

This is a repository copy of *Protected areas do already act as steppingstones for species responding to climate change*.

White Rose Research Online URL for this paper:

<https://eprints.whiterose.ac.uk/id/eprint/203603/>

Version: Accepted Version

Article:

Gillingham, Phillipa and Thomas, Chris D orcid.org/0000-0003-2822-1334 (2023)
Protected areas do already act as steppingstones for species responding to climate change. *Global Change Biology*. ISSN: 1354-1013

<https://doi.org/10.1111/gcb.16941>

Reuse

This article is distributed under the terms of the Creative Commons Attribution (CC BY) licence. This licence allows you to distribute, remix, tweak, and build upon the work, even commercially, as long as you credit the authors for the original work. More information and the full terms of the licence here:

<https://creativecommons.org/licenses/>

Takedown

If you consider content in White Rose Research Online to be in breach of UK law, please notify us by emailing eprints@whiterose.ac.uk including the URL of the record and the reason for the withdrawal request.

1 Author accepted version, Global Change Biology (2023), <https://doi.org/10.1111/gcb.16941>

2
3
4 Protected areas do already act as steppingstones for species responding to climate change

5
6 Phillipa Gillingham, Department of Life and Environmental Sciences, Bournemouth University, Fern
7 Barrow, Poole, BH12 5BB, UK.

8
9 Chris D. Thomas, Leverhulme Centre for Anthropocene Biodiversity, Department of Biology,
10 University of York, Wentworth Way, York YO10 5DD, UK.

11
12 Parks *et al.* (2023) modelled the future climatic connectivity of the global Protected Area network,
13 and came to the conclusion that Protected Areas (PAs) are unlikely to act as steppingstones for most
14 species undergoing range changes towards the poles, thereby not enabling them to reach newly
15 suitable climatic conditions.

16
17 However, we have empirical evidence that PAs have already acted as steppingstones for a large
18 proportion of range-shifting species under recent climate change. Of 256 species across eight
19 taxonomic groups that have been expanding their distributions within Great Britain with sufficient
20 data for analysis, predominantly in response to climate change, 251 (98%) were more reliant on PAs
21 for this expansion than expected by chance, with PAs more important for habitat specialists than
22 generalists (Thomas *et al.* 2012). Across the two taxa with available abundance data, PAs supported
23 higher abundances in colonised regions than non-PA land for a majority of species (Gillingham *et al.*
24 2015). Moreover, PAs have also acted as landing pads for eight birds colonising Great Britain
25 naturally from Europe, whilst resisting invasion by six introduced species (Hiley *et al.* 2014).

If PAs can act as steppingstones for species shifting their distributions within Britain, the same is likely true elsewhere, as the country has low levels of land under protection (at the time of our analyses just 6% of England was protected within areas the IUCN would consider as PAs), with little semi-natural habitat available outside PAs (Lawton *et al.* 2010). We do agree that PAs may not be sufficient to allow species to ‘keep up’ with climate change (Willis *et al.* 2009), but the above evidence suggests that they do contribute to the range expansions of many species into climatically-suitable regions, despite some lags.

This is not the only contribution of PAs to species survival; they play a key role in facilitating species survival in climatic ‘overlap zone’ (past, current and future climates all suitable for a particular species in a given PAs) and enable species to shift their distributions *within* large, montane and otherwise heterogenous reserves (via elevational and aspect shifts, see Thomas & Gillingham 2015 for a review of the within- as well as between- contributions of PAs to species distributions and survival under climate change). Since suitable habitats for individual species are often patchily-distributed within, for example, large and mountainous PAs, this may commonly represent a within-PA steppingstone effect.

We agree with Parks *et al.* (2023), however, that PAs and the management of intervening landscapes will be insufficient to enable many, especially localised species, to track suitable climates, and that assisted colonisation will be required if they are to survive in future (e.g., Hoegh-Guldberg *et al.* 2008; Willis *et al.* 2009). We also agree with the authors that 30x30 targets for protection may contribute if located strategically to facilitate both between-PA steppingstone contributions to latitudinal range shifts and within-PA heterogeneity contributions to smaller-scale elevational and other shifts. Appropriate management of PAs for biodiversity can also increase the likelihood of colonisation (and thus expansion), as illustrated by the silver-spotted skipper butterfly *Hesperia comma* in the UK (Lawson *et al.* 2014).

