates of population size in three specified areas within the study areas based on visual aerial and land-based surveys of wintering divers, seabirds and grebes. Finally, density surface profiles of four species were constructed for the Scotland Marine SPA consultation; these included Long-tailed Duck, Great Northern Diver, Common Eider and Red-breasted Merganser (SNH 2016). Land-based counts rarely detect birds beyond 2 km from the coast (Webb and Reid 2004), therefore, this distance is used to set a maximum observation buffer for land-based surveys in order to identify areas with minimal survey coverage.

2.2. Licensed Activities Data

The concentration of licensed activities around Orkney and the Western Isles was assessed using the local distribution of different fisheries, aquaculture, offshore energy operations (renewable and hydrocarbon), aggregate mining and shipping (see Table 3 for data sources). Recreational shipping activities are largely restricted to the summer months and were therefore excluded. In addition, fisheries that are largely operational during the summer months were excluded: i.e. squid and herring.

All data were supplied as discrete shapefiles, with the exception of fisheries, shipping and dredging (Table 2). Fisheries data were supplied as raster images of effort for each fleet. To generate polygon shape files we grouped the rasters for each fishery (i.e., commercial vessels <1 5m; demersal, pelagic, Nephrops and shellfish, see Table 2), and bounded the area that exceeded the average level of activity for the UK. This enabled a comparison across multiple activities to identify areas of concentrated usage. Manipulation of raster files was conducted in program R using the statistical package “raster” (Hijmans et al. 2016). The polygons for shipping and dredging were also bounded to areas that experience levels of activity above the national average.

3. Results

3.1. Overlap Between Sea Duck Distribution and Concentration of Marine Activities

Land based data collected by BTO WeBS, BTO NEWS, Lawson et al. (2016), EMEC (2011a) and EMEC (2011b) show high numbers of wintering sea ducks, divers and grebes in Orkney. In particular, Scapa Flow, Shapinsay Sound and the north coast of South Ronaldsay experience high concentrations and diversity (Figure 2B; Figure 3). Density surface models also highlight the north coast of Hoy, and the strait between Rousay and Kirkwall, to experience high concentrations of multiple species (Figure 2C-F; SNH, 2016). However, all of these areas experience more than one licensed activity, specifically aquaculture and greater than average concentrations of shipping and fishing from commercial vessels under 15 m (Figure 4).

Land based data collected by BTO WeBS, BTO NEWS, Lawson et al. (2016) and Hall et al. (2014) show large variation in seaduck, diver and grebe density wintering in the western Isles. High concentrations and diversity occurred in Loch Roag, Broad Bay and the north coast of Harris (Figure 5B, Figure 6), and density surface models highlighted the south coast of South Uist and the north coast of North Uist to also experience high concentrations of multiple species (Figures 5C-F; SNH 2016). These areas do not currently experience more than one licensed activity, with the exception of Loch Roag which experiences aquaculture and high levels of fishing effort from commercial vessels under 15 m (Figure 7E). In addition, there is a wave energy development off the coast from Loch Roag (Figure 7C).

3.2. Areas of Concentrated Activities that Lack Survey Coverage for Sea Ducks

Survey coverage of the Orkney Archipelago coast line for wintering sea ducks is almost exhaustive, albeit with different methodologies. The northern islands, western mainland and the south coast of Hoy have not been aerially surveyed, however land-based data are available for the majority of these areas, with the exception of Hoy (Figure 2A). Several licensed activities operate in the waters of the northern islands and western mainland, including tidal and wave energy developments, shipping, aquaculture, fishing activity from commercial vessels under 15 m, and shellfish fishing (Table 4; Figure 4). In contrast, the south coast of Hoy currently experiences little activity. Consequently, survey work aimed at increasing

our understanding of birds in areas of concentrated activity should focus on the northern islands and western mainland (Table 4).

