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Published in:
Entomologia Experimentalis et Applicata

DOI:
10.1111/eea.12667

Publication date:
2018

Citation for published version (APA):
Beukeboom, L. W. (2018). What makes an insect invasive? An introduction. *Entomologia Experimentalis et Applicata*, *166*(3), 149-150. https://doi.org/10.1111/eea.12667

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DOI: 10.1111/eea.12667

SPECIAL ISSUE: POPULATION STRUCTURE AND DYNAMICS OF INVASIVE SPECIES

What makes an insect invasive? An introduction

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Many insects are expanding their distribution range due to climate change and transport by human activities. Some of these species become invasive, they compete with the native fauna, and can be a threat for agriculture and food storage. Predicting which species will be able to establish in a novel environment is important, but we do not yet have a good understanding of the biological factors that determine invasiveness. Study of population structure and dynamics of invasive species will help to identify which biological traits and environmental conditions lead to establishment and range expansion. This special issue contains studies on life-history traits and dispersal behavior of a number of invasive insect pests of forests and agricultural crops.

A well-known example of an invasive species is the multicolored Asian ladybird *Harmonia axyridis* (Pallas) (Coleoptera: Coccinellidae) that was introduced as a biological control agent of aphids in Europe, the Americas, and northern Africa, but established in nature where it competes with native ladybirds. Surprisingly little is known about the biological traits that make this species so successful in its new habitats. Raak-van den Berg et al. (2018) compare larval development and survival of *H. axyridis* and the native ladybird *Adalia bipunctata* L. (Coleoptera: Coccinellidae) under field conditions and find that *H. axyridis* develops faster and survives better, which may be among the reasons for its invasion success.

An important determinant of invasiveness is the availability of alternative breeding sites and the preference of adult females for these novel oviposition substrates. Wang et al. (2018) studied the effects of apple cultivars on the performance of the Oriental fruit moth, *Grapholita molesta* (Busck) (Lepidoptera: Tortricidae), an important pest in apple orchards. In a laboratory feeding assay they demonstrate that many life-history traits of this borer are affected by apple variety. Oviposition preference and larval development speed and survival appear to be the main determinants of the performance of the moths. Knowing this pest's population dynamics may help deciding which apple cultivars to grow.

The Emerald ash borer, *Agrilus planipennis* Fairmaire (Coleoptera: Buprestidae), is an invasive pest of ash trees in North America where it has reached a wide distribution. As infested logs are collected and kept in the laboratory for some time to obtain beetles for study, Fick & McQuarrie (2018) investigated the effects of storage on the beetle's fitness. In contrast to anecdotal previous observations, they do not find strong effects on body condition and adult fitness, although the numbers of emerging beetles decreases after prolonged storage. These results are relevant for determining invasion risk as they show that *A. planipennis* can survive long transport periods of ash wood shipping around the globe. In a study in South America, Grilli & Fachinetti (2018) used pine land cover data in combination with trapping and flight mills to establish the ability of *Arhopalus rusticus* (L.) (Coleoptera: Cerambycidae) to disperse and colonize new forest patches. This longhorn beetle from the Northern hemisphere has rapidly invaded pine forests in Argentina, where its larvae cause damage to the timber industry. As some individuals were able to fly more than 15 km, the data indicate that even the more isolated host patches can easily be reached.

Information of population structure can be informative about the invasion history, but also be used to predict colonization risk. Husch et al. (2018) used microsatellite markers and population samples from various regions to determine the population structure of the Neotropical brown stinkbug, *Euchistus heros* (Fabricius) (Hemiptera: Pentatomidae), a major pest of soybean in Brazil. They find high genetic variation, yet low genetic differentiation between populations, which is consistent with multiple introductions of this hemipteran into the region. It reflects high gene flow and population density following the expansion of soybean production in the area. Duque-Gamboa et al. (2018) investigated to what extent *Prodiplosis floricola* Felt (Diptera: Cecidomyiidae) and its congeneric *Prodiplosis longifila* Gagné, polyphagous pests of

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Solanaceae, are threatening the citrus industry in Colombia. Using genetic markers, they find that local fly populations are genetically well differentiated. As these flies have low dispersal ability, these results point toward multiple independent founding events, probably resulting from human transport activity.

Tracing invasive species in space and time requires efficient monitoring schemes. Whiteflies, such as *Bemisia tabaci* (Gennadius) (Hemiptera: Aleyrodidae), are among the most devastating insect pests of commercial crops worldwide. Czepak et al. (2018) investigated the distribution of several developmental stages of whiteflies on soybean plants during harvest. They find clear differences in the locality of eggs, larvae, pupae, and exuviae, depending on the maturation stage of the plant. Based on their results they propose an optimized sampling plan for whiteflies in soybean cultivars, which represents a recently colonized crop in Brazil.

Detailed knowledge of insect life histories, as well as on how the environment affects the development and dispersal of invaders, is a prerequisite for developing effective integrated pest management (IPM) programs. As many pest insects have colonized habitats outside their native range, they can be studied to identify the biological factors that lead to successful invasion. The articles in this issue point to a number of important life-history traits, such as oviposition preference, larval performance on alternative hosts, and dispersal capacity.

Together with monitoring the distribution, abundance, and condition of their host plants, this information should eventually lead to a better control of invasive pest insects.

References

Czepak C, Guedes Coelho AS, Rezende JM, Senechal Nunes ML, Weber ID et al. (2018) *Bemisia tabaci* MEAM1 population surveys in soybean cultivation. Entomologia Experimentalis et Applicata 166: https://doi.org/10.1111/eea.12656.

Duque-Gamboa DN, Castillo-Cárdenas MF, Hernández LM, Guzmán YC, Manzano MR & Nelson Toro-Perea N (2018) The bud midge *Prodiplosis floricola* in citrus crops in Colombia. Entomologia Experimentalis et Applicata 166: https://doi.org/10.1111/eea.12654.

Fick WE & McQuarrie CJK (2018) An artificial delay in emergence influences the number but not the fitness of adult emerald ash borer emerging from infested ash wood. Entomologia Experimentalis et Applicata 166: https://doi.org/10.1111/eea.12671.

Grilli MP & Fachinetti R (2018) The role of host patch characteristics and dispersal capability in distribution and abundance of *Arhopalus rusticus* in central Argentina. Entomologia Experimentalis et Applicata 166: https://doi.org/10.1111/eea.12653.

Husch PE, Gomes Ferreira D, Seraphim N, Harvey N, Silva-Brandão KL et al. (2018) Structure and genetic variation among populations of *Euschistus heros* from different geographic regions in Brazil. Entomologia Experimentalis et Applicata 166: https://doi.org/10.1111/eea.12666.

Raak-van den Berg CL, de Jong PW, Gort G, Manly BFJ & van Lenteren JC (2018) Life histories of an invasive and native ladybird under field experimental conditions in a temperate climate. Entomologia Experimentalis et Applicata 166: https://doi.org/10.1111/eea.12658.

Wang Y, Kong W-N, Zhao L-L, Xiang H-M, Zhang L-J et al. (2018) Methods to measure performance of *Grapholitha molesta* on apples of five varieties. Entomologia Experimentalis et Applicata 166: https://doi.org/10.1111/eea.12655.