Invasion in the light of evolution: an integrative approach using two widespread widow species

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As invasive species spread around the world, understanding the factors underlying invasion success has become increasingly important. Using an evolutionary perspective to examine biological invasions, I investigated how organisms are able to rapidly adapt to new environments, and how selection on phenotypic traits changed over time during sequential stages of the invasion process. I used lab and field studies to assess the importance of behaviour, physiology, morphology, and plasticity to widow spider invasion success. Using this variation in invasion history, I explored patterns across organismal, population, and species-level scales. First, I investigated the effects of metabolic rate on behaviour in Australian redback spiders, Latrodectus hasselti, and links between behavioural variation and fitness components measured in the field and laboratory. My work showed that metabolic rate influences fitness via correlation with multiple behaviours, but that metabolic rate alone does not drive all individual behavioural differences. Then, I tested preadaptation and local adaptation in a native and an invasive population of L. hasselti to investigate tolerance of novel environmental conditions experienced in the invasive range. In this study, I showed that invasive populations may be able to thrive in novel environmental conditions because of increased behavioural plasticity, tolerance of temperature fluctuations, and higher fecundity. Next, I compared populations of L. hasselti that are native, established invasive, and newly invasive, and assessed the relative importance of phenotypic traits likely to predispose a species to invasion success. I found that invasive populations of Australian redback spiders diverged from the native Australian population in behaviour, life history, and morphology. To follow up on these patterns, I tested hypotheses of behaviourally mediated spatial sorting and changes in tradeoffs during invasive spread using two independent invasions of brown widow spiders. I found similar patterns of increased dispersal propensity in two independent invasions of brown widow populations in Israel and the United States. These common patterns suggest that dispersal ability under positive selection in invasive populations, particularly the recently established populations. I infer that behavioural plasticity and dispersal propensity, together with a preference for human-disturbed environments, may underlie invasion and establishment in invasive widow species. In sum, my work has expanded our knowledge of how evolutionary processes affect the spread of invasive species through local adaptation, selective filters in the invasion process, and spatial sorting.

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