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LETTER TO THE EDITOR

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Improving the management of Japanese knotweed *s.l.*: a response to Jones and colleagues

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Abstract

In a recent paper, Jones et al. (2020a) claimed that we recommended the use of mowing for the "landscape management of invasive knotweeds" in an article we published earlier this year (i.e. Martin et al. 2020), a recommendation with which they strongly disagreed. Since we never made such a recommendation and since we think that, in order to successfully control invasions by Japanese knotweed *s.l.* taxa (*Reynoutria* spp.; syn. *Fallopia* spp.), stakeholders need to acknowledge the general complexity of the management of invasive clonal plants, we would like to (i) clarify the intentions of our initial article and (ii) respectfully discuss some of the statements made by Daniel Jones and his colleagues regarding mowing and knotweed management in general. Although we agree with Jones et al. that some ill-advised management decisions can lead to "cures worse than the disease", our concern is that the seemingly one-sided argumentation used by these authors may mislead managers into thinking that a unique control option is sufficient to tackle knotweed invasions in every situation or at any given spatial scale, when it is generally admitted that management decisions should account for context-dependency (Wittenberg and Cock 2001; Pyšek and Richardson 2010; Kettenring and Adams 2011).

Keywords

adaptive management strategies, efficacy assessment, herbicides, invasive plant management, mechanical control, *Reynoutria* spp./*Fallopia* spp.

The criticisms of Jones et al. (2020) missed the points of our article

Despite the assertion of Jones et al. (2020a), the "landscape management of invasive knotweeds" through mowing or cutting was never recommended in the article of Martin et al. (2020). In this paper, we reported the results of a mesocosm experiment in which we investigated how homogeneous or heterogeneous conditions of light stress (shade) and disturbance (mowing) affected the clonal growth dynamics of *Reynoutria japonica* Houtt. and "how these responses might be relevant to improve the management of *R. japonica* by mowing/cutting or by ecological restoration using dense cover of competitive species" (Martin et al. 2020). Although we discussed the results' implication in terms of management, this study was a clear case of fundamental research simply reproducing some growing conditions frequently found by knotweed populations to improve our understanding of the factors affecting their clonal growth strategies. Amongst other things, we showed that partially mowed/cut knotweed stands were able to compensate for the loss of half of their aboveground organs and, thus, that stands should *a minima* be entirely mowed/cut to be affected by this control method. We also highlighted that three mowing/cutting events per year was insufficient to kill young regenerating ramets of *R. japonica* (arising from rhizome fragments weighing approximately 16 g), illustrating the resilience of the plant and the necessity to use more intense control methods to ensure the eradication of newly-established *R. japonica* individuals (Martin et al. 2020). In both cases, we documented the responses of knotweed towards mowing, but it definitely does not mean that we said nor implied that mowing was a particularly good control option (although it depends on local context and management objectives, as we will explain later). For various reasons, managers frequently mow knotweed stands (Clements et al. 2016; Lavoie 2019), often partially (e.g. along roads) and we simply wanted to show some of the effects of mowing on these plants and how this practice could be improved.

The reference to the "landscape management" of knotweeds made by Jones et al. (2020a) is even more surprising as our article does not even mention the word "landscape" (Martin et al. 2020). As stated in our paper, since we worked on young establishing clones, our observations are more relevant for the Early Detection and Rapid Response (EDRR) or for the control of small knotweed stands than for large scale management. Incidentally, we fully agree that a management strategy at the landscape scale, based only on mowing, would be very ineffective to control a knotweed invasion.

On the complex question of defining and measuring the efficacy of a control method

To support their critics against mowing, Jones et al. (2020a) repeatedly claimed that this method is ineffective, unpractical, as well as economically and environmentally unsustainable and that "to achieve the successful control and long-term management of invasive rhizome-forming plants, we should do more with less, as the evidence guides us (Jones et al. 2018)”. It thus seems that these authors not only think that mowing should be utterly avoided, but also that knotweeds should only be controlled through the spraying of non-selective herbicides twice a year, as recommended by Jones et al. (2018). In turn, we disagree with these assumptions for at least three reasons:

