



Montana Invasive Species Council

Key Findings of *Mogulones crucifer* Science Advisory Panel: A workshop on the current status of *M. crucifer* and recommendations regarding future efforts towards the biological control of houndstongue

A seven-person panel of leading researchers and expert senior representatives from regulatory and management agencies was assembled in late April and early May 2019 by the Montana Invasive Species Council (MISC) to scope the potential for approval of *Mogulones crucifer* for classical biological control of houndstongue in the U.S. An eighth panel invitee was unable to attend, but did provide input.

Key Challenges and Recommendations by Panelists

Challenges

- Losses due to houndstongue are very large and there are limited options for control
 - The sole agent currently used for biocontrol in North America is not a permitted agent in the US
 - Other agents are not yet ready for the initiation of a petition for permitted release
 - Adventitious feeding by other herbivores on houndstongue is variable with very limited impact
- A permitted agent in Canada, *M. crucifer*, has been successful in the control of houndstongue, but has spread southward into the US
 - It is not a permitted biocontrol agent in the United States
 - There is insufficient detail on the status of specific populations of this agent in affected States
 - Impacts on potential target houndstongue infestations are unknown
- As a biocontrol agent, *M. crucifer* has a broad fundamental host range within the family of its targeted weed host (Boraginaceae).
 - Evidence from no-choice tests to determine potential feeding or oviposition on related species
 - Plants subjected to no-choice exposure included non-target threatened and endangered Boraginaceae species
 - Limited feeding and reproduction was observed on some species of concern (Boraginaceae)
- There are a number of native and non-native Boraginaceae in the areas where *M. crucifer* has spread
 - Diversity and abundance of non-target Boraginaceae increases along a southward gradient
 - Knowledge on the distributions of these varies by species
 - Potential impacts on non-targets by *M. crucifer* is not well known for the U.S. distributions
 - Small, isolated populations of threatened and endangered (T & E) species are well known but potentially vulnerable to *M. crucifer*
- *M. crucifer*, as an unpermitted agent, cannot be recommended for biocontrol of houndstongue
 - Movement of *M. crucifer* cannot be aided by humans in current status
 - Federal regulations exist on interstate transport (APHIS) and provide for protection of T & E species (US FWS)
 - Jurisdiction and enforcement are complicated by perceptions about a Pest Alert, which is not a regulatory document; it is a concise summary of relevant information
- Potential mitigation tools for *M. crucifer*, if needed, are not well known and limited in effectiveness
- The finding of broad fundamental host range of *M. crucifer* under no choice conditions is not supported in practice

- The ecological host range is narrow and dominated by a strong preference for houndstongue
 - Ongoing experiments indicate this is governed by the chemical ecology of host choice and supported by recent behavioral experiments coupling visual cues and houndstongue volatiles, but these are not yet finalized
- Detailed field observation and experiments in Canada since *M. crucifer* was first permitted also confirm a narrow ecological host range
 - Locations where nontarget borages and houndstongue co-occur show negligible spillover effects on nontargets from large populations of *M. crucifer* that are devastating houndstongue
 - Use a precise and accurate definition of spillover (Hinz et al. 2019)
 - This does include situations where T & E species may be impacted
 - Based on numerous years of field observation in Canada, spillover is infrequent and mild and, at this time, that level is considered acceptable
- *M. crucifer* in the US is unlikely to cause problems, but biocontrol practitioners are unable to use it
 - Land managers cannot capitalize on efficacy as a biological control agent
 - Current status results in an unfunded need to monitor non-target Boraginaceae species and *M. crucifer* populations
 - There are resource and jurisdictional challenges that complicate greater awareness
 - Specifically, which types of funds can be used to monitor *M. crucifer* when it is not an approved biocontrol agent and similarly, who should monitor the changes in distribution
- Current research findings are not all published
- The historical draft petition for the release of *M. crucifer* in the US was withdrawn due to concerns about non-target impacts
- Use the improved understanding of regulatory decision making process, obtained during the SAP, to eliminate ambiguity in facts presented to support a petition for release of *M. crucifer*

