CORRESPONDENCE

Blurring Alien Introduction Pathways Risks Losing the Focus on Invasive Species Policy

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The pathways by which alien species are introduced to new regions fall into six broad classes: deliberate *release*; *escape* from captivity; *contaminant* of a commodity; *stowaway* on a transport vector; via an infrastructure *corridor* (without which spread would not be possible) or *unaided* from other invaded regions (Hulme *et al.* 2008). However, Gilroy *et al.* (2016) argue that species dispersing naturally, through the infrastructure corridor or unaided pathway, should be classed as native rather than alien. We contend their proposal is not only unworkable but also unwise.

The key issue is not how we classify species after they become introduced but the way policies are implemented to prevent biological invasions. Overwhelming evidence confirms infrastructure corridors (as distinct from landscape corridors) as major routes for alien species introductions. In Europe, over 40% of alien marine species have been introduced via canals with subsequent impacts on maritime economies and biodiversity (Katsanevakis *et al.* 2013). Similarly, many alien species spread unaided from one country to another with often serious conservation consequences such as the alien ruddy duck (*Oxyura jamaicensis*) hybridising with the endangered native white-headed duck (*Oxyura leucocephala*) in Spain.

Gilroy *et al.* (2016) suggest that, by classifying species that arrive through these pathways as native, policymakers could simply target the subset of new introductions that become pests. But classifying species status by introduction pathway is ambiguous and unworkable since many alien species are introduced through several pathways (e.g., stowaway and corridor) thus preventing an absolute classification of a species as native. Furthermore, the difficulty in predicting which alien species

might become a pest means this is often only known after their introduction (Ojaveer *et al.* 2015). A "pest" rather than "alien" based policy would limit opportunities for preventative action and result in costly pest management instead. In contrast, classifying such species as alien might require anyone undertaking major infrastructure developments to prove beyond a justifiable level of doubt that their actions will not result in biological invasions. Likewise, any decision not to manage established alien species in a territory, such as North American grey squirrels (*Sciurus carolinensis*) spreading from Italy, will need to ensure such inaction would not result in harm beyond political borders.

The transboundary nature of invasive species risk assessment has received scant attention but by ensuring alien species spreading unaided continue to be treated as alien would permit the development of a polluter pays principle to manage invasions (Hulme 2015). These policies also enshrine the precautionary principle and the potential for them to change the way we manage biological invasions is substantial. While existing national legislation may be contradictory (Gilroy *et al.* 2016), increased regulatory harmonisation is likely to result from the Convention on Biological Diversity adopting the Hulme *et al.* (2008) framework as the international standard for classifying introduction pathways (CBD 2014). Thus classifying species that disperse naturally through the infrastructure corridor or the unaided pathway as alien not only aligns with recent international policy developments but also facilitates the implementation of cost-effective preventative measures rather than costly pest management.

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