53

54 Suggestions that PAs are unlikely to act as steppingstones in the context of climate change are
55 contrary to the evidence. They often fulfil this function. However, we agree that this is not sufficient
56 on its own to protect all species. Additional strategically-placed PA designations and identifying
57 opportunities for management (inside PAs and in connecting landscapes) that increase persistence
58 and expansion rates are all areas for consideration for ongoing conservation decision-making – as
59 well as the development of assisted colonisation strategies and decision-making protocols, which are
60 currently insufficient. There is room for hope here since reserve managers are beginning to manage
61 with climate change in mind (e.g. see Prober *et al.* 2019).

62

63 References

- 64 1. Gillingham, P.K., Alison, J., Roy, D.B., Fox, R. and Thomas, C.D. (2015), High Abundances of
65 Species in Protected Areas in Parts of their Geographic Distributions Colonized during a
66 Recent Period of Climatic Change. *Conservation Letters*, 8: 97-106.
67 <https://doi.org/10.1111/conl.12118>
- 68 2. Hiley, J.R., Bradbury, R.B., and Thomas, C.D. (2014). Introduced and natural colonists show
69 contrasting patterns of protected area association in UK wetlands. *Diversity and*
70 *Distributions* 20, 943-951. <https://doi.org/10.1111/ddi.12219>
- 71 3. Hoegh-Guldberg, O., Hughes, L., McIntyre, S., Lindenmayer, D.B., Parmesan, C., Possingham,
72 H.P. and Thomas, C.D., 2008. Assisted colonization and rapid climate
73 change. *Science*, 321(5887), pp.345-346. [DOI: 10.1126/science.1157897](https://doi.org/10.1126/science.1157897)
- 74 4. Lawson, C.R., Bennie, J.J., Thomas, C.D., Hodgson, J.A. and Wilson, R.J. (2014), Active
75 Management of Protected Areas Enhances Metapopulation Expansion Under Climate
76 Change. *Conservation Letters*, 7, 111-118. <https://doi.org/10.1111/conl.12036>.
- 77 5. Lawton, J.H., Brotherton, P.N.M., Brown, V.K., Elphick, C., Fitter, A.H., Forshaw, J., Haddow,
78 R.W., Hilborne, S., Leafe, R.N., Mace, G.M., Southgate, M.P., Sutherland, W.J., Tew, T.E.,

Varley, J., and Wynne, G.R. (2010) Making Space for Nature: a review of England's wildlife sites and ecological network. Report to Defra.

6. Parks, S.A., Holsinger, L.M., Abatzoglou, J.T., Littlefield, C.E. and Zeller, K.A. (2023) Protected areas not likely to serve as steppingstones for species undergoing climate-induced range shifts. *Global Change Biology* 29, 2681-2696
7. Prober, S.M., Doerr, V.A.J., Broadhurst, L.M., Williams, K.J., and Dickson, F. (2019) Shifting the conservation paradigm: a synthesis of options for renovating nature under climate change. *Ecological Monographs* 89:e01333. [10.1002/ecm.1333](https://doi.org/10.1002/ecm.1333)
8. Thomas, C.D. and Gillingham, P.K. (2015) The performance of protected areas for biodiversity under climate change, *Biological Journal of the Linnean Society*, Volume 115, 718–730, <https://doi.org/10.1111/bij.12510>
9. Thomas, C.D., Gillingham, P.K., Bradbury, R.B. et al. (2012) Protected areas facilitate species' range expansions. *Proceedings of the National Academy of Sciences* 109, 14063–14068. <https://doi.org/10.1073/pnas.1210251109>
10. Willis, S.G., Hill, J.K., Thomas, C.D., Roy, D.B., Fox, R., Blakeley, D.S. and Huntley, B. (2009), Assisted colonization in a changing climate: a test-study using two U.K. butterflies. *Conservation Letters*, 2: 46-52. <https://doi.org/10.1111/j.1755-263X.2008.00043.x>