Recommendations

- Develop consistent protocol for monitoring *M. crucifer* and non-targets
 - Use existing agency inventory and monitoring programs to do this
 - Identify botanical expertise and coordinate at the State level
 - Use a two-tiered protocol; 1) land managers and 2) biocontrol experts
- Develop mitigation strategies to follow on science-based decisions
 - Requires strong expertise in plant taxonomy to be effective
 - Mapping of houndstongue relative to the distributions of non-target Boraginaceae of concern and post-mitigation monitoring essential
 - Prepare fact sheets with photos to facilitate identification of *M. crucifer* and its feeding damage
- Conduct cage studies to confirm feeding and oviposition choices made between houndstongue and nontarget borages by female *M. crucifer* support strong preference for houndstongue
 - Laboratory experiments are compelling, but outdoor cage trials are required
- Publish findings on chemical ecology, sensory level data and behavioral trials that support that *M. crucifer* may be unable to detect, or be repelled from, T & E nontarget Boraginaceae
- Fully utilize all new field and laboratory data that are available to support petition decisions being made based on the ecological host range of *M. crucifer*
 - No such criteria currently exist for consideration of chemical ecology and associated behavior; strong and overwhelming regulatory agency encouragement that such information, specific to *M. crucifer*, be used to do this and possibly establish a new model for assessing the fidelity of future biocontrol agents

- There is no requirement for peer reviewed publication of data supporting a petition; a petition can occur concurrently or before submission of research findings to a scientific journal
 - Compilation of observational data be coordinated from across western states and across international borders to support a petition for the release of *M. crucifer* in the US
 - Inclusion of data on root system morphology of houndstongue and non-target species may help to explain relative survival of *M. crucifer* on these hosts of differing suitability
 - A petition be developed and submitted for the release of *M. crucifer* in the US
 - The petition should be prepared by Mark Schwarzlaender, based on strong leadership in evaluating and defining the ecological host range of *M. crucifer* using chemical ecology and behavior
 - Of marked importance is the opportunity to summarize field level data on host use by *M. crucifer* obtained since its first release in 1997; Rosemarie De Clerck-Floate will provide this in support of the petition and share any findings on root system suitability.
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Conclusion and Next Steps

The MISC *Mogulones crucifer* Science Advisory Panel was a successful step in the process of moving toward a successful petition for the release of *M. crucifer* on houndstongue in the US. The management of invasive houndstongue in the US presents unique political and management challenges, including non-target effects of measures other than biological control on fragile species in wildlands. A clear synthesis of current knowledge on the ecological host range of *M. crucifer* provided an opportunity for clarification on how such information might be used to successfully prepare and submit a petition. A special opportunity is afforded by the fact that the release of this species in Canada allows for an unprecedented treatment of potential non-target interactions, including T & E species, over one or two decades. The detailed data from numerous studies in Canada point to rare and limited spillovers when houndstongue and nontargets grow together. There is information on potential impacts of these rare spillovers on nontarget populations that are not available to most petitions submitted for scrutiny. It is probably the addition of the experimental laboratory data and the years of field observations that make this a likely case for a compelling petition. The panel voiced and received strong regulatory encouragement for seizing this opportunity to present how current science and modern techniques can be incorporated in a petition where a broad (within family) fundamental host range is encountered. Additionally, it was recognized that State partners are essential in terms of providing adequate botanical expertise for the assemblage of native and nonnative borages in the US. A clear path forward was identified, with a firm timeline for submission of a petition. Action on this issue will require international effort and include highly knowledgeable researchers and expert regulators to compile and assess the large and pioneering data that are in place. This is an issue that affects invasive species management far beyond the boundaries of Montana and moves forward with benefits to agencies and stakeholders across jurisdictions.

MISC has identified the following steps to use the information from the panel:

- Share all information from the scientific advisory panel with interested parties
- Encourage the compilation of an international data set on the ecological host range of *M. crucifer* into a petition to permit release in the US
- Recognize and support Dr. Mark Schwarzlaender as the petitioner
- Facilitate funding to Dr. Schwarzlaender to accomplish this by successfully identifying sponsors
- Play a key role in providing oversight to allow for Dr. Schwarzlaender to complete the petition
- Ensure that the timeline towards a late Spring 2020 submission of the petition is upheld