Atlantic Puffin *Fratercula arctica*

Summary

Atlantic Puffin is projected to decline considerably in population size in the INTERREG VA area from 1998-2002 to 2050 under climate change, particularly in the north. Overall, Atlantic Puffin is projected (with poor confidence) to have high vulnerability under climate change in the INTERREG VA area.

Table 1. Current (observed) and future (projected) Atlantic Puffin population size (breeding pairs) in GB & Ireland, INTERREG VA area and MarPAMM management areas.

Area	1998-2002	Projection for 2050
GB & Ireland	600751	68588 ↓-89%
INTERREG VA area	241671	16731 ↓-93%
Argyll	2333	196 ↓-92%
Co. Down – Co. Louth	0	0
N Coast Ireland – N Channel	3201	483 ↓-85%
Outer Hebrides	234666	15903 ↓-93%

Under climate change, Atlantic Puffin **population size** is projected to **decline** considerably in the INTERREG VA area between 1998-2002 and 2050, at a higher rate than across Britain and Ireland as a whole (Table 1, Fig. 2a).

Atlantic Puffin is projected to decline in abundance everywhere across the INTERREG VA area, but at a greater rate in the north (Fig. 2a). It is unlikely that new sites will become more suitable for Atlantic Puffin under climate change (Fig. 2b); therefore this projected decline in abundance is unlikely to be compensated for by colonisation.

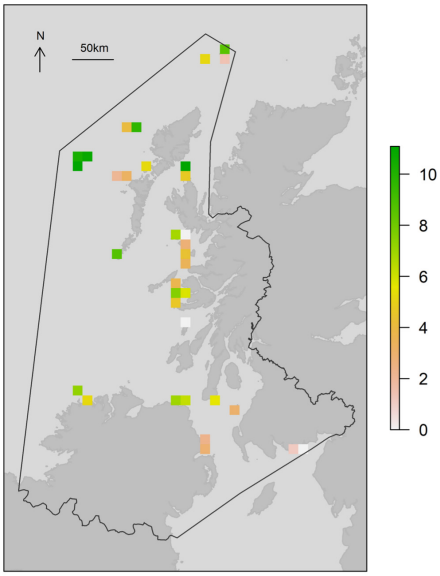

Figure 1. Observed Atlantic Puffin abundance (log breeding pairs), 1998-2002. Black polygon = INTERREG VA area.

This work was produced as part of the Marine Protected Area Management and Monitoring (MarPAMM) project. MarPAMM has been supported by the European Union's INTERREG VA Programme, managed by the Special EU Programmes Body.

