

indirect trait effects in community dynamics is to incorporate dynamic state variable models [14] into community models. Also, the traits of predators and prey often depend on the traits of other predators and prey; for example, where and when prey forage is shaped by the distributions and behaviors of other prey and predators [15]. Thus, in these cases, prey behavior is not only a function of the densities of interacting species, but also of the individual traits of those other species. How the dynamics of these games interact with changes in the densities of the players will require integrating game models into community models.

### Conclusions

Preisser *et al.* show that how a predator affects prey traits is often just as important as how many prey a predator eats. The size of trait effects will depend on the system, but can sometimes be similar to the total predator effect. Therefore, understanding community dynamics will often require understanding not only density impacts between predator and prey, but also how scared prey alter their interactions with other species. Changes in prey traits responding to predation risk have too large an effect to be ignored in either empirical or theoretical studies.

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### Letters

## The future fate of the Antarctic marine biota?

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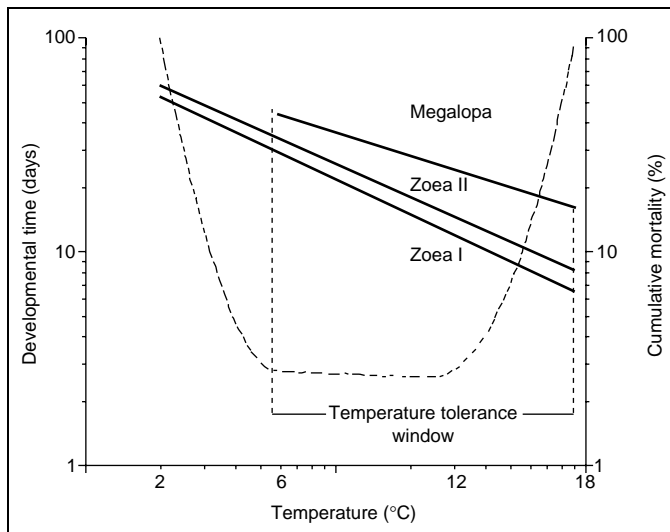
Antarctica has always been regarded as the most isolated marine environment, isolated physically by the circum-Antarctic Polar Front, which, as far we currently know, is also an effective physiological barrier to most marine life from either side of the Front. In their recent Research Focus article in *TREE*, Clarke *et al.* [1] questioned the isolation of Antarctica by summarizing little but intriguing evidence for faunal exchange through the Polar Front, possibly by means of mesoscale eddies or ship traffic in and out of Antarctica [2]. They argue that, under conditions of climate change, introduced invertebrate larvae [2] might be able to establish and threaten Antarctic marine communities.

I disagree with Clarke *et al.* [1], who assume that changes in Antarctic marine communities as a result of invasive species might soon be observed and reach the

same scale of changes as observed in the terrestrial fauna and flora at the Antarctic Peninsula through the impact of climate change. So far, there is no proof of any recently established populations of alien species in Antarctic waters. When considering the potential for non-native species to establish in Antarctic waters, it is important to distinguish between temperature adaptation on evolutionary timescales, which resulted in species such as lithodid king crabs being able to reconquer Antarctic benthic communities [3,4], and pelagic organisms occasionally being transported into Antarctic waters, but without being able to survive there [1–3,5]. For example, the successful speciation of limatulid bivalves across the Polar Front [6] is likely to have occurred only as a result of physiological preadaptations to the environmental conditions.

Unless there is considerable warming of the Southern Ocean above critical thresholds for non-native species, the Polar Front will continue to be an effective physiological

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**Figure 1.** Schematic overview of temperature-dependent larval development and cumulative mortality (%) of the spider crab *Hyas araneus* from its southernmost distributional limit in the North Sea. Whereas successful larval development slightly below the 6°C tested under laboratory conditions is likely, the development of the megalopa larval stage at the upper threshold (<18°C) is hampered by strongly increasing mortality, lipid consumption and changes in O<sub>2</sub> consumption rates [9], which all indicate increased thermal stress. In nature, the benthic megalopa stage usually encounters temperatures ranging from 5°C to 13°C [8]; successful larval development, and thus survival, at the low temperatures that are typical of Antarctic seas (<1°C), is impossible. At the upper temperature threshold, already sub-tropical temperatures are lethal to both larval instars and the megalopa stage. Data, with permission from author, from [8].

filter of species. Mesoscale eddies are an important means of transport for the early pelagic life stages of benthic invertebrates across the Polar Front, as the recent record of early-stage pelagic anomuran and brachyuran crab larvae demonstrated [2]. However, for alien species to become established successfully, suitable ecological and habitat conditions, as well as the ability to tolerate the extreme temperatures, are also required; thus, for example, the pelagic larvae of the mole crab *Emerita*, as discussed in [1], would be unlikely to settle and establish successfully in Antarctica [2–4].

The lack of evidence for sub-Antarctic invertebrate species establishing successfully in Antarctic waters is in fact the best evidence of the physiological isolation of Antarctica. However, a faunistic change might occur as a result of pre-adapted Arctic species being introduced

through ship traffic. The recently published record of the finding in 1986 of single male and female specimens of the North Atlantic spider crab *Hyas araneus* at the Antarctic Peninsula [7] highlights this potential. This collection record, however, prompts the question of how larvae or adults on ship hulls or in ballast water survive lethal sub-tropical temperatures [8,9] (Figure 1), and thus questions their origin [4]. The record might be the result of mislabelled collection material.

Antarctica is physically not as isolated as was previously believed. However, since the circum-Antarctic Polar Frontal system was established as a physiological barrier to invasion some 35 million years ago, its marine biota remain among the best protected from alien species worldwide. Thus, I think that it is unlikely that we will witness considerable changes in the Antarctic marine biota as a result of the impact of invasive species in the near future.

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# Female songbirds still struggling to be heard

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Although acoustic mating signals are widespread, vocal learning is not. Against this background, the versatile vocal learning abilities of songbirds are striking and the

diversity of song-learning strategies puzzling. In their stimulating recent review in *TREE*, Beecher and Brenowitz [1] identify variation among songbirds in several features of song learning that have been revealed by comparative studies. However, by focusing solely on male song, they

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