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Multiple threats: Partitioning climate predictions from existing habitat and species stressors

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Climate change has emerged as one of the hottest topics in global change ecology and rightfully so, contended to being the greatest challenge to biodiversity conservation targets in the 21st century. In retrospect, this appraisal is typically acted upon from a monotypic (and or causality) context. Here we present a first of its kind, global-level approximation of pressures faced by species from a multi-threat perspective. Our results indicate a strikingly clear pattern that climate vulnerable species are threatened by more non-climatic threats than non-vulnerable species. Further, this pattern displays a distinct trend that is highly relevant with a species IUCN Red List conservation status. In this study, we do not imply that climate change is directly responsible for a greater likelihood of a species being threatened by other stressors. While this may be true for some species, several studies indicate that vulnerability is the sum of cumulative effects from multiple threats and others contend that vulnerability is controlled by the species life-history traits (exposure, sensitivity and adaptability). What we are suggesting is that researchers need to better understand if and why the combined effects of stressors are greater than the sum of individual effects in a multi-threat context. This should serve as a reminder of likely complexities of species under projected climate impact and potential interactions with other rapidly evolving non-climatic threats that are equally confounding.

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Cadmium toxicity and plant response: A case study on barley

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Cadmium (Cd) is potentially toxic to both plants and animals. Recently Cd accumulation in biotic systems as a consequence of human activities is becoming a major environmental issue worldwide; particularly in agricultural ecosystems, where it might endanger crop productivity and quality. Meanwhile, Cd contamination is a non-reversible accumulation process and high plant-soil mobility to be easily accumulated in plant tissues. Furthermore, Cd is believed to cause damage even at very low concentrations and healthy plants may contain levels of Cd that are toxic to mammals. Considering the huge scale of contaminated farmlands in China, breeding of crop cultivars tolerant to Cd toxicity and with low Cd accumulation in edible parts would be a cost-effective and practical substitute mode to fully utilize natural resource and guarantee safe food production. Accordingly, it is imperative to elucidate the mechanism of Cd accumulation/tolerance for developing low Cd accumulation cultivars to minimize soil-to-plant transfer of Cd and increase food production for a rapidly increasing world population. Genotypes with low grain Cd accumulation and Cd tolerant were successfully screened from 600 barley genotypes. Physiological mechanism for genotypic differences in Cd accumulation and tolerance in barley was elucidated via characterizing physiochemical characters, including Cd uptake and subcellular distribution, photosynthesis, free amino acid, phytochelatin, an atomic structure, ATPase, reactive oxygen species (ROS) metabolism and other physiochemical responses. The long-distance transport of Cd into the developing grains was studied using the markers for phloem (rubidium) and xylem (strontium) transport. Furthermore, stress-specific proteins and relevant genes associated with Cd tolerance were identified. Quantitative trait loci (QTLs) were detected for root Cd concentration and Cd tolerance index (CTI) of shoot dry weight, root glutathione peroxidase and dehydroascorbate reductase. Meanwhile, ZIP genes (ZIP3, ZIP8) were isolated from low and high grain Cd accumulation barley genotypes, respectively and incorporated into barley plants (Golden Promise) using *Agrobacterium* transformation. In addition, we investigated the effects of Zn, GSH, NO and ASA on alleviating Cd stress, indicating that rational Zn, GSH, NO, or/and Se application could alleviate Cd toxicity to plants and reduce Cd uptake and accumulation. Our results have provided a comprehensive understanding of the underlying mechanisms of Cd- tolerance in crop plants and built a solid foundation for the identification of candidate genes conferring Cd-tolerant and low Cd barley varieties.

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