Projected change in breeding pairs

Projected change in presence probability

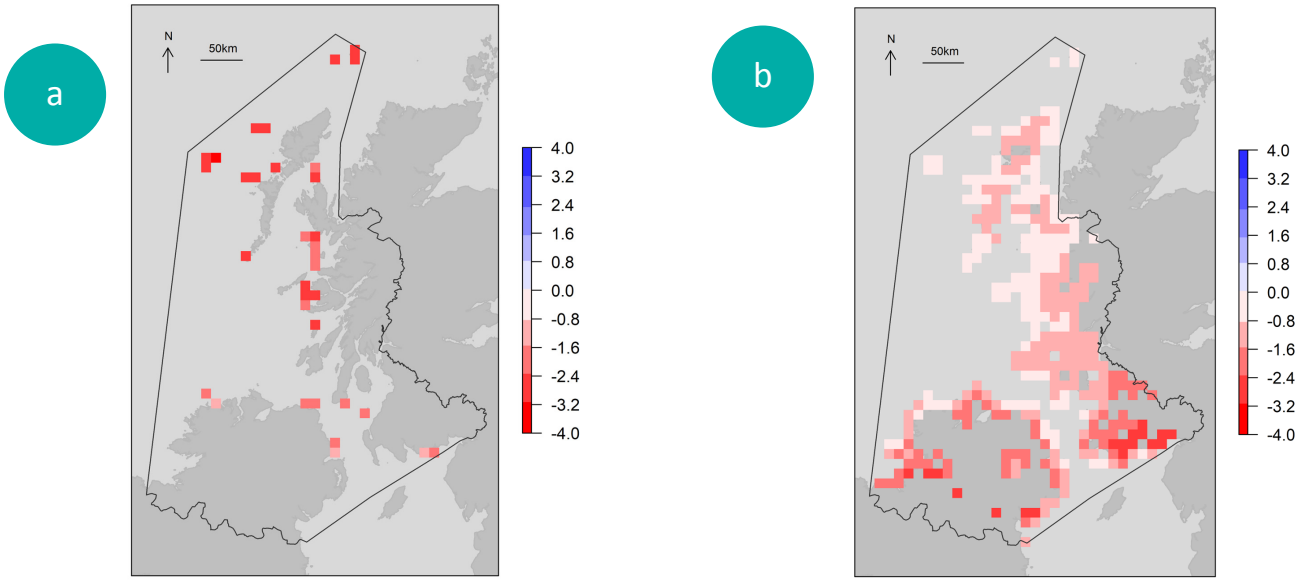

Figure 2. Projected change (1998-2002 to 2050; log proportional change) in: a) Atlantic Puffin breeding pairs, for all cells where Atlantic Puffin was present in 1998-2002; (b) Atlantic Puffin presence probability for all squares where any seabird was censused in 1985-1988 or 1998-2002. White/blue = increase, red = decrease. Black polygon = INTERREG VA area.

Model predictive power was good for the presence/absence component of the model, and moderate for the abundance component*. Atlantic Puffin presence/absence and abundance had significant relationships with terrestrial climate and nuisance variables (Table 2).

Table 2. Effect on presence and abundance for significant variables in model*. Variables included in table if significant in at least one model component; field left blank if variable not significant in that model component. Variables shown in parentheses represent quadratic terms. Projections made using full model (i.e. not just significant variables).

Variable	Presence	Abundance
Breeding season maximum temperature	-	
Winter minimum temperature	+	
Winter precipitation	-	
Coast length	+	+
Distance inside coast	-	-

Table 3. Projected change for Atlantic Puffin at the ten sites with the most breeding pairs in 1998-2002. Sites are as defined in Seabird 2000 census. Superscript denotes MarPAMM management region, where applicable: [A], Argyll; [B], Co. Down - Co. Louth; [C], North Coast Ireland - North Channel; [D], Outer Hebrides.

Site	Breeding pairs, 1998-2002 (count)	Projected breeding pairs, 2050 (median & 95% CI*)	Projected % change in breeding pairs (median & 95% CI*)
Shiant Islands[D]	65170	6016 (474, 37460)	-90.8 (-99.3, -42.5)
Dun, St Kilda[D]	55417	3659 (67, 49777)	-93.4 (-99.9, -10.2)
Boreray, St Kilda[D]	50999	1974 (20, 75503)	-96.1 (-100, +48)
Soay, St Kilda[D]	27600	1576 (23, 33010)	-94.3 (-99.9, +19.6)
Flannan Isles[D]	15761	1276 (18, 39837)	-91.9 (-99.9, +152.8)
Hirta, St Kilda[D]	8248	523 (9, 8131)	-93.7 (-99.9, -1.4)
North Rona[D]	5265	438 (8, 14340)	-91.7 (-99.8, +172.4)
Mingulay[D]	3827	270 (6, 3713)	-93 (-99.8, -3)
Berneray[D]	1979	139 (3, 1920)	-93 (-99.8, -3)
Treshnish Isles[A]	1904	160 (3, 3083)	-91.6 (-99.8, +61.9)

* See main report for details of modelling, variables, categories of model predictive power and derivation of confidence intervals for projections.

Climate Change Mechanisms

The review of climate change mechanisms affecting seabirds (Johnston et al. 2021) identified largely indirect effects of climate variation on Atlantic Puffin demography, through food supply. The relationship between Atlantic Puffin productivity and SST varies around the north-east Atlantic, depending on the effects of SST on the spring plankton bloom. Similarly, effects of SST and NAO on Atlantic Puffin breeding phenology vary around the region, but can be important in some areas. There may be a hump-shaped relationship between SST and Atlantic Puffin survival, and survival can follow a lagged response to the previous breeding season's conditions.

Overall, climate change is projected (with **poor confidence**) to present Atlantic Puffin with **high risk** and **low opportunity** in the INTERREG VA area.

Citation: Atlantic Puffin factsheet. From Davies, J.G., Humphreys, E.M. & Pearce-Higgins, J.W. 2021. Projected future vulnerability of seabirds within the INTERREG VA area to climate change. Report to Agri-Food and Biosciences Institute and Marine Scotland Science as part of the MarPAMM Project. BTO, Thetford

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www.mpa-management.eu