The west coast of the Western Isles has been extensively surveyed from the air and land, however the east coast of Harris is limited in coverage (Figure 5A), and the recent NEWS survey indicates that at least some of the coastline may be important for wintering red-breasted merganser (Figure 6). The eastern coast experiences several concentrated activities; including shipping, aquaculture, fishing from commercial vessels under 15 m, shellfish fishing, Nephrops fishing, and off the east coast of Lewis, pelagic fishing (Table 5; Figure 7). Consequently, survey work to increase our understanding of birds in areas of concentrated activity should focus on the eastern coasts of Uist, Harris and Lewis (Table 5).

Table 1

Survey data for seabirds and divers in the near shore waters of Orkney.

Location	Duration	Data Type	Reference	Data Processing	
<i>Orkney</i>	Scapa Flow (South of Mainland Orkney)	Dec 2002; Feb 2004; Mar 2005; Jan 2006; Feb 2006	Visual aerial	Lawson et al. (2015)	Distance sampling
		Winter seasons of: 1998/99, 2000/01; 2006/07	Land (incl. BTO WeBS) and Boat	Lawson et al. (2015)	Distance sampling
		Monthly: Oct 2010 – Feb 2011	Land	EMEC, 2011	None
				SNH (2016)	Density Surface modelling
	North Mainland Orkney	Winter seasons of: 2005/06, 2006/07; 2007/08	Visual aerial	Lawson et al. (2015)	Distance sampling
		Winter seasons of: 2007/08; 2008/09	Land (incl. BTO WeBS)	Lawson et al. (2015)	Distance sampling
				SNH (2016)	Density Surface modelling
Shapinsay Sound	Monthly: Oct 2010 – Feb 2011	Land	EMEC, 2011b	None	
Pentland Firth	Winter seasons of: 2010/11; 2012/13	Digital aerial	APEM, 2013	None	
All Orkney	Winter seasons of: 1985; 1997/98; 2006/07; 2015/16	Land (BTO NEWS)	-	-	
	Monthly 1981-2016 (predominantly Mainland)	Land (BTO WEBS)	-	-	

Table 2

Survey data for seabirds and divers in the near shore waters of the Western Isles.

Location		Duration	Data Type	Reference	Data Processing
<i>Western Isles</i>	West coast of Lewis	Dec 2012; Feb 2013	Digital aerial	Hall et al., 2014	None
		Dec 2012; Feb 2013	Land	Hall et al., 2014	None
		Monthly 1981-2016	Land (BTO WEBS)	-	-
	Loch Roag	Apr 2012; Jan 2013; Feb 2013		Hall et al., 2014	None
	West coast of Uist	Mar 2003; Feb 2004; Mar 2005; Jan 2006; Mar 2007	Visual aerial	Lawson et al. (2015)	Distance sampling
		Winter seasons of: 2007/08, 2008/09; 2009/10	Land (incl. BTO WeBS)	Lawson et al. (2015)	Distance sampling
		Monthly 1981-2016	Land (BTO WEBS)	-	-
				SNH (2016)	Density surface modelling
	Uist	Winter seasons of: 1985; 1997/98; 2006/07; 2015/16	Land (BTO NEWS)	-	-
	Broad Bay	Feb 2009, Mar 2009; Feb 2010	Visual aerial	Lawson et al. (2015)	Density-surface modelling

Winter seasons of: 07/08; 08/09; 09/10	Land	Lawson et al. (2015)	Density-surface modelling
Winter seasons of: 1985; 1997/98; 2006/07; 2015/16	Land (BTO NEWS)	-	-
Monthly 1981-2016	Land (BTO WEBS)	-	-

Table 3

Licensed activities and data source.

