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Under a Changing Environment Rare Species do poorly than Widespread Species

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Introduction

Ecology is currently facing a significant difficulty in predicting how species, especially rare and endangered ones, will respond to climate change. The niche width of rare species is anticipated to be smaller than that of common species. We don't know much about their adaptability to changing climatic conditions, though. We moved 35 different plant species to five different botanical gardens in Switzerland with diverse altitudes to mimic climate change. We calculated the climate difference between each species' natural habitat and the unique climate of the corresponding botanical garden. We discovered that unusual species often produced less biomass and had worse survival rates than common species. Additionally, when the amount of precipitation varied more from the amount in their native environment, rare plant species fared worse. Contrarily, common species thrived in all climates and even expanded their biomass in wetter or drier environments. Our research demonstrates that rarer species are less able to adapt to climate change than more common species, which may even profit from these changes. This suggests that future climate change may have a significant negative impact on already rare and endangered plant species.

One of ecologists' greatest on-going concerns is figuring out how organisms react to a changing rare, already endangered species may be particularly vulnerable to climate change. Knowing how these species react to climate change can help conservation and management initiatives are more effective. The anticipated fluctuations in precipitation and temperature can have a significant impact on plant growth and survival. Plants are directly impacted both abiotic and biotic factors are altered by an increase of 1 to 2°C in the global mean surface temperature (IPCC 2014), a decrease in average precipitation, and the occurrence of more extreme occurrences like droughts [1].

Description

Plant populations can move to follow favourable environmental circumstances in order to survive climate change, or they can accept the new climate and adapt. Numerous models therefore predict that species will modify their ranges in response to climatic changes. Models predict that a greater number of plant species will be threatened in the near future by the loss of climatically suitable areas because migration may be constrained, for example, by topographic boundaries such as mountains or the increasing fragmentation of our landscapes. So, for plant populations, climate change tolerance may be especially crucial [2].

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Species of plants and experimental layout

35 plant species from 16 plant families were utilised (see Table S1 in Supporting Information). Of those, 24 were rare species with a high conservation priority in Switzerland, while 11 were common species with wide distribution in Switzerland. In Switzerland, rare plant species' wild seeds (one population per species) were collected. Common species' seeds were either procured from commercial seed sources or gathered from the wild. We germinated the seeds in March 2012 and individually planted 50 seedlings of each species into 2-L pots with potting soil. After that, the plants were placed in a public garden where they continued to grow for another two months [3].

Differences in precipitation between a botanical garden and the species' natural range had no impact on the above-ground biomass of uncommon species. However, common species produced more biomass when the conditions were wetter and more humid than in their normal range, and when the conditions were drier and hence sunny. This suggests that whereas rarer plant species are less plastic and exhibit a relatively steady biomass output, more common plant species are able to plastically increase their biomass in these settings. Overall, survival and biomass production were lowest when a species' natural range's mean temperature was most different from that in a botanical garden (significant squared temperature difference impact), and this was true for both rare and common species [4].

Compared to typical plant species, rare plant species are less resilient to climate change

The niche breadth hypothesis, which states that species that can maintain populations across a wider range of environmental conditions can reach bigger geographic ranges than species with narrow ecological niches, is one of the most significant hypotheses explaining species rarity and commonness. Studies that compared the extent of a species' range to its actual niche supported the pattern. Unknown, however, is whether this implies that more common species contain individuals with larger fundamental niches (general-purpose genotypes) than do rare species and, as a result, a greater capacity to adapt to changing climatic conditions. In our experiment, plant species generally fared better and produced more biomass when the botanical gardens' mean annual temperature was higher [5].

Reflecting the presence of a climatic niche brought on by physiological constraints, which is a crucial premise for determining how climate change would affect species ranges. Similar to this, plants fared better when the average annual precipitation matched that of their native area, although this was only true for uncommon plant species, which were adversely affected by variations in precipitation (when conditions where either dryer or wetter than the ones at their origin). In contrast, more widespread species showed the same high survival rate at all precipitation levels, regardless of the levels of their origin, and were unaffected by variations in precipitation. Our findings show that uncommon species do indeed have a smaller overall niche. In their range, widely distributed species are likely to encounter a wider variety of ecological and climatic situations. Indeed, a wider niche width appears to be a general tendency in widespread species based on the species' existing distribution and our data also support this (positive correlation between range size and the climatic width). A species might have a wider range of niches because it has a large number of locally adapted populations which divide the species' broad climate tolerance. Additionally, species can consist of genotypes that are phenotypically malleable, general-purpose genotypes or individual generalists that excel in a wide variety of environmental circumstances.

Conclusion

In contrast to the findings regarding survival, fewer species' aboveground biomass production barely varied in response to variations in precipitation. However, more widespread species increased their biomass, especially when precipitation was less than in their native range. It's possible that a dryer environment entails more sunshine days and, consequently, better circumstances for plant growth. Therefore, it appears that more common species are more able to plastically expand their biomass when growth conditions are good, whereas rarer species appear to be less able to alter their phenotypes in response to environmental variation. More widespread species were also able to increase their biomass when precipitation levels were higher than in their normal habitats. This plastic reaction in more common species suggests.

Acknowledgement

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Conflict of Interest

None.

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