Successful rapid response to an accidental introduction of non-native lizards *Podarcis siculus* in Buckinghamshire, UK

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SUMMARY

Italian wall lizards *Podarcis siculus campestris* were accidentally introduced to a site in Buckinghamshire, UK with a consignment of stone originating in Italy. Many populations of this lizard and closely related species have been established outside their native range, sometimes from a small number of founders. Mindful of the potential for these lizards to establish in the UK, we decided on a "rapid response" intervention. We captured four lizards, including a gravid female, and removed them to a secure captive collection. The capture operation comprised two visits, with specialist advice assisting estate management and nature conservation staff. Vegetation around the stone was cut back to dissuade dispersal in an effort to contain any remaining lizards. The imported stone and surrounding area were placed under surveillance, and no further lizards were found over the course of two years. Good communications between landowners, a government agency and reptile specialists expedited this intervention. We conclude that this simple, low-effort example of rapid response has eliminated the risk of a non-native invasive species establishing.

BACKGROUND

Introductions of invasive non-native species (INNS) are increasingly recognised as a threat to biodiversity (e.g. Millennium Ecosystem Assessment 2005). Strategies to address threats posed by INNS typically incorporate a "rapid response" element, since effective removal from the wild is more straightforward for recent introductions (e.g. Kraus & Duffy 2010). Removing introduced animals that have been present for some time is complicated by several factors, notably (a) an increase in population size, (b) a broader demographic profile compared to the founders, (c) increased familiarisation with the receptor site, leading to more effective crypsis, and (d) spread from the point of introduction. Removal operations therefore become progressively more complex, protracted and expensive with increasing time from the introduction event.

Rapid response is often a short-lived, unsophisticated intervention, and perhaps because of this there are relatively few documented examples in the literature (Simberloff 2009). Here we describe an undemanding yet effective example of rapid response to an accidental lizard introduction, as a contribution to the evidence base for detecting and managing INNS.

Italian wall lizards *Podarcis siculus campestris* were detected in June 2010 by staff at Stowe, a large 18th Century landscape garden in Buckinghamshire, central England, UK. Stowe encompasses lakes, valleys, open park grassland, shrubberies and woodland, along with built structures including temples and monuments.

The lizards were found on a consignment of tufa (a type of soft, porous limestone) in the estate

Figure 1. Tufa consignment in estate yard at Stowe (Photograph: J Hodgkins)

yard, an area used by the estate staff for storage of equipment and machinery. The tufa had been imported from Italy in March 2010 for a restoration project on an 18th century grotto in the gardens at Stowe. The large blocks of uncleaned, uncut tufa were stored on open pallets in the yard (Figure 1). Staff at Stowe and a local resident had observed 'bright green' lizards sunning themselves on the tufa and eventually reported this to the Trust's Nature Conservation Adviser (JH).

The effective response to Italian wall lizard introduction described here highlights two points of broader interest to the management of invasive non-native species. Firstly, the introduction pathway was clearly identified: as stowaways with stone imported from Italy. INNS entry pathways are seldom reliably determined, particularly when some time has passed since entry. Identifying proven pathways allows policy makers to assess risks and implement management measures. Managing risk of entry by addressing introduction pathways is likely to be more effective than implementing taxon-specific measures (see, e.g., Kraus 2009), and clearly prevention is preferable to reliance on rapid response.

Interestingly, the Italian wall lizard seems to be unusual among reptiles in that accidental introductions have been relatively well recorded. For example, Valdeón et al (2010) and Rivera et al (2011) report inadvertent introductions with olive tree imports from Italy into Spain; the latter authors surmise that other non-native reptiles may also have been introduced via the same pathway. Silva-Rocha et al (2012) note that that the behaviour and habitat associations of this species promote inadvertent translocation by humans.

The second general point illustrated here is that decisions and removal action were quick to follow from the initial detection. This could well have prevented population establishment, especially given that one of the lizards was carrying fertile eggs. Although this species has apparently never become established in the wild in the UK, it has successfully bred and survived the winter in outdoor vivaria here (CD, pers. obs.). The closely related common wall lizard *P. muralis* is now established at multiple sites in the UK (Lever 2009). The Italian wall lizard is thriving at other locations outside its native range (Kraus 2009), and as far removed as New York, USA (Ferner 2004). We therefore concluded that the possibility of a population establishment in the UK was realistic.

ACTION

Following detection of the lizards, the National Trust rapidly sought advice from herpetologists and the government wildlife conservation agency, Natural England. This resulted in reliable identification of the lizards and advice given to remove them as rapidly as possible. Monitoring and prospective capture visits were made by staff, reptile specialists and a local resident. Further advice on containment and long-term monitoring was also provided.

