in mature trees. Host-specificity studies (no-choice development, no-choice and multiple choice oviposition tests) were conducted in the Florida, USA, quarantine laboratory using 30 plant species in 11 families. Laboratory tests indicated that \( P. \) ichini is capable of continuous reproduction only on Brazilian peppertree and its congener \( S. \) molle L., a prized ornamental tree in California native to Peru that is becoming invasive in some areas. If approved for release in the USA, \( P. \) ichini is unlikely to survive in the arid environment where \( S. \) molle thrives in California. In addition, field surveys in Brazil confirmed that under natural conditions where both \( Schinus \) species coexist, \( S. \) molle is not attacked by \( P. \) ichini.

The nature of risk from biological control

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Risk is a relative concept commonly used when uncertainty can be quantified. The probabilities of possible outcomes are estimated, such as risk of damage to a non-target species from a biological control agent. “Acceptable risk” is used when uncertainty is quantified to the subjective satisfaction of a viewer. Uncertainty is measured by the deviation from “expected values”, which may also be difficult to quantify. Thus, when probabilities of different outcomes are unknown, uncertainty is transformed into risk, where probabilities of outcomes are weighted according to their likelihood of occurrence. Each potential outcome is weighted by its probability of occurrence (by past trends, subjective judgments, experimentation etc.), and the weighted outcomes are summed to arrive at a mean, or expected, value. Incomplete information complicates objective estimates of risk, so the subjective valuation of risk is biased, and usually overstated. Herein lies the problem for biological control. Most risk (and most fears) in biological control is measured by the assumption of potential damage to non-target species. However, there is an equal risk to non-target species from not using biological control to manage invasive pests. Also, it is difficult to isolate the exclusive impact of potential risk by biological control agents on non-target species, mainly because environmental factors other than natural enemies influence risk, and if omitted, bias (overestimate) estimates of risk. It is also difficult to compare across different types of risk. Clearly, in biological control, the risk to non-target species from a macrocyclic, autoecious rust fungus such as \( Puccinia \) chondrillina or \( Uromyces \) heliotropii, is far less than the potential risk from an oligophagous or polyphagous biological control agent. It is argued that the term “the risk from biological control” is meaningless and a risk analysis model is proposed for use with biological control of weeds.

(This presentation was a keynote address for Theme 3)

Host-specificity investigations of a gall midge for the biological control of alien invasive hawkweeds in North America

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Several hawkweed species of Eurasian origin have been deliberately or accidentally introduced into other parts of the world and some have become invasive weeds. Thus, in New Zealand, where there are no indigenous \( Hieracium \) spp., \( Hieracium pilosella \) is a severe weed in pastures, reserves and national parks. \( H. caespitosum \), \( H. glomeratum \), \( H. praecatum \) and \( H. aurantiacum \) are weeds in rangelands, national parks and clear-cut areas in North America. One of several insect species studied for the biological control of hawkweeds in New Zealand is the multivoltine gall midge \( Macrolabis pilosellae \). Gall midge attack leads to shorter stolons and reduced numbers of leaves and flower heads. Host-specificity investigations carried out for New Zealand showed that the gall midge is at least genus-specific, developing on \( H. pilosella \), \( H. caespitosum \) and \( H. praecatum \). Therefore, \( M. pilosellae \) was selected as a potential biological control agent of alien invasive hawkweeds in North America. In
contrast to the situation in New Zealand, there are native hawkweed species in North America, and so a narrower host range is necessary. To assess its potential field host range, the gall midge is being tested on a range of North American test plant species including native and invasive *Hieracium* spp. using different test designs. North American invasive alien hawkweed species are in the subgenus *Pilosella*, whereas the native ones are in the subgenera *Hieracium* and *Stenotheca*. All those hawkweed species from the subgenus *Pilosella* on which normal gall development occurred in no-choice tests and which were tested under less restricted conditions were also accepted as hosts in these test designs. *Hieracium* spp. from the subgenera *Hieracium* and *Stenotheca* were accepted to a varying extent in no-choice gall formation tests, but not or only to a very limited extent under more natural conditions.

**Our changing perception of *Cactoblastis cactorum* in North America**

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Control of prickly pear cacti, *Opuntia* spp. (Cactaceae), by the South American cactus moth, *Cactoblastis cactorum* (Pyralidae), is a classic example of successful weed biological control. Unfortunately, in 1989 *C. cactorum* was found in the Florida Keys feeding on endangered *O. corallicola*. The insect attacks all six native Florida opuntias. The insect was not introduced into Florida as a biological control agent, but most likely as a Caribbean immigrant on ornamental cacti. Of major concern is the potential spread of *C. cactorum* to the opuntia-rich areas of the western US and Mexico. This could have devastating effects on the landscape and biodiversity of this region. In addition, the forage and vegetable opuntia industries in Mexico will likely be severely impacted by this “pest”. This study is addressing three objectives: 1) determine the current distribution and spread of *C. cactorum* in North America; 2) determine the potential impact of native natural enemies on the spread (and possible control) of *C. cactorum*; and 3) explore the potential of the inherited sterile insect technique (SIT) to control *C. cactorum*. The moth’s range continues to expand and now reaches as far north as Charleston, SC along the Atlantic and the Florida Panhandle along the Gulf of Mexico. The moth is spreading most quickly on cacti along the coast. However, infestations noted in the interior are becoming more common. Parasitoids (Tachinidae, Ichneumonidae) found attacking the native cactus moth, *Melitara prodenialis* (Pyralidae), were also found attacking *C. cactorum*, but at lower rates. Irradiation studies have determined the dose at which *C. cactorum* males are 100% sterile and the deleterious effects inherited by the F1 generation minimized. A SIT program may be useful in controlling *C. cactorum* along its leading edge to limit geographical range, to eradicate isolated populations far in front of the leading edge, or as an abatement program to protect rare and endangered *Opuntia* spp.