



The potential for biological control on cryptic plant invasions

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ABSTRACT

Cryptic invasions can be defined as 'the occurrence of an invasive species or genotype that was not previously recognised as alien in origin or not distinguished from other aliens'. Such invasions can result in negative impacts on the recipient ecosystems and disturb the evolutionary history of native plant populations. Many cryptic invasions have become so problematic that there is a need to implement control measures. This paper explores the potential for biological control to be implemented as a means of managing cryptic invasions. Firstly, the paper defines the different forms of cryptic invasion, differentiating between interspecific and intraspecific invasions; this hierarchy influences how to detect, study and ultimately implement biological control when cryptic invasions occur. Secondly, unique challenges associated with biological control programmes for cryptic invasions are addressed, including: the need for intraspecific level host specificity in agents, the occurrence of hybridisation between native species/lineages and the target weed, the role of enemy release in cryptic invasions in the presence of closely related native plant species/lineages, and a review of potential stakeholder conflicts of interest and legislation. Biological control of cryptic invasions has been shown to be possible, however the process will be more difficult and complex than controlling traditional targets and will likely take up more time and resources. If these challenges are overcome, then biological control programmes against cryptic invasions should be able to proceed and maintain the same standards as traditional biological control programmes.

1. Introduction

Species and their geographic ranges are not static and are shaped by a wide range of factors including both natural processes and anthropogenic activities. As such, delineating the biogeography of invasive alien plants (hereafter referred to as IAPs) has become increasingly difficult (Essi et al., 2018). Species that have unknown origins or poorly resolved taxonomy have often been assumed to be native in the absence of molecular and paleontological evidence (Avery et al., 2013). Similarly, many expansive local populations or taxa with widespread distributions have often been overlooked as potential IAPs and labelled as overabundant (attribute to environmental factors) and cosmopolitan (Morais and Reichard, 2018). With advances in molecular techniques it is now becoming apparent that many such taxa can be considered cryptogenic and invasions may be a result of the introduction of cryptic non-native lineages or species (Carlton, 1996). The determination of an

invasive species status as being cryptic is pivotal as it will influence the type of management that can be put in place to control the populations.

Novak (2011) defined cryptic invasions as 'the occurrence of a species or genotype that was not previously recognised as alien in origin or not distinguished from other aliens'. Cryptic invasions occur in two circumstances 1) interspecific cryptic invasion – an invasion of non-native species that goes unnoticed due to misidentification with a morphologically similar native species or another non-native species that is often closely related, and 2) intraspecific cryptic invasion – an invasion of genotypes of a species into an area where the species already exists. The introduced genotypes belong to a lineage of the species that is distinct from that of the local genotypes (Morais and Reichard, 2018). Cryptic invasions as they are defined here do not encompass broader research on cryptic genetic variation in non-native plants whereby invasive populations can have distinct lineages such as *Lantana camara* L. (Verbenaceae) (Ray and Quader, 2014) and

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