Licensed Activity	Time Period	Source
<i>Fishing</i>		
Commercial vessels (<15m)	2007-2011	http://www.gov.scot/Topics/marine/science/MSInteractive/Themes/fish-fisheries
Commercial vessels (>15m)	2009-2013	
Demersal: mobile, static		
Pelagic: mackerel		
Nephrops: mobile, static		
Shellfish: lobster, scallop, crab		
Aquaculture (Active and Inactive)	2016	http://marine.gov.scot/maps/aquaculture-finfish-shellfish-and-fishery-sites-31082016
Shellfish, finfish, fishery site		
<i>Offshore energy operations</i>		
Hydrocarbons	2016	https://www.gov.uk/guidance/oil-and-gas-offshore-maps-and-gis-shapefiles
Licensed blocks and wells		
Renewables	2016	http://www.thecrownestate.co.uk/energy-minerals-and-infrastructure/downloads/maps-and-gis-data/
Wind farm: Area of search, consented, in operation, pre-planning application, under construction		
Tidal: Leased sites		
Wave: Leased sites		
<i>Aggregates</i>		
Licensed blocks, mines and exploration areas	2015	http://www.thecrownestate.co.uk/energy-minerals-and-infrastructure/downloads/marine-aggregate-downloads/
Vessels engaged in dredging or underwater operations	2013	https://data.gov.uk/dataset/mmo1066-vessel-density-grid-2013
<i>Shipping</i>		

Un-known vessels; Non-port
service craft; port service craft;
high-speed craft; military and
law enforcement; passenger;
cargo; tankers

2013 [https://data.gov.uk/dataset/mmo1066-
vessel-density-grid-2013](https://data.gov.uk/dataset/mmo1066-vessel-density-grid-2013)

Table 4

Areas in Orkney without density surface modelling for the focal species and the licensed activities present.

Area with limited survey coverage	Licensed activities present
1. Pentland Firth	Shipping; Fishery <15m
2. West of Mainland	Wave; Fishery <15m
3. Stronsay	Tidal; Shipping; Fishery <15m; Shellfish fishery; Aquaculture
4. Eday	Tidal; Shipping; Fishery <15m; Shellfish fishery; Aquaculture
5. North Ronaldsay	Fishery <15m; Shellfish fishery

Table 5

Areas in the Western Isles without density surface modelling for the focal species and the licensed activities present.

Area with limited survey effort	Licensed activities present
East coast of North and South Uist	Fishery <15m; Nephrops fishery; Shellfish fishery; Shipping; Aquaculture
East coast of Lewis and Harris	Fishery <15m; Nephrops fishery; Shellfish fishery; Pelagic fishery; Shipping; Aquaculture

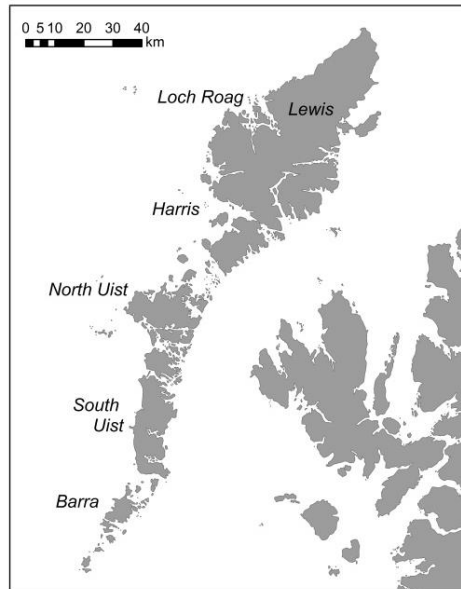


Figure 1: Reference maps for Orkney and the Western Isles (projection British National Grid).

