An Assessment of Foliar Application of Triclopyr of Varying Concentrations for Managing Glossy Buckthorn (*Rhamnus frangula*) Seedlings and Resprouts (Michigan)

Andrew DiAllesandro (corresponding author), U.S. Fish and Wildlife Service, Seney National Wildlife Refuge, 1674 Refuge Entrance Rd., Seney, MI 49883, 701/799-0731, andrew_diallesandro@fws.gov

For many governmental and non-governmental conservation agencies, management of invasive species is a top priority. For instance, over the past decade glossy buckthorn (*Frangula alnus*) has been the target of management at Seney National Wildlife Refuge (SNWR) in Upper Michigan, with the goal to reduce the dominance and abundance of this exotic, invasive shrub (USFWS 2009). Current management of glossy buckthorn consists of foliar applications with 2.5% active ingredient glyphosate (brand name *Garlon®*, Dow AgroSciences, LLC, Indianapolis, IN, USA) (Corace et al. 2008, Nagel et al. 2008). However, as is often the case, plants repeatedly sprayed with the same herbicide can form resistance, eliminating the effectiveness of the selective herbicide (Holt and LeBaron 1990). While resistance by glossy buckthorn to glyphosate has yet to be documented, glyphosate resistance has been documented in several agricultural weeds (Yu et al. 2007). To be proactive, managers at SNWR should consider alternative methods for glossy buckthorn management before glyphosate resistance develops.

Triclopyr (brand name *Garlon® Ultra*, Dow AgroSciences, LLC, Indianapolis, IN, USA) is an herbicide indicated for management of woody plants and herbaceous broadleaf weeds, including glossy buckthorn (product label). However, little information exists in the literature about the efficacy of foliar applications of triclopyr. Most research conducted with triclopyr on glossy buckthorn and closely related European buckthorn (*Rhamnus cathartica*) has utilized either a cut-stump or basal bark application at relatively high concentrations (>15%) of active ingredient mixed with mineral oil or diesel oil (Pergams and Norton 2006). However, these methods are less attractive than foliar application because cut stems may resprout vigorously and seedlings too must be managed (Corace et al. 2008, Nagel et al. 2008), while the use of fuel oils further increases costs. Moreover, as suggested by Relyea (2005), using the lowest effective concentration is favorable to reduce negative human and environmental health risks. This study tested the efficacy of varying concentrations of triclopyr to determine the best strategy for glossy buckthorn management at SNWR. The study site was located on an anthropogenic dike comprised of coarse sands within SNWR. In June 2011, I set up 40 1-m² plots comprised of glossy buckthorn resprouts and seedlings with at least 1 m between each plot. At each plot, I recorded the number of glossy buckthorn stems, as well as the average stem height and diameter. The mean number of pre-treatment stems (± SE) was 14.8 (± 1.6). The majority of the plots (63%) had stems <1 m in height, with the remaining stems between 1–2 m tall. Mean stem diameter was <2 cm in all but 2 of the plots. I then divided the plots evenly into 4 treatment groups: 0% active ingredient (tap water without surfactant, control), 1.25% active ingredient, 2.5% active ingredient, and 5% active ingredient, following the methods of Corace and colleagues (2008). I mixed each solution using a base concentration of 60.45% active ingredient triclopyr diluted with tap water per label recommendations. On 6 June 2011, I treated the plots with low-volume hand-held sprayers during appropriate weather conditions. I treated each stem to a point of about 50% foliar coverage. I then monitored the plots once per week for 5 wks to document a stress gradient from chlorosis (least severe stress), to shriveled leaves, to shriveled/no leaves and brittle stems (indicating a dead stem). After 2 wks, severe chlorosis was apparent on all treated stems, regardless of concentration. Within 3 wks, 99% of stems were dead, with 100% stem mortality observed in the 4th week (Figure 1). These results were similar to those of Corace and others (2008).

Our results indicate that foliar applications of triclopyr at low concentrations mixed with water can be effective for managing glossy buckthorn in Upper Michigan, adding to the repertoire of management techniques for this invasive plant species. While complete removal of invasive plant species is highly unlikely, a broad range of management techniques can help to reduce their geographic extent and dominance over several treatment periods (Pergams and Norton 2006, Nagel et al. 2008). Herbicide resistance to glyphosate and triclopyr has yet to be documented in glossy buckthorn. Utilizing a rotation of these 2 herbicides will greatly reduce the likelihood of glossy buckthorn developing a resistance. This is especially important when managers may be limited in techniques available due to constraints such as wetland approved herbicide use or lack of resources. Based on this study and past studies within...
the SNWR landscape (Corace et al. 2008, Nagel et al. 2008), a number of potential research questions could still be addressed that would guide land management actions. First, given more time, managers should address glossy buckthorn regeneration in the triclopyr treated plots in the next growing season to determine resprouting response. Also, if herbicide resistance could be documented in areas that have been treated for several growing seasons with the same herbicide, what is an appropriate model for addressing questions about herbicide rotations? Finally, land managers may want to test competing hypotheses regarding rates of colonization on uninfested areas because these areas could represent spatially distinct subpopulations that may still be effectively managed by glyphosate.

**Acknowledgements**

I would like to thank the staff, volunteers, and interns of Seney National Wildlife Refuge for their support, especially Greg Corace (Refuge Forester), Mark Vaniman (Refuge Manager), and Laural Tansy (Administrative Technician). Also, I thank the Seney Natural History Association for their support and funding of field assistants, Ellen Comes, Meghan Cornwall, and Jennifer Field.

**References**


