Island species experience higher niche expansion and lower niche conservatism during invasion

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Using a global dataset of contemporary biological invasions, the recent paper by Liu et al. (1) presents a comprehensive test of the niche conservatism hypothesis. Specifically, Liu et al. demonstrate compelling support for climatic niche conservatism in most invasive species, even when accounting for differences in ecology and physiology (1). However, there exists an additional, yet overlooked, dimension in those species which experienced niche conservatism versus niche expansion during invasion of areas outside of their native range: the biogeography of the native distribution.

I classified all terrestrial species in the Liu et al. (1) dataset as originating from either an island or a (continental) mainland. Island species comprised 4% of all species in the dataset and had significantly higher niche expansion than mainland species. In other words, a lower ratio of the breadth of native climatic niche to that of the introduced climatic niche (island species: −0.76 ± 0.52 [mean niche breadth ratio ± 1 SD], $n = 21$; mainland species: 0.41 ± 0.85, $n = 474$; $t_{25.02} = -9.66$, $P < 0.001$; Fig. 1*B*). Additionally, island species represented nearly 35% of the 26 species (of 495 species total) that experienced both niche expansion in the invasive range (native/invasive niche breadth ratio <0) and high niche dissimilarity between native and invasive distributions (Sørenson niche similarity index <0.5; Fig. 1*A*, *Lower Left Quadrant*).

Islands are often smaller and less environmentally and climatically heterogenous than continental mainlands (2). As such, the limited climatic niche space available to most island species may lead to a more constrained realized native niche than mainland species. Similarly, island coastlines represent hard geographic barriers to dispersal to novel climatic niche space, and the remote nature of islands further inhibits dispersal potential (3). If islands present inhabitants with both limited climate diversity and hard barriers to disperse to expand climatic niches, then it follows that a greater disparity between realized and fundamental niches may be expected relative to mainland species. Such a pattern may also suggest that the fundamental niches of island species are conserved from mainland ancestors, presenting a novel hypothesis in understanding the divergent pattern of niche dynamics in island versus mainland species uncovered in the Liu et al. (1) dataset. Similarly, whether such niche dynamics also exist for species from "island-like" environments (4), such an insular lakes or montane habitats, deserves further attention.

Accounting for the biogeography of native distributions is critical for comprehensively understanding patterns of niche conservatism during biological invasions. The divergent pattern of niche expansion and conservatism in island versus mainland species that emerges from Liu et al.'s (1) dataset provides the empirical basis to establish novel tests of the niche conservatism hypothesis. Disentangling whether such patterns are consistent across a diversity of taxa, ecology, and physiology, as presented by Liu et al., will expand our understanding of the phenomenon of niche conservatism.

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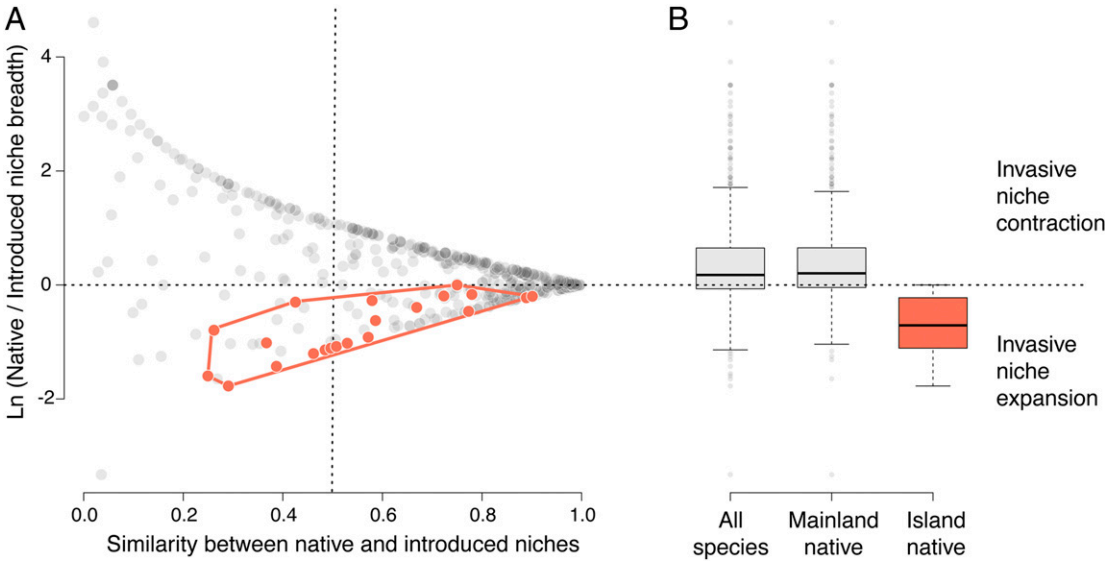

Fig. 1. Island species experience higher niche expansion and lower niche conservatism relative to mainland species. (*A*) Following Liu et al. (1), niche similarity is quantified using the Sørenson similarity index, and breadth ratio is the ln-transformed ratio of the breadth of native niche to that of the introduced niche. Points with breadth ratio lower than 0 indicate that the introduced niche is larger than the native niche, and niche similarity less than 0.5 indicates that the two niches occupy different positions in environmental space. Mainland species are black, island species are orange; a minimum convex polygon outlines the distribution of island species. (*B*) Island species show significantly more niche expansion compared to species originating from mainland distributions. One island species (*Anolis distichus*) was removed from this analysis as the niche data could not be replicated from open-access distributional data. Adapted with permission from ref. 1.

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