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Editorial: Global Changes and Plant Invasions

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Editorial on the Research Topic

Global Changes and Plant Invasions

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INTRODUCTION

Biological invasions are a significant contributor to global environmental change (Dawson and Schrama, 2016). Globalization has resulted in a significant increase in the introduction of alien species to new areas with deleterious effects on ecosystems (Hanfling and Kollmann, 2002). Invasive plants can displace native plants, degrade ecosystems, and negatively impact human health (Zhu et al., 2018; Xie et al., 2020). Plant invasions may also contribute to the homogenization of biological systems worldwide and global biodiversity loss (Soulé, 1991; Lockwood and Mckinney, 2001). Funding is required to deal with these problems, and it is conservatively estimated that invasive species cost the worldwide economy more than $1.4 trillion per year (Pimentel et al., 2001).

In recent times, another great threat that has become much more apparent is human-induced climate change. Interactions between biological invasions and climate change can have severe environmental impacts (Crowl et al., 2008). Drastic environmental changes have already accelerated the spread of invaders (Demertzis and Iliadis, 2018), and promoted the expansion of previously resident native species (Kurz et al., 2008). Over the last two decades, there has been increasing interest in the interactions between global changes and plant invasions (**Figure 1**). To more fully appreciate these links, it is imperative that we enhance our understanding of the mechanisms that promote invasions (Dai et al., 2020). Specifically, it is necessary to examine when and how these mechanisms produce the most serious of invasions. This Research Topic assembles articles focusing on interactions between plant invasions and global changes (particularly between introduced plants and the abiotic and biotic environment).

ABIOTIC AND BIOTIC INTERACTIONS UNDER GLOBAL CHANGE AND PLANT INVASIONS

Invasive plants are exposed to new abiotic and biotic conditions in the novel range (Hierro et al., 2005; Mitchell et al., 2006). As the climate changes, new conditions are encountered by invasive species with shifts in each global change factor (e.g., temperature, rainfall, nutrient cycling). Climate change will likely increase the magnitude and duration of extreme events worldwide, such as heat waves, floods, and droughts (IPCC, 2007). Changes in rainfall and temperature have long been known to affect growth and survival of plants, including invasive species (Thuiller et al., 2008). In South Africa, heavy rainfall enhanced the growth of invasive trees in arid savannah (Richardson et al., 2000). Similarly, climate warming has been found to alter the timing and rate of germination, as well as longevity of

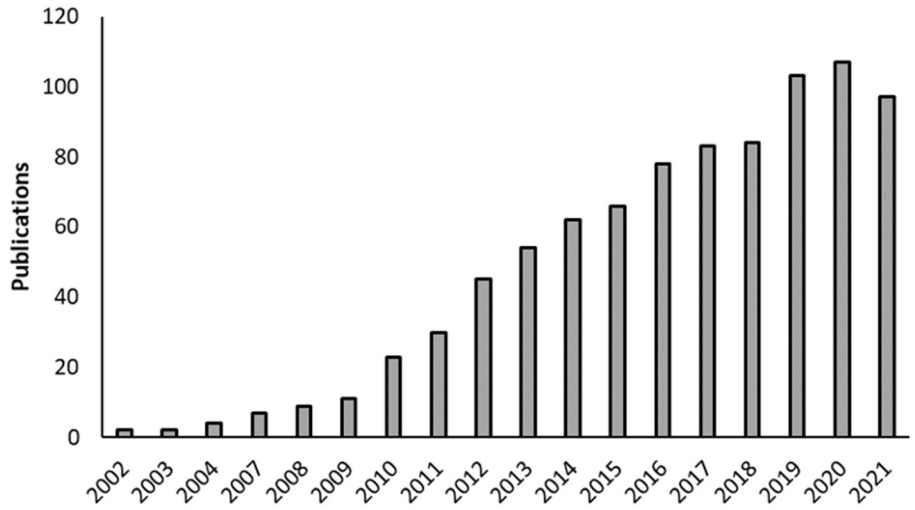

FIGURE 1 | Publications retrieved (per year) using four combinations of keywords "global change(s)" and "plant invasion(s)" to search the PubMed database (https://www.ncbi.nlm.nih.gov/pmc).

seeds (Bernareggi et al., 2015), which has implications for plant invasions (explored in this topic by Zhou and He).