- In some contexts, mowing can also be a smart option. If we agree that sloppy mowing operations can do more harm than good by increasing the risk of knotweed spread, we think that careful mowing/cutting is an acceptable and interesting practice under certain circumstances. It is true that the eradication of established knotweed stands through mowing/cutting alone is extremely unlikely, but it is also true for almost any other control options tested so far (Child and Wade 2000; Kabat et al. 2006; McHugh 2006; Bashtanova et al. 2009; Gerber et al. 2010; Delbart et al. 2012; Jones et al. 2018; Lavoie 2019). Therefore, mowing/cutting may be viewed as “ineffective” as any other method. However, labelling any method as ineffective because it fails to kill mature knotweed stands supposes that the eradication of mature stands is the only objective sought by managers. As various objectives may underpin the management of invasive plants, various ways exist to assess the “efficacy” of any control method. For instance, if you need to maintain the accessibility or visibility along a transport infrastructure for security reasons (e.g. Boyer et al. 2018) or if you want to reduce the vigour of knotweeds to favour the restoration of a competitive cover of native plants (e.g. Dommanget et al. 2015), mowing/cutting can be an effective solution. Most criticisms against mowing made by Jones et al. (2020a) can similarly be put into perspective when the context and application details are considered. Mowing or cutting can be performed in various ways and with various tools (mowers, lopper cutters, strimmers etc.). As such, when stems are cleanly cut (individually) and properly disposed of (cf. Child and Wade 2000; Barthod and Boyer 2017; Lavoie 2017), mowing/cutting is a fairly safe and easy control option that can be beneficial for the environment (Gerber et al. 2010; Vanderklein et al. 2014). Let us be clear, we are not implying that mowing/cutting is flawless or is intrinsically a good control option, we are simply suggesting that this technique may sometimes be appropriate to reach “discernible management benefits” (sensu Jones et al. 2020a).
- In their 2018 study, Jones et al. compared the “efficacy” of various knotweed control methods with a strong focus on chemical control since only one out of the nineteen tested methods did not involve the use of herbicides. If valuable lessons can be learned from this study, particularly concerning the dosage and timing of application of herbicides, the debate regarding the general “efficacy” of all existing knotweed control methods is far from being settled. Firstly, none of the 19 tested methods resulted in the eradication of knotweeds. Secondly, there are hundreds of possible combinations of methods, modalities of application, environmental conditions and knotweed characteristics (age, size, and taxon) that have naturally not been tested during these field trials. For instance, Jones et al. (2018) worked on three nearby sites in Wales and applied their treatments on subplots located within very large knotweed stands, that is, within blended populations of knotweed individuals whose identity and characteristics

cannot be ascertained (cf. Martin 2019). It is reasonable to think that the observed effects of the tested treatments would differ (positively or negatively) if applied to smaller or younger knotweed stands, to single individuals, to establishing ramets or to seedlings or to knotweeds located in an area with very different environmental conditions. As such, despite the quality of this work and the rarity of pluri-annual comparative studies on control methods efficacy, these results should not be over-interpreted and further work is still required before drawing any definitive conclusion. This is why, contrary to what Jones and his colleagues seem to suggest, there is actually no consensus about the best way to control knotweed invasions or if they always need to be controlled at all (Delbart et al. 2012; Lavoie 2019; Cottet et al. 2020).

- Similarly to most invasive species, an effective long-term strategy for knotweed management is necessarily more complex than relying on a single control method. Besides, it is largely accepted that the most effective management solutions are prevention and EDRR, while containment or eradication efforts are used as last resorts (Pyšek and Richardson 2010; Lockwood et al. 2013; Simberloff et al. 2013). Moreover, in most cases, managers are facing invasive species that are at various stages of invasion, making prioritisation very difficult (Hulme 2003; Pyšek and Richardson 2010). Consequently, we think that the landscape management of knotweeds should be performed through an adaptive and sustainable strategy that account for this complexity (Cottet et al. 2020), while the "efficacy" of control should only be measured with regard to explicit management objectives.

Concluding remarks

We understand that knotweed invasions are a particularly concerning problem in the United Kingdom as well as in many regions of the world and we understand that, as such, management recommendations should be carefully formulated. However, while the access to quality information regarding the management of knotweeds is often difficult (Robinson et al. 2017; Lavoie 2019), we doubt that a debate in the scientific literature, based on unfair criticisms or partial interpretations, will help managers making good management decisions, hence the nuanced clarifications we tried to bring in the present response.

The use of pesticides to control invasive knotweeds, as recommended by Jones et al. (2018), is becoming increasingly complicated in many invaded habitats (e.g. along rivers) or regions (e.g. in the European Union) because of environmental and health concerns, although some people deplore it (Pergl et al. 2020). In this context, we deem that it is important to continue assessing the efficacy of all control methods and modalities of application in various contexts (including chemical control, for instance by addressing the very interesting questions raised by Bashtanova et al. (2009)), as well as supporting research efforts for non-chemical solutions. Amongst these, we think that the control of knotweeds through the restoration of competitive native species, when combined with other methods (e.g. mowing/cutting, tarping, uprooting), represents a promising perspective as this technique offers the huge advantage of fulfilling several management objectives at once: i) it reduces the vigour and lateral expansion rate of knotweeds (Dommanget et al. 2019); ii) by maintaining a dense vegetation cover, this method increases the biotic resistance against re-invasion from knotweeds or other invasive plants (Dommanget et al. 2015); and iii) in riparian corridors, it could favour the stabilisation of riverbanks and thus lower the rate of knotweed dispersal downstream (Martin 2019). Other promising methods are currently being investigated by various teams, such as biological control (Jones et al. 2020b), tarping/covering using geotextiles or geomembranes (Marie-Anne Dusz, pers. comm.) or wire meshes (David Clements, pers. comm.), or diverse methods of rhizome crushing (Boyer and Brasