Managing non-native species: don't wait until their impacts are proven

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Biological invasion is a controversial issue, even with respect to its own definition. From an ecological point of view, invasive alien species are those spreading in a novel environment (the geographical criterion). However, some researchers and managers believe that a species must have a major impact on the novel environment to be considered invasive (the impact criterion) (Valéry et al. 2008). This distinction is not trivial: alien invasions are considered among the major threats to biodiversity and there is a heated debate on why and how to deal with them (Davis et al. 2011, Simberloff 2011a, Lambertini et al. 2011).

In a recent article, Bauer and Woog (2011) pose the question whether the limited resources, political will and public support available should be targeted at non-native bird species proven to be harmful for native biota, following the impact criterion. On the basis of similar efforts for other taxonomic groups, they propose a pragmatic approach that places non-native birds within three categories with an increasing need for management: category 3 for good aliens for which there is no evidence of negative impacts – these could be tolerated unless they pass a given impact threshold; category 2 for species having an impact on native bird populations but requiring more research to decide whether they warrant conservation actions; and category 1 for those species requiring immediate management to avoid population declines or even extinction of native species. We agree that a more thorough scientific review of available data (and, where necessary, new data collection) should be undertaken to inform policy-makers and managers. However, we feel this approach is overly optimistic regarding our ability to measure the wide-ranging potential impacts of exotic birds, and our ability to manage them successfully once negative impacts are indeed established. Instead, we propose that, as well as dealing with problematic established species, management of exotic birds should be especially targeted at small, establishing populations that can be eliminated effectively and efficiently, well before they become invasive on the basis of both geographical and impact criteria.

An important problem of the approach proposed by Bauer and Woog (2011) is the difficulty in assessing the impacts of non-native species. There are documented impacts for only a small proportion of non-native bird species (e.g. Lever 2005, Kumschick & Nentwig 2010) but data scarcity does not necessarily imply absence of effects. The potential negative effects on native bird species are many, including direct predation, competition for food or breeding sites, alteration of habitats, hybridization, introduction or spread of diseases, and innumerable interactions with other non-avian species and additional or confounding factors. Some of these impacts are not easily detected, such as the transmission of diseases (e.g. Carrete et al. 2009) or subtle changes in life-history traits linked to fitness (Freed & Cann 2009). This means that there is a high risk of type 2 error (i.e. not detecting an effect when in fact there is one) when testing the null hypothesis of no harm. A second problem in properly identifying the harmful effects of non-native species are the often large time lags between introduction and the detection of their effects on native biota (e.g. Tablado et al. 2010), imposing the need of costly and difficult long-term studies when evaluating the actual impact of invaders (Strayer et al. 2006). As Bauer and Woog (2011) also argue, future changes in distribution or local conditions can change the balance between native and exotic species in ways that are extremely hard to foresee, and large-scale cascading effects far from the introduction site (Peters et al. 2007) add even more difficulty to the identification of impacts. Moreover, while the Bauer and Woog (2011) categories for management focus only on negative effects on native bird populations, non-native species may also impact whole ecosystems (Simberloff 2011b), economy and human health, which may require even higher monitoring efforts. Finally, it is difficult to identify the threshold value that defines an impact, and the same non-native species may cause different effects in different recipient ecosystems and regions of the world (Valéry et al. 2008). Impacts should be therefore studied at a local scale. This adds a further problem: research effort on non-native invasions, which is needed to identify their impacts, varies greatly among countries (Speziale et al. in press). Therefore, when following the criteria of Bauer and Woog (2011), countries with low research effort would be inclined or forced to tolerate non-native bird species in the absence of evidence for their local impacts.

