3.3 Assessing Host Use and Population Level Impacts on Non-target Species by Introduced Natural Enemies: Can Host Range Testing Provide Insight?

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The prediction of potential non-target impacts from introduced biological control agents remains an important issue, despite significant improvements in quarantine practices. Depending on strict physiological host range, characterization in quarantine has resulted in very conservative selection of biological control agents, and no non-target impacts are known to have occurred from introductions made since 1970, at least in Hawaii (Funasaki *et al.*, 1988). Pre-release host range assessment options include investigations of host range under quarantine conditions, host range determined during quarantine programs in other areas, host ranges reported from other programs that resulted in releases, and predicted host range in the release area based on the natural enemies' host ranges in their place of origin.

This paper explores these options by review of data from pre-release screening and post-release non-target impacts, and retrospective examination of host range of parasitoids in their native provenance, compared with post-introduction non-target impacts.

Parasitism of the endemic Hawaiian koa bug, *Coleotichus blackburniae* White (Hemiptera: Scutelleridae), by prospective biocontrol agents, *Trissolcus* (Hymenoptera: Scelionidae) and *Trichopoda* (Diptera: Tachinidae) were anticipated prior to release of the insects in Hawaii. Laboratory observations suggested that the natural enemies may perform reasonably well (*Trissolcus*), to poorly (*Trichopoda*) on koa bug (Davis, 1964), although no predictions of population level impact were made. Johnson *et al.* (2005) later demonstrated that koa bug mortality from the introduced natural enemies was influenced by environmental conditions, and that accidentally introduced predators had a larger impact on the non-target host than the biocontrol agents did.

Attempts to compare predicted non-target impact using parasitism and habitat data for parasitoids from their native provenance, with actual parasitism rates in Hawaii were made, using data of known habitat and host-range from places of origin of parasitoids introduced to Hawaii (Kaufman and Wright, 2017). Results showed that if comprehensive host-range data were available from the place of origin, reasonably accurate predictions of non-target parasitism could be made using probabilistic risk assessment procedures. Results for one species, *Cotesia marginiventris* (Cresson) (Hymenoptera: Braconidae), are shown in Fig. 3.3.1, illustrating reasonable correlation between the predicted and actual parasitism rates.

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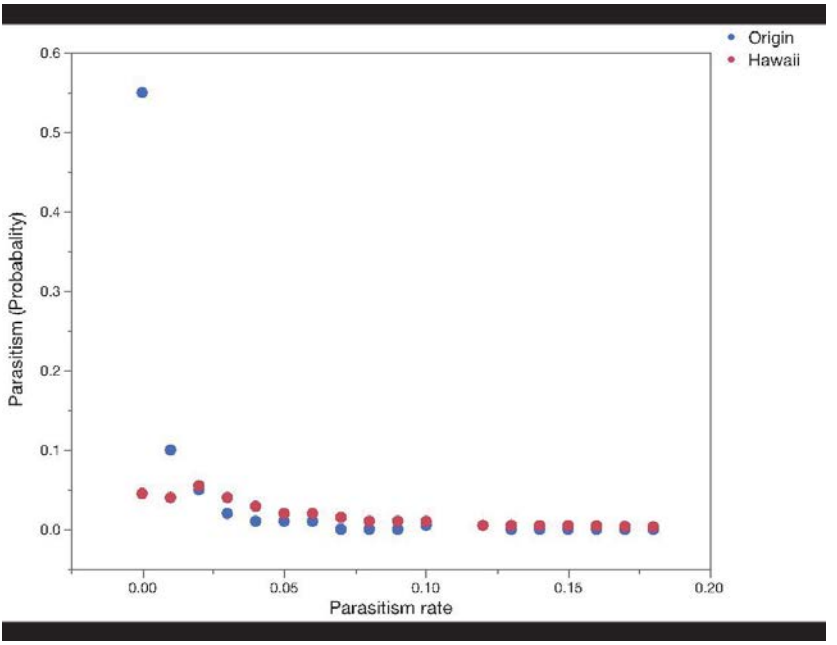

Fig. 3.3.1. Probability of occurrence of *Cotesia marginiventris* parasitism rates of an endemic Hawaiian moth, *Udea stellata*, predicted from the place of origin of the parasitoid, compared with actual levels measured in Hawaii.

Non-target host use is likely well predicted, albeit conservatively with the potential for false-positives, by physiological host range testing in quarantine. Strict adherence to quarantine testing and selecting species with high physiological host specificity appears to provide an effective protocol for avoiding non-target use. We may be able to make the process less conservative by employing probabilistic risk assessment procedures during screening, and by incorporating ecological and host-range data from previous studies. Predicting population level impacts is more complex, and requires substantial data. To predict non-target population impacts would require completion of life-table studies and careful assessment of additional stressors that may impact non-target species in the area of release.

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