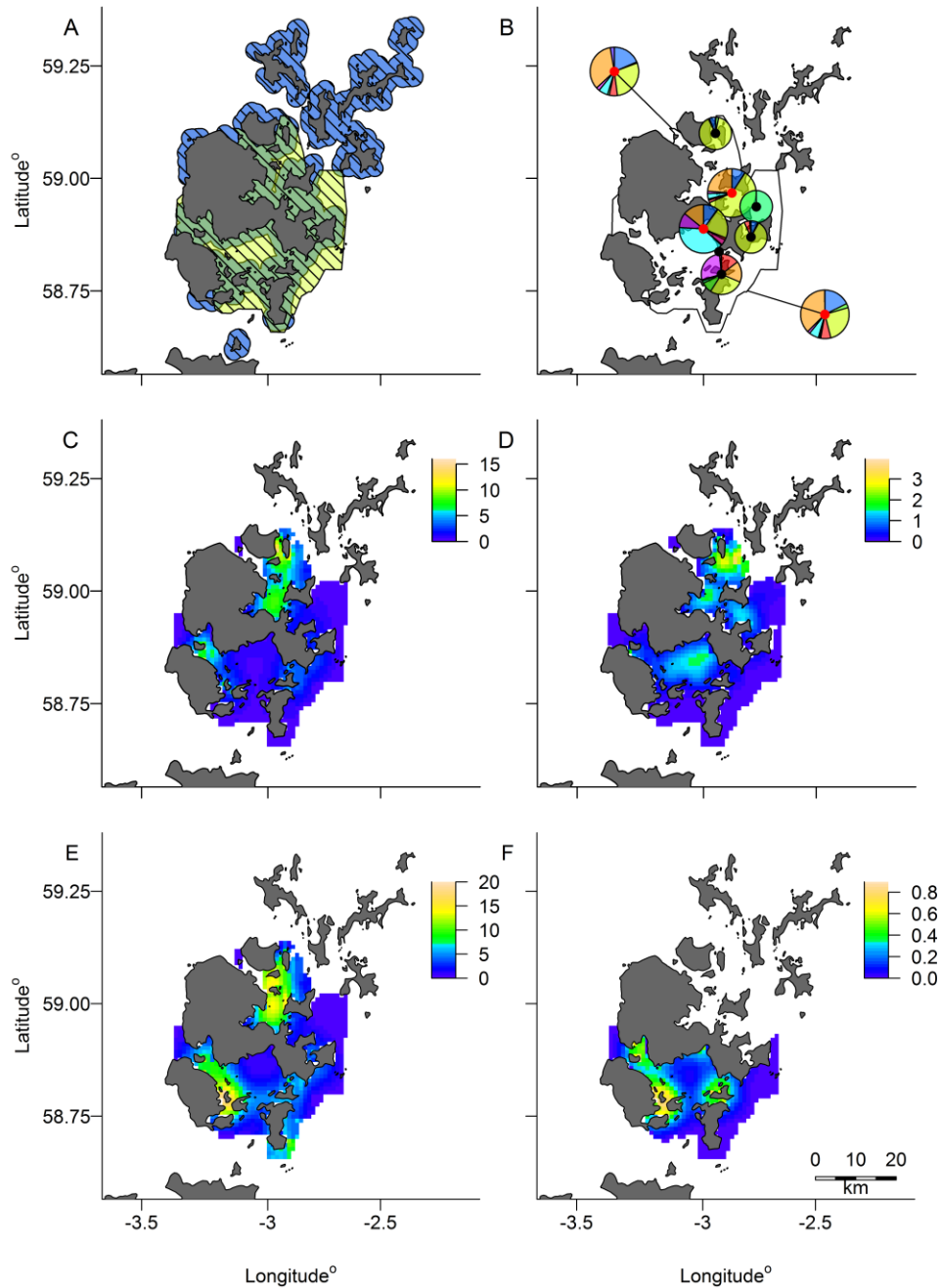


Figure 2: A) Identified coverage of aerial (yellow hatched) and land-based (light-blue hatched) survey efforts in Orkney that can be used to assess the distribution of seabird species; B) Maximum count per survey for each species from the coastal WEBS survey (black points) and the data reported by EMEC (2011a, 2011b) and Lawson et al. (2015) (red points; Lawson et al. report estimated population size for the two marked areas, North Mainland and Scapa Flow) (smallest pie maximum 100-500 total birds per survey; second size class pie maximum 500-1000 birds per survey, largest pies maximum 1000+ birds per survey; red – Red-breasted Merganser; orange – European Shag; yellow - Common Eider; bright green - Common Goldeneye; pale green - Red-throated Diver; light blue – Great Northern diver; dark blue – Long-tailed Duck; purple – Velvet Scoter; magenta – Black-throated Diver); C) Density surface model output for Long-tailed Duck (SNH 2016) D) Density surface model output for Great Northern Diver (SNH 2016); E) Density surface model output for Common Eider (SNH 2016); F) Density surface model output for Red-breasted Merganser (SNH 2016) (all maps are projection British National Grid).



