

Selection Criteria And Ecological Consequences Of Importing Natural Enemies



Article

Assessing Probabilistic Risk Assessment Approaches for Insect Biological Control Introductions

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Abstract: The introduction of biological control agents to new environments requires host specificity tests to estimate potential non-target impacts of a prospective agent. Currently, the approach is conservative, and is based on physiological host ranges determined under captive rearing conditions, without consideration for ecological factors that may influence realized host range. We use historical data and current field data from introduced parasitoids that attack an endemic Lepidoptera species in Hawaii to validate a probabilistic risk assessment (PRA) procedure for non-target impacts. We use data on known host range and habitat use in the place of origin of the parasitoids to determine whether contemporary levels of non-target parasitism could have been predicted using PRA. Our results show that reasonable predictions of potential non-target impacts may be made if comprehensive data are available from places of origin of biological control agents, but scant data produce poor predictions. Using apparent mortality data rather than marginal attack rate estimates in PRA resulted in over-estimates of predicted non-target impact. Incorporating ecological data into PRA models improved the predictive power of the risk assessments.

Keywords: risk assessment; origin; natural enemies; non-target species

1. Introduction

The rate of biological invasions globally has increased dramatically in the past 500 years due to an increase in human activities such as transportation, migration, and commerce [1]. Invasive species cause direct and indirect effects on organisms living in the environment they invade, and therefore threaten biodiversity, agriculture, and human health. Besides the environmental impacts, invasive species cause major economic losses in different sectors of the U.S. economy [2]. The practice of classical biological control (CBC), as the intentional transfer of natural enemies from one place to another, has traditionally been used as a tool to fight invasive species in agricultural settings and is now also being used to control invasive species in natural areas [3,4].

The enemy release hypothesis states that organisms become invasive in a new area because they have escaped the natural enemies that suppress their populations in their area of origin. Exotic species thus have an advantage over competitors in areas of introduction where indigenous species are still suppressed by their indigenous natural enemies [5]. Therefore, CBC works under the premise that the reestablishment of top-down control by introduction of natural enemies will reduce the populations of invasive species and therefore restore balance [3].

The history of biological control provides many examples of remarkable successes [6]. Prime examples include the introduction of the Australian lady beetle *Rodolia cardinalis* (Mulsant) (Coleoptera: Coccinellidae) to control the cottony cushion scale, *Icerya purchasi* Maskell, an introduction that is credited with saving the California citrus industry, and the introduction of

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when the predator has multiple prey species (30). . Selection Criteria and Ecological Consequences of Importing. More difficult to assess are environmental costs due to habitat loss or species . In "Selection Criteria and Ecological Consequences of Importing Natural. nontarget impacts, regulations governing releases of natural enemies are becoming more stringent, as evi- selection of agents with high levels of host and habitat fidelity. . impact monitoring of imported biological control agents . Although the exact ecological impact of biological con- Selection criteria and ecologi-. Thomas Say Proceedings: Selection Criteria and Ecological Consequences of Importing Natural Enemies. Lanham, MD: Entomological Society. vironmental costs due to habitat loss or species extirpation or extinction tions of non-indigenous species should be subject to impact risk assessment (Wittenberg and .. In Selection Criteria and Ecological Cnsequences of Importing.

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