

*Letter to the Editor*

## Alien Parasites May Survive Even if Their Original Hosts Do Not

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In their assessment of the role of parasites as drivers and passengers of biological invasions, Blackburn and Ewen (2016) argue that the average success of alien parasites is likely to be lower than for their hosts because they will not become aliens if their hosts fail to establish following arrival to new areas. This is certainly true if the hosts die already during their transport to new areas. However, if they manage to reach them but fail to establish, they still give the parasites they carry a chance to survive.

The basic prerequisite of this scenario is spillover of parasites to new local hosts. In order to survive, it would seem that the parasites must find a new host before the original ones die out, but the complex life cycles of some parasites include free-living larvae, eggs, or resting stages that may survive long enough after their alien hosts' extinction to allow them to find and acclimate to new ones. Some parasites may also be less susceptible to factors that are fatal to their hosts. For instance, internal parasites of warm-blooded tropical taxa may find equally suitable conditions inside new hosts living in cooler climates. The chances for alien parasites may also be higher because the establishment success of some of them is less affected by propagule pressure than it is for their hosts: asexual reproduction is more common among parasites than among their hosts, or male and female parasites may occur in the same host individual.

The paucity of supportive examples for these scenarios is due in part to the fact that the chances of finding them are inversely related to the period of time in which the alien hosts managed to survive after introduction, and this time may be too short for their presence to be detected. This holds true particularly if such unsuccessful aliens are introduced unintentionally. The temporary occurrence of such species belonging to understudied taxonomic groups, or introduced in undersampled areas or habitats, is likely to remain unnoticed. When it comes the introductions dating back centuries, our knowledge will remain incomplete even if those introductions were intentional and successful.

A spectacular example of an alien parasite's survival long after its original host had died out is the discovery of the North American liver fluke (*Fascioloides magna*), recorded in southwestern Poland around 1930 and then in 1953 (Demiaszkiewicz et al. 2015). The parasite was found in the red deer (*Cervus elaphus*) in an area where the North American wapiti (*Cervus canadensis*) had been introduced in 1850. As there is no further information on the local wapiti population, they must certainly have died out quickly, so the first record of the parasite they brought in was about 80 years after that failure to establish. It took another 60 years to rediscover *F. magna* in that same area in 2015 (Demiaszkiewicz et al. 2015).

The risk of new parasite invasions may be underestimated even if the transient occurrence of their hosts is well documented, such as in the case of escapes (or releases) of alien companion animals. While records of some of them have become so common that they stopped drawing any-

one's attention, sightings of less common species are often highlighted in the media, particularly if these are attractive or dangerous exotics. For a number of reasons, including adverse climate, many of such introductions have no chance of success. Accordingly, such records, however common or widely publicized, tend to remain off the radar of invasion science, and their potential consequences are not adequately addressed in frameworks aimed at reducing the threat of biological invasions.

An example illustrating the need to focus also on anecdotal records of non-established alien species is the detection of the oesophagostomum nematode *Bourgelatia diducta* in wild boars (*Sus scrofa*) in southern Poland (Nosal et al. 2013). This was the first European record of this parasite, whose native range is in subtropical Southeast Asia. The most plausible scenario of its occurrence in wild boars is transmission from Vietnamese potbellied pigs. In Poland, there have been only single media reports of these pets that escaped or were released by their owners. Other anecdotal records of exotic hosts having no chance of establishment in Poland include reptile pets, such as the Green iguana (*Iguana iguana*) or Ball python (*Python regius*), which were demonstrated carry eight alien tick species (Nowak 2010). Even more suggestive is the record of two pirapitingas (*Piaractus brachypomus*) caught in northwestern Poland. The fish were infested with two unknown monogenoid neotropical parasites, subsequently described as *Mymarothecium viatorum*, new to science (Boeger et al. 2002). Although neither this parasite nor the alien ticks found on exotic reptiles have been recorded in native species as yet, these examples show that even the ephemeral presence of apparently harmless alien hosts, unable to survive, may have unexpected long-term consequences.

Our imperfect knowledge of the history of unsuccessful introductions of alien hosts, combined with inadequate scrutiny in our assessments of the risks posed by the temporary occurrence of alien species with no establishment potential, may have important theoretical and practical

consequences. The origin status of their surviving parasites may be assigned incorrectly, particularly since they may be found long after their initial host has failed locally. An alien parasite survivor discovered as new to science may even be misidentified as native in its *locus typicus*, particularly if it is taxonomically similar to species already present there. Likewise, new records of parasites previously known from elsewhere may be treated as new localities within the native range of the species. In both cases, the species may also be classified as cryptogenic, of unclear origin, but this is often done after only a superficial assessment of the available information (Pociecha et al. 2016). Such inaccuracies blur our understanding of the basic rules of biogeography, ecosystems evolution, their functioning, and, as demonstrated by Blackburn and Ewen (2016), biological invasions mechanisms. As a consequence, practical efforts to mitigate the effects of past invasions of alien species and to prevent new ones may be hampered.

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