Figure 3: Coverage of study species based on data collected under the BTO NEWS in the Orkney Islands 2015/16.

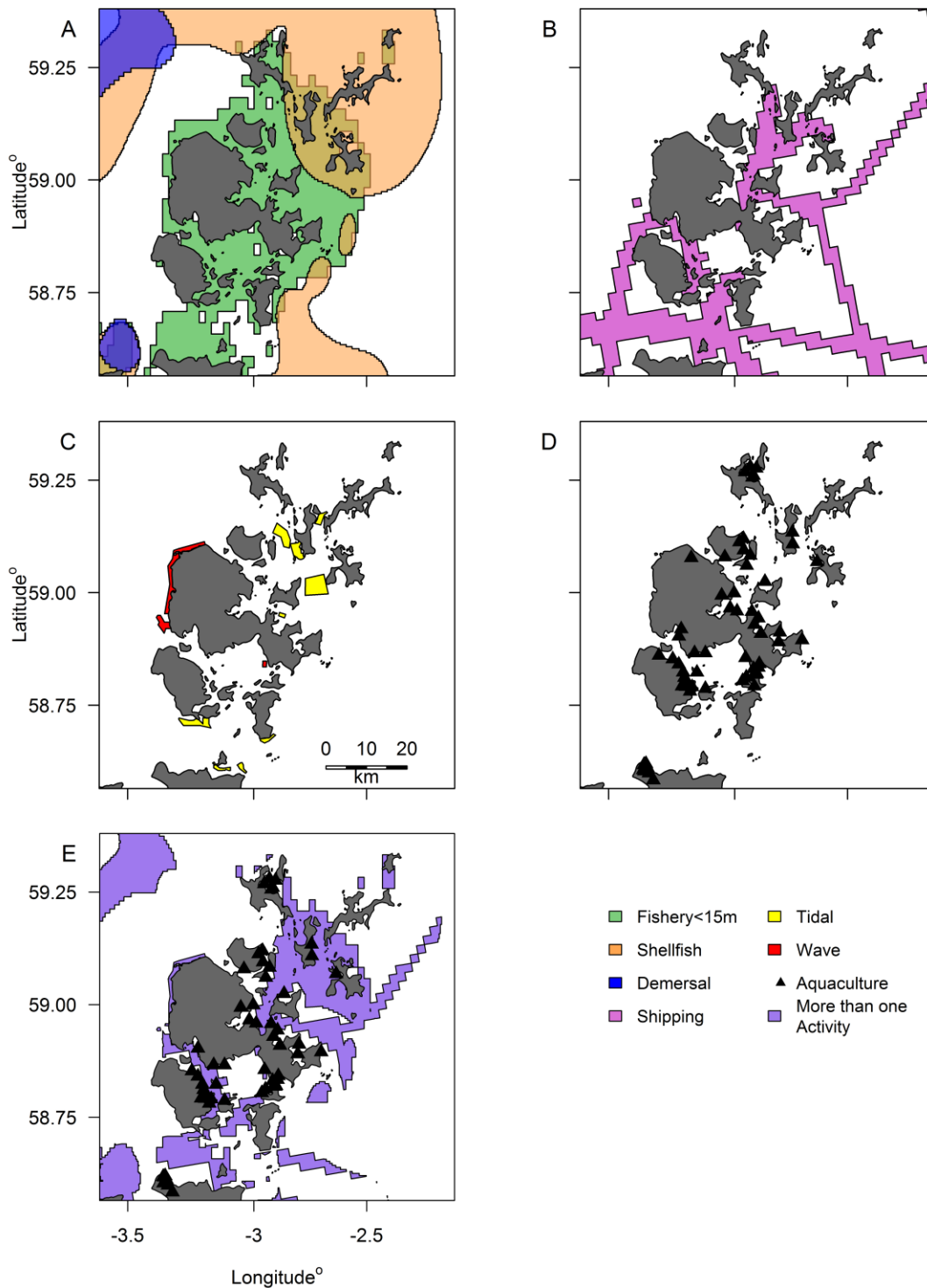


Figure 4: A) Areas with greater than national average fishing activities in Orkney by fleet; B) Areas with greater than national average shipping activity in Orkney; C) Offshore renewable energy developments in Orkney; D) Distribution of aquaculture in Orkney; and E) Areas with more than one licensed activity present; aquaculture sites that overlap other activities shown as triangles (all maps are projection British National Grid).