Lizard removal: A local ecological consultant captured one Italian wall lizard by net. Two of us [CD and JH] then visited the site in ideal weather conditions (mixed sunshine and cloud) and collected three further lizards by noosing. We used a visual search method to locate the lizards, focussing on three microhabitat types:(a) surfaces that were readily warmed by insolation, and thus likely to be used for basking, (b) vegetated areas likely to support lizard prey, and (c) potential egg-laying sites such as loose sandstone. By walking slowly and inspecting such areas from a few metres distance, it was possible to detect and approach the lizards without triggering their flight response. Noosing is a popular, low cost method for capturing lizards that frequent rocky or well vegetated habitats, and we have found it works well for Italian wall lizards (see Fitzgerald 2012 for practical instructions.) The method has no appreciable non-target impacts. It took around 2 hours to capture these three additional lizards. An additional 2 hours were spent before we decided no further lizards were available for capture on that visit.

In total, lizard removals thus comprised four individuals, with two days capture effort. The removals comprised one adult male, one immature male and two females, of which one

was gravid. Information from a local resident who had been observing the lizards increased our confidence that we had captured all the animals present.

Three of the animals were captured on or in close proximity to the tufa consignment, while the gravid female was around 10 metres away; we speculate she may have been searching for an egg-laying site. The number captured corresponded with the animals observed and photographed by a local resident. The animals were brought into captivity, quarantined and then re-homed at a secure captive collection in the UK managed by experienced herpetologists. This was done under Natural England licence, since possession is an offence under the Conservation of Habitats & Species Regulations 2010 (the UK legislation that implements the EC Habitats Directive). Once in captivity, the gravid female laid a clutch of five fertile eggs, about two weeks after capture.

Containment and monitoring: Estate management staff at Stowe were instructed in methods to check for further uncaptured lizards. This involved instruction in lizard behaviour, particularly where they were most likely to be found at key times of the day (focussing on the microhabitats mentioned above.) Initially, we intended to set up a quarantine area for the stone in another part of the site, and to install temporary fencing to prevent further lizard dispersal. However, we discovered an additional INNS (an invertebrate, to be reported on separately) on the stone, meaning that the consignment ought not to be moved. Work access problems and the lack of rapid financing meant that no temporary fence was installed. Instead, staff cut down the vegetation in a buffer zone around the stone to make the surrounding areas less attractive to lizards, and regularly checked the area for lizards and their eggs. These checks were made daily for 10 days after the lizard removal, then weekly for 3 weeks, and thereafter approximately every 2-3 weeks until the daytime temperature declined substantially. The stone was later moved as part of the invasive invertebrate eradication, and no lizards were found; nor would any likely survive the treatment, which included gassing.

CONSEQUENCES

No lizards were subsequently detected over a period of two years with regular checks around once per month from June to September, and we therefore assume that we captured all surviving lizards from the introduction. The outcome of the rapid response, then, is complete removal of the introduced lizards, and hence elimination of the risk of a new INNS population.

This case demonstrates that stone importation is an entry pathway for lizards (as well as invertebrates and plants). Simple measures to thoroughly clean stone before export from the country of origin would reduce the risk of inadvertently introducing non-native species. This is especially the case with materials like tufa that have numerous voids (Figure 1), increasing the likelihood that stowaways will enter the stone and survive transport.

The decision to undertake removal action was quick to follow from the initial detection. This could well have prevented population establishment, especially given that one of the lizards was carrying fertile eggs.

The fact that expert advice and field assistance was available quickly meant that the lizards were removed with negligible delay and cost in this case. In our experience, this seldom follows when introductions are initially reported. A more common response is that no decision is made on removal and a “wait and see” approach is adopted. Such prevarication may lead to non-native species establishing and spreading beyond the point of feasible removal (see Genovesi *et al.* 2010).

Grounds staff did not at first realise the significance of their lizard sightings, and this may highlight a need for additional training and awareness, as well as further policy and guidance on the importation of materials such as tufa. However, despite this minor delay, the successful outcome in this case was largely due to good communications between grounds staff, conservation advisors, a local resident and herpetologists. Such relations are comparatively well developed in the UK, where there are good opportunities for government and voluntary organisations to interact over reptile conservation matters. That situation is not mirrored in some countries, in our experience, especially where volunteers and professionals work independently. Under such conditions, rapid and decisive action to remove INNS may be less likely.

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