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Editorial: Biological invaders: Always the bad guys?

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Editorial on the Research Topic

Biological invaders: Always the bad guys?

Invasive species are recognized as one of *the* major environmental problems worldwide and responsible for a myriad of impacts on ecosystems and ecosystem processes. Although many invasive species exert a range of detrimental effects a more nuanced approach is now emerging, which acknowledges that they can make a positive or beneficial contribution (Schlaepfer et al., 2011; Vimercati et al., 2020, 2022; Mantoani et al., 2022). Clearly, a positive impact may not always be beneficial (Vimercati et al., 2022) and nutrient enrichment due the introduction of an alien nitrogen-fixing plant species, for instance, could result in the loss of important resident species with low nutrient requirements.

Whilst there was a reluctance in the past to recognize positive or beneficial effects there is now a better appreciation of the contrasting impacts associated with introduced species. The question is when do invasive species have positive or beneficial effects and on what processes and to what extent? We also need to know whether any positive effects have biodiversity/societal/economic benefits or are they responsible for a change that is still unacceptable.

In this series of papers, a complex range of positive, beneficial, and negative effects associated with alien species are described and the implications for their management discussed.

Many alien species were introduced for sound agronomic reasons. Where would we be without the crops that supply us with the food, and raw materials that we need? Given the challenge of producing more food and dietary protein can we utilize problematic species for this purpose without them having any negative environmental impacts?

Crayfish aquaculture can be a source of nutritional protein, but this is typically carried out in open systems, where their escape into natural ecosystems is ever-present. The marbled crayfish (*Procambarus virginalis*) is also invasive but, as Tönges et al. show these are remarkably resilient species that have the potential to be grown sustainably in closed production systems where the risks of escape are minimized. Not only would they provide a valuable source of protein, but they could also be utilized to produce bioplastics. Given the danger of escape, even in supposedly closed systems, further work will be required if we are to exploit the benefits of marbled crayfish without compromising freshwater ecosystems.

One of the conservation-related conundrums of any management practice is that it may be disadvantageous to resident species, although this has received little attention. The Ebro Delta National Park is an important area not just for rice production but also because of its waterbird populations, where the flooding of fields during winter is seen as an important conservation measure. With the arrival of the invasive apple snail (*Pomacea maculata*) farmers stopped the winter flooding to reduce crop damage. At first site this could have had major negative impacts on waterbird populations but, rather surprisingly, [Bernardo-Madrid et al.](#) found no evidence for this and indicated that there was little evidence for a positive effect of winter flooding and questioned the value of this approach in agri-environmental schemes.

Can native species “encourage” invasions? It is known that positive interactions may be important in driving plant community assemblage through facilitation, but how specific are these interactions and could they facilitate plant invasions? In a study on plant community assembly in a desert ecosystem, [Lucero et al.](#) showed that several introduced plant species were more abundant near native shrubs. However, invasive *Schismus* spp. was less abundant close to native shrubs, indicating the importance of invader identity. Native shrubs not only facilitated plant invasions, but also increased their impact on native species. Whilst the mechanism associated with these effects are not known they do highlight the importance of understanding the role(s) of both native and non-native species in the development of appropriate management interventions.

Although a lack of herbivores has often been touted as a major reason for the success of alien species (escape from enemy hypothesis), herbivory often has a limited impact on plant performance and most of the loss of primary productivity is associated with the decomposition of plant litter. The extent to which this is decomposed, and nutrients recycled, will vary with litter quality and the environmental conditions, and could have significant impacts on soil organisms. Even if the litter is unpalatable, it could still impact on soil organisms through an increase in micro-habitat availability. [Landsman et al.](#) show that the enhanced litter associated with two plant invaders, garlic mustard and Japanese stilt grass, increased spider abundance and diversity and increased soil invertebrates. However, one species, mock strawberry, had a negative impact on soil invertebrates. As the authors recognize, information on litter palatability will be required to fully understand the impacts of introduced species.

Public perceptions of biological invasions have increased significantly in recent years. Almost everyone has a view, generally negative, about their impact. Due to globalization,

concepts such as “native” and “non-native” or “pristine” and “disturbed” often have little meaning. Few habitats on earth remain undisturbed and what is a native vs. what is a non-native is often based on historical connotations. The public, however, remain largely unaware of this and alien introductions are almost always considered to have negative impacts. This fails to recognize that many novel ecosystems comprising introduced species can provide valuable ecosystem services. What we need, as [Cordell et al.](#) propose is a framework that embraces an invader and location -based approach, and how this could be utilized to develop management strategies that support biodiversity and ecosystem services. We need to get away from generalizations about the impact of alien introductions and recognize their site and species-specific effects.

If nothing else, this collection of papers highlights the complexity of impacts associated with alien introductions and their interactions with resident species. Clearly, positive effects are not uncommon, although they may be just as harmful as negative effects. We are also likely to see an increased reliance on the beneficial effects of introduced species given the global challenges that we face. The question is how we do this without compromising ecosystem services, biodiversity, human health, and well-being?

Author contributions

BO wrote the editorial and handled all the manuscripts with input from MG.

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