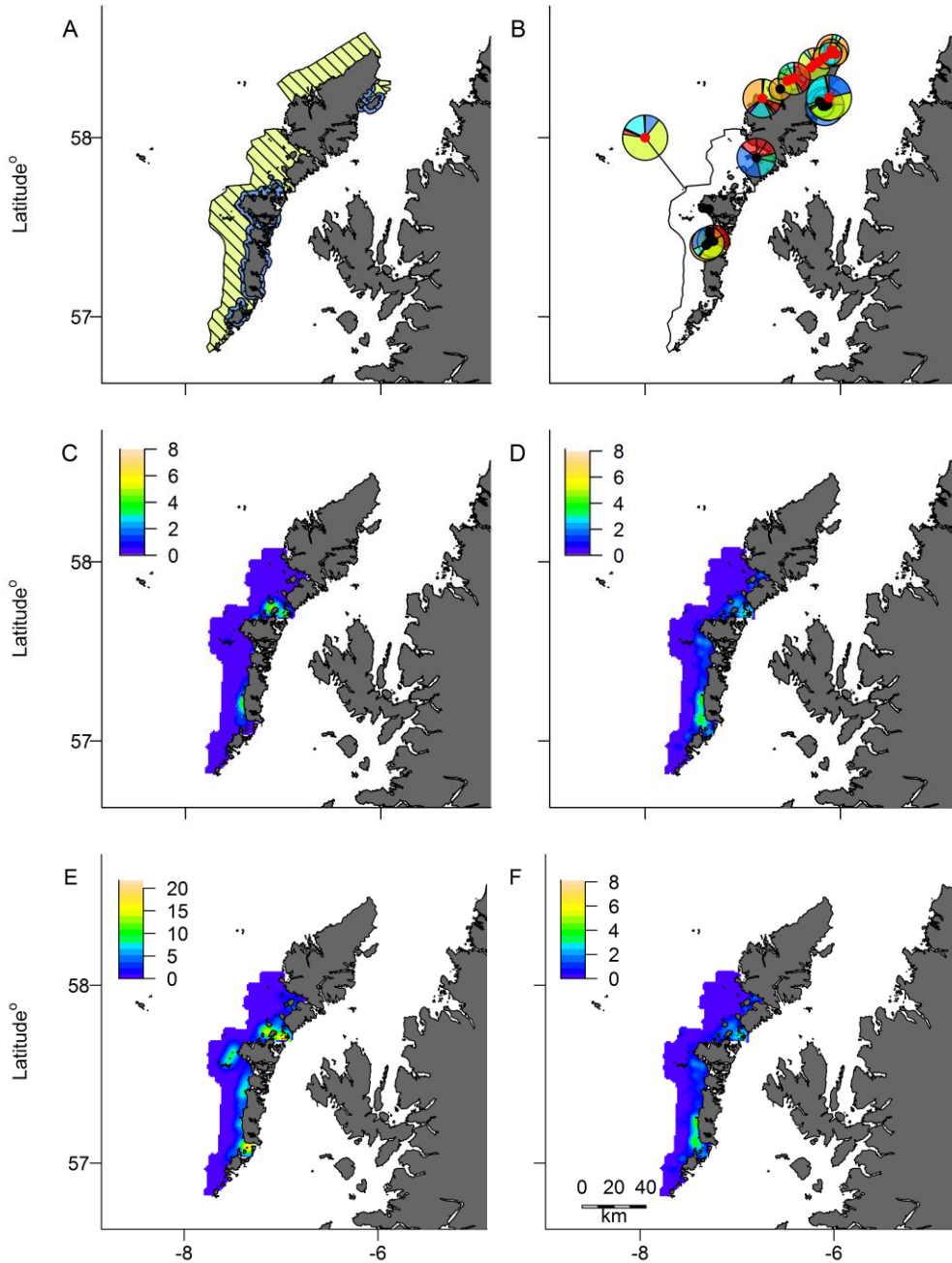


Figure 5: A) Identified coverage of all aerial (yellow hatched) and land-based (light-blue hatched) survey efforts in the Western Isles that can be used to assess the distribution of seaduck species; B) Maximum count per survey for each species from the coastal WEBS survey (black points) and the data reported by Hall et al.(2014) and Lawson et al. (2015) (red points; Lawson et al. report estimated population size for the marked area; West Uist) (smallest pie 1-10 birds per survey; second size class pie 10-100 birds per survey, third size class pie 100-500 birds per survey, largest pies 1000+ birds per survey; red - red breasted merganser; orange - shag; yellow - eider; bright green - goldeneye; pale green - red-throated diver; light blue – great northern diver; dark blue – long tailed duck; purple – velvet scoter; magenta – black throated diver); C) Density surface model output for long-tailed duck (SNH 2016); D) Density surface model output for great northern diver (SNH 2016); E) Density surface model output for eider (SNH 2016); F) Density surface model output for red-breasted meganser (SNH 2016) (all maps are projection British National Grid).



Figure 6: Coverage of study species based on data collected under the BTO NEWS in the Western Islands 2015/16.

