

1 Protected areas do already act as steppingstones for species responding to climate change

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9 Parks *et al.* (2023) modelled the future climatic connectivity of the global Protected Area network,

10 and came to the conclusion that Protected Areas (PAs) are unlikely to act as steppingstones for most

11 species undergoing range changes towards the poles, thereby not enabling them to reach newly

12 suitable climatic conditions.

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14 However, we have empirical evidence that PAs have already acted as steppingstones for a large

15 proportion of range-shifting species under recent climate change. Of 256 species across eight

16 taxonomic groups that have been expanding their distributions within Great Britain with sufficient

17 data for analysis, predominantly in response to climate change, 251 (98%) were more reliant on PAs

18 for this expansion than expected by chance, with PAs more important for habitat specialists than

19 generalists (Thomas *et al.* 2012). Across the two taxa with available abundance data, PAs supported

20 higher abundances in colonised regions than non-PA land for a majority of species (Gillingham *et al.*

21 2015). Moreover, PAs have also acted as landing pads for eight birds colonising Great Britain

22 naturally from Europe, whilst resisting invasion by six introduced species (Hiley *et al.* 2014).

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24 If PAs can act as steppingstones for species shifting their distributions within Britain, the same is

25 likely true elsewhere, as the country has low levels of land under protection (at the time of our

26 analyses just 6% of England was protected within areas the IUCN would consider as PAs), with little

27 semi-natural habitat available outside PAs (Lawton *et al.* 2010). We do agree that PAs may not be
28 sufficient to allow species to 'keep up' with climate change (Willis *et al.* 2009), but the above
29 evidence suggests that they do contribute to the range expansions of many species into climatically-
30 suitable regions, despite some lags.

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

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41 We agree with Parks *et al.* (2023), however, that PAs and the management of intervening landscapes
42 will be insufficient to enable many, especially localised species, to track suitable climates, and that
43 assisted colonisation will be required if they are to survive in future (e.g., Hoegh-Guldberg *et al.*
44 2008; Willis *et al.* 2009). We also agree with the authors that 30x30 targets for protection may
45 contribute if located strategically to facilitate both between-PA steppingstone contributions to
46 latitudinal range shifts and within-PA heterogeneity contributions to smaller-scale elevational and
47 other shifts. Appropriate management of PAs for biodiversity can also increase the likelihood of
48 colonisation (and thus expansion), as illustrated by the silver-spotted skipper butterfly *Hesperia*
49 *comma* in the UK (Lawson *et al.* 2014).

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51 Suggestions that PAs are unlikely to act as steppingstones in the context of climate change are
52 contrary to the evidence. They often fulfil this function. However, we agree that this is not sufficient

53 on its own to protect all species. Additional strategically-placed PA designations and identifying
54 opportunities for management (inside PAs and in connecting landscapes) that increase persistence
55 and expansion rates are all areas for consideration for ongoing conservation decision-making – as
56 well as the development of assisted colonisation strategies and decision-making protocols, which are
57 currently insufficient. There is room for hope here since reserve managers are beginning to manage
58 with climate change in mind (e.g. see Prober *et al.* 2019).

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