The case of the Ruddy Duck Oxyura jamaicensis, also discussed by Bauer and Woog (2011), is a good example of some of the problems of establishing or

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predicting negative impacts, and adjusting management to them. After escaping several decades ago in the UK, this exotic species spread over Western Europe and it was not until recently that it began to threaten the globally threatened White-headed Duck Oxyura leucocephala in Spain by hybridization. Only once these negative impacts were scientifically documented (Hughes et al. 1999) did the management community spring to action, at significant costs in terms of economics, public image and animal suffering. In addition, lasting success is not guaranteed, because shooting the last Ruddy Ducks in the UK will be difficult, and additional populations are established elsewhere in Europe. If the Bauer and Woog (2011) criteria had been applied when Ruddy Ducks first escaped, the same situation would be the result. Who could have predicted that decades later, negative effects would come to light in a distant country? And if someone had, would this prediction be judged to have sufficient scientific weight to warrant an elimination action? Most likely not.

Instead, if there was just a simple, no-tolerance guideline for newly establishing exotic species, then the few Ruddy Ducks that escaped would have been culled quickly and cheaply and the problem solved. Eliminating these small, newly establishing populations before any negative effects are documented has several advantages. First, negative effects on native communities and ecosystems are prevented. Secondly, the necessary actions will be small-scale, saving time and money. Thirdly, the amount of animal suffering is smaller than when many more individuals have to be eliminated later on. Fourthly, public attention or outcry against culling will be much reduced. Fifthly, it gives off a signal to the public that establishment of additional exotic species is not welcome, which may discourage further deliberate releases, hence slowing down the rate of introduction of exotic species. Sixthly, it eliminates the need to follow any newly establishing exotic species for their negative impacts, saving long-term scientific/conservation and economic efforts (see also Simberloff 2003). Taking all of this into account when quantifying the priority of each non-native species for conservation action (as urged in Bauer & Woog 2011), new populations of exotic species should rank highly for elimination because it is very easy and effective to do so, even if negative impacts are not (yet) known.

Further efforts need to be made to discover these newly establishing populations. Governments and the conservation community need to inform both the public and professional people working in the field that they need to report observations of new exotic species/populations, and we need to facilitate the collection and analysis of such data in a centralized manner. Potential attempts to establish new populations can thus be located rapidly, and efforts can be targeted to eliminate these as early as possible, increasing elimination success rate.

The general literature on invasive species is also moving towards the same conclusion. First, we should prevent new establishments as much as possible, and scientific knowledge on characteristics of species (e.g. Blackburn et al. 2009) or introduction pathways (e.g. wild-bird trade vs. captive breeding: Carrete & Tella 2008) that influence establishment success can help us to improve management tools and prevent new establishments. But if this fails, we should remove new establishments as soon as possible. Eradication is considered a priority goal when detecting a new invasive species (Edwards & Leung 2009) and successful eradications have typically occurred in the early stages of invasion (Simberloff 2009). When faced with already well-established and spreading species, and given the limited nature of resources, the focus should be on areas (e.g. islands) and species (e.g. those proven to have negative impacts) that are most problematic, as proposed by Bauer and Woog (2011). But even more important is prevention and swift early action, when specific proof of negative impacts will generally not be available and should not be required (Simberloff 2003).

Consensus about these arguments is probably growing, but much of the discussion on how to handle exotic species is also influenced by the ethics of how we treat individuals, populations and species, even though that is not always made explicit. Similarly, conservation of native species also often has an ethical basis. In that context, the argument of enhancement of local biodiversity by invasive species does not justify inaction against exotic species, as exotic species are rarely threatened with global extinction yet negative impacts on native biota may have gone undetected or may yet occur. Another ethical argument used against eliminating exotic species is that we may not want to harm individuals of some exotic species if they do not cause harm (Blackburn et al. 2010), similar to the judicial notion of innocent until proven guilty. However, past scientific documentation makes most alien species sufficiently suspect of harm that we should effectively apply the Precautionary Principle. In addition, the cumulative amount of individual suffering is minimized by acting as soon as possible when newly established populations are still small. For example, the 7000 Ruddy Ducks shot now compare negatively with the few Ruddy Ducks that established initially.

Even when several countries have legislation or signed international agreements that promote the elimination of exotic populations, it is hardly implemented. While the review of the scientific evidence of negative impacts of each well-established exotic species as proposed by Bauer and Woog (2011) certainly can help prioritize management actions, we suggest that their proposal should not be interpreted as a plea against the eradication of newly establishing non-native species until sufficient harm has been scientifically documented.

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