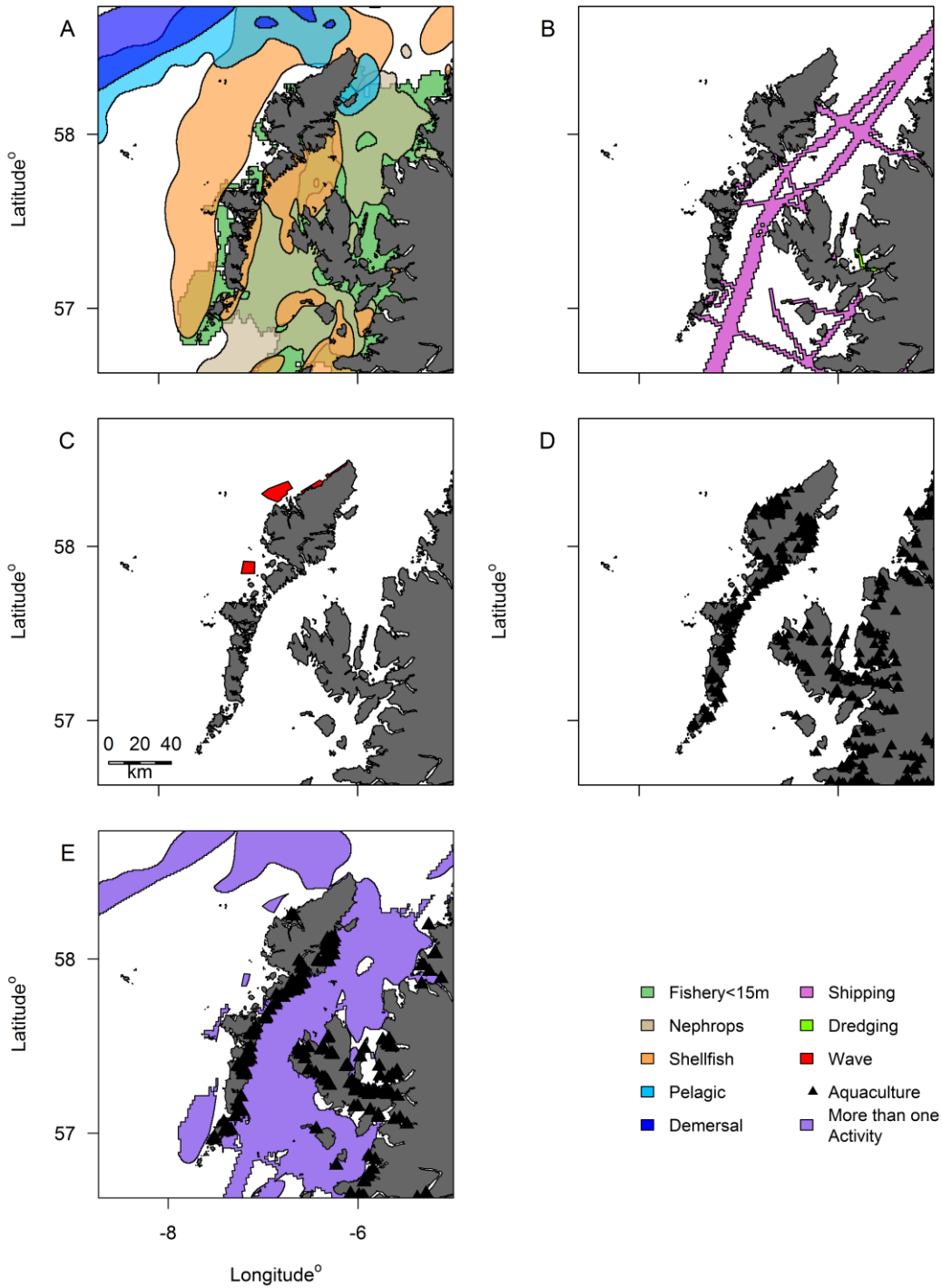


Figure 7: A) Areas with greater than national average fishing activities in the Western Isles by fleet; B) Areas with greater than national average shipping and dredging activity in the Western Isles; C) Offshore renewable energy developments in the Western Isles; D) Distribution of aquaculture in the Western Isles; and E) Areas with more than one licensed activity present; aquaculture sites that overlap other activities shown as triangles (all maps are projection British National Grid).

4. Acknowledgements

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5. Bibliography

- APEM. 2013. Year 2: Investigation of the utilisation of sea space by sea birds in the Pentland Firth & Orkney area 2012 / 13. Scottish Government, Edinburgh.
- EMEC. 2011a. Scapa Flow Scale Site : Environmental Description. European Marine Energy Centre Ltd, Stromness.
- EMEC. 2011b. Shapinsay Sound Scale Site : Environmental Description. European Marine Energy Centre Ltd, Stromness.
