1.4 Can Native Parasitoids Benefit From Accidental Introductions of Exotic Biological Control Agents?

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Interspecific interactions between native and exotic parasitoids can impact community structure and are relevant not only from an ecological standpoint, but also from a biological control standpoint. A thorough understanding of these interactions is critical to estimate the range of potential direct and indirect effects, positive or negative, associated with the establishment of an exotic parasitoid, irrespective of whether its introduction was intentional or accidental.

Exotic pests can be exploited by native natural enemies (food source diversification and/or novel host); however, this exploitation is only adaptive for the native species if it results in enhanced survival and/or reproduction. In environments that have undergone rapid change, previously reliable cues for survival and reproductive success may no longer be associated with adaptive outcomes, resulting in an evolutionary trap that reduces the fitness and reproductive success of the native organism (Schlaepfer *et al.*, 2002). If, for example, a native parasitoid accepts an invasive species as a host but fails to complete development, then the host becomes an evolutionary trap for the native species (Abram *et al.*, 2014). This evolutionary trap could benefit native host species by reducing overall parasitoid numbers, and thus, parasitoid load in those host populations. However, phenotypic plasticity can permit escape from an evolutionary trap if the organism in question learns avoidance behaviour, undergoes morphological changes, or overcomes defensive barriers to development in the host (Berthon, 2015).

The potential occurrence of an evolutionary trap has been associated with the widespread establishment of the invasive pest, *Halyomorpha halys* Stål (Hemiptera: Pentatomidae), in Europe and North America. In invaded areas, *H. halys* eggs are readily attacked by native Scelionidae, but are unsuitable for parasitoid offspring development (Abram *et al.*, 2014; Haye *et al.*, 2015). To further increase the complexity of the current system, the exotic Asian parasitoid, *Trissolcus japonicus* (Ashmead) (Hymenoptera: Scelionidae) is being considered for introduction as a classical biological control agent for *H. halys* in recently invaded countries, and has already been documented as an adventive introduction in the USA (Talamas *et al.*, 2015).

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We determined the outcomes of larval competitive interactions between the exotic *T. japonicus* and the European *Trissolcus cultratus* (Mayr) (Fig. 1.4.1), simulating what may happen under natural conditions if both species occupy the same ecological niche (Konopka *et al.*, 2017). Sequential exposure of *H. halys* egg masses to *T. japonicus* and *T. cultratus* at different time intervals demonstrated that native parasitoids can act as facultative hyperparasitoids of the exotic parasitoid, but only during a limited window of opportunity. As such, the secondary invader, *T. japonicus*, could facilitate the use of the primary invader, *H. halys*, as host by a native species, *T. cultratus* in this case, that it would otherwise be unable to effectively exploit as a resource, thus providing a potential mechanism for the native species to escape from an evolutionary trap. In contrast to previously described negative synergistic effects of multiple exotic species on invaded ecosystems, our work suggests that an exotic species could act as an 'invasional lifeline' for resident species, mitigating the negative ecological effects of other biological invasions.

Fig. 1.4.1. *Trissolcus cultratus* foraging on eggs of *Halyomorpha halys* previously parasitized by *Trissolcus japonicus*.

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