Comment on Havens and Colleagues (2019)

Havens and colleagues (2019) concluded that “given the uncertain efficacy and the demonstrable risks of biocontrol, its use should be less frequent, better regulated, and better monitored.”

In contrast, we argue that:

(1) *The frequency of implementation of biocontrol should continue based on records of specificity, safety and cost-effective success.*

All examples of nontarget attack and impact cited by Havens and colleagues were from first-generation biocontrol programs and are not representative of current biocontrol practice (for a review, see Hinz et al. 2019).

The authors have overlooked a large body of literature addressing economic impact assessments of weed biocontrol (e.g., Page and Lacey 2006, De Lange and van Wilgen 2010). Despite the “tremendous resources… invested in biological control programs.” these accounts show extremely advantageous cost:benefit ratios of up to 1:4000 (Culliney 2005).

As Havens and colleagues correctly stated, “partial control of the plant populations can make other management efforts… more cost effective.” Therefore, statements such as “agents cannot be deemed successful unless population level impacts are apparent” are overly simplistic and incorrect. Some of the most successful integrated management programs against woody invaders in South Africa are based on a combination of physical removal of established trees and seed-feeding biocontrol agents (e.g., *Hakea sericea*; Esler et al. 2010).

(2) *Weed biocontrol is already well regulated.* The current US review process for release of weed biocontrol agents includes a thorough consultation with stakeholders within and outside federal and tribal governments and takes at least 2–4 years.

The review is focused entirely on the risks of biocontrol releases for individual species, thereby ignoring the significant risk to entire habitats of no management, and the potential benefits of biocontrol for those habitats.

(3) *Thorough and systematic postrelease monitoring, quantifying impact of biocontrol agents on target and nontarget species should continue to be the standard for biocontrol projects, as has been advocated previously in several papers.*

We agree that the study of plant demography at sites with or without the respective biocontrol agents can yield important information on success and safety (e.g., Catton et al. 2016). However, the authors’ decision to entirely exclude post-release studies lacking experimental controls ignores spatial and the extended temporal scales at which ecological systems including biocontrol operate. Controlled demographic studies by their intensive nature are typically limited to single or very few sites. As an alternative, long-term postrelease monitoring studies (longer than 10 years) over large spatial scales, even when lacking control sites, can estimate effects of biocontrol agents on weed population growth rates (e.g., Van Hezewijk et al. 2010). In addition, mechanistic modeling combined with model selection (e.g., Schooler et al. 2011, Weed and Schwarzländer 2014) provides an opportunity to simultaneously evaluate multiple hypotheses including individual and interactive effects of agent density, competition and climate to explain weed population dynamics. These approaches can provide valuable insights and should not be ignored.

In summary, biocontrol should continue to be an important tool for invasive plant management, regulation should include benefit–risk analysis for all actions and inaction, and postrelease monitoring should consider all available data.

HARIET L. HINZ, ROBERT S. BOURCHIER, URS SCHAFFNER, MARK SCHWARZLÄNDER, AND AARON WEED

Hariet L. Hinz (h.hinz@cabi.org), and Urs Schaffner are affiliated with the CABI, in Delémont, Switzerland. Robert S. Bourchier is affiliated with the Agriculture and Agri-Food Canada, in Lethbridge, Canada. Mark Schwarzländer is affiliated with the University of Idaho, in Moscow, USA. Aaron Weed is affiliated with the National Park Service, in Woodstock, USA.

References

Catton HA, Lalonde RG, Buckley YM, De Clerck-Floate RA. 2016. Biocontrol insect impacts population growth of its target plant species but not an incidentally used nontarget. Ecosphere 7: 1–17.

Culliney TW. 2005. Benefits of classical biological control for managing invasive plants. Critical Reviews in Plant Sciences 24: 131–150.

De Lange WJ, van Wilgen BW. 2010. An economic assessment of the contribution of biological control to the management of invasive alien plants and to the protection of ecosystem services in South Africa. Biological Invasions 12: 4113–4124.

Esler KJ, van Wilgen BW, te Roller KS, Wood AR, van der Merwe JH. 2010. A landscape-scale assessment of the long-term integrated control of an invasive shrub in South Africa. Biological Invasions 12: 211–218.

Havens K, Jolls, CL, Knight TM, Vitt P. 2019. Risks and rewards: Assessing the effectiveness and safety of classical invasive plant biocontrol by arthropods. BioScience 69: 247–258.

Hinz HL, Winston RL, Schwarzländer M. 2019. How safe is weed biological control? A global review of direct non-target attack. Quarterly Review of Biology 94: 1–27.

Page AR, Lacey KL. 2006. Economic Impact Assessment of Australian Weed Biological Control, CRC for Australian Weed Management Technical Series No. 10.

Schooler SS, et al. 2011. Alternative stable states explain unpredictable biological control of *Salvinia molesta* in Kakadu. Nature 470: 86–89.

Van Hezewijk BH, Bourchier RS, De Clerck-Floate RA. 2010. Regional-scale impact of the weed biocontrol agent *Mecinus janthinus* on Dalmatian toadflax (*Linaria dalmatica*). Biological Control 55: 197–202.

Weed AS, Schwarzländer M. 2014. Density dependence, precipitation and biological control agent herbivory influence landscape-scale dynamics of the invasive Eurasian plant *Linaria dalmatica*. Journal of Applied Ecology 51: 825–834.

doi:10.1093/biosci/biz110