- Hall, L. M., R. J. Smith, E. S. Munro, I. Matejusova, C. E. T. Allan, A. G. Murray, S. J. Duguid, N. K. G. Salama, A. J. A. Mcbeath, I. S. Wallace, N. Bain, and R. S. Raynard. 2014. Strategic surveys of seabirds off the west coast of Lewis to determine use of seaspace in areas of potential marine renewable energy developments. *Scottish Marine and Freshwater Science* 5:1–162.
- Hijmans, R. J., J. van Etten, J. Cheng, M. Mattiuzzi, M. Sumner, J. A. Greenberg, O. P. Lamigueiro, A. Bevan, E. B. Racine, and A. Shortridge. 2016. raster: geographic data analysis and modeling. <https://cran.r-project.org/web/packages/raster/raster.pdf>.
- Lawson, J., K. Kober, I. Win, C. Bingham, N. E. Buxton, G. Mudge, A. Webb, J. B. Reid, J. Black, L. Way, and S. O'Brien. 2015. An assessment of numbers of wintering divers, seaduck and grebes in inshore marine areas of Scotland.
- Schwemmer, P., B. Mendel, N. Sonntag, V. Dierschke, and S. Garthe. 2011. Effects of ship traffic on seabirds in offshore waters: implications for marine conservation and spatial planning. *Ecological Applications* 21:1851–1860.
- SNH. 2016. Marine SPA consultation. Scottish National Heritage, Inverness.
- Webb, A., and J. B. Reid. 2004. Annex B: Guidelines for the selection of marine SPAs for aggregations of inshore non-breeding waterbirds. Joint Nature Conservation Committee, Peterborough.