Increases in global temperature are predicted to significantly change vegetation communities around the world (Lu et al., 2013) and may promote plant invasions. In Swiss forests, the range of alien evergreen plants has already expanded in response to declines in the frequency of frost intervals (Walther, 2002). The complexity of global change factors on plant invasions is further exemplified in this Research Topic, where the interaction between competition and different hydrological conditions on *Bunias orientalis* invasion was investigated (Corli et al.). It was found that conditions such as disturbance and the presence of dry habitats likely aided the invasion. The effects of warming on plants can depend on precipitation rate, as well as the biome (Fazlioglu and Wan, 2021). The importance of testing the effects of hydrological shifts on invaders across different ecosystems is highlighted in this topic.

Increases in temperature and droughts are predicted to change the composition and activity of plant-associated microbial communities, thereby affecting the growth of resident plant species (Compant et al., 2010). Shifts in the abundance of arbuscular mycorrhizal fungi (AMF) can alter soil properties to benefit the invader and enhance its competiveness over natives (Chen et al.; Shen et al.). In turn, invasive species can modify soils leading to functional shifts (e.g., changes in the cycling of nutrients, Trognitz et al., 2016). Such shifts are associated with the reorganization of internal feedback mechanisms (e.g., plant-soil feedbacks, Gaertner et al., 2014). For instance, litter decomposition from invasive *Sphagneticola trilobata* changed soil properties, which promoted its own growth while inhibiting its native congener (Sun et al., 2021). Similarly, soil organic carbon is altered with invasion by *Alternanthera philoxeroides* across wetland and river habitats with potential impacts on microorganisms and functional shifts (Yang et al.).

IMPLICATIONS FOR MANAGEMENT AND FUTURE RESEARCH

The relationship between plant invasions and global change is highly complex (IPCC, 2007; Vilà et al., 2007). Although some changes in abiotic conditions are predicted to enhance invasion (e.g., increases in CO_2), others may help or hinder invasions (e.g., changes in temperature and precipitation) (Bradley et al., 2010). Global changes are likely to impact different invasive species differently, and untangling cause and effect is often extremely difficult for natural phenomena. Thus, there is a great deal of uncertainty regarding the impact of alien species under global environmental change (Bradley et al., 2010). This makes developing management strategies for invasive species and predicting which introduced species will become problematic highly challenging. Elucidating the effects of multiple factors on both native and invasive plants is an important first step toward this goal.

A multifaceted approach is likely most useful in untangling the complexity of the interaction between climate change and plant invasions (Kueffer, 2010). Transcriptomics in combination with growth experiments are increasingly being used to identify the genes involved in abiotic and biotic interactions of invasive plants (e.g., Manoharan et al., 2019; Zhang et al., 2021). Examining alien species at the population level in both the native and invasive ranges (Bossdorf et al., 2005) and incorporating genomics (e.g., Rutherford et al., 2021) could advance our understanding of the mechanisms underlying plant response to global changes. Assessing the impacts of environmental changes on invasions during each invasion stage is important (Catford et al., 2020), as

well as long-term experiments (Corli et al.). The field of biological invasions is evolving rapidly as massive changes are underway at the global level. The authors believe that an expansion of approaches in this direction will lead to significant insights that would best equip us to overcome the challenges ahead.

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Z-CD, SR, and JW conceptualized this editorial. BZ contributed ideas. SR and JW wrote the manuscript. All authors reviewed the manuscript and provided comments. All authors contributed to the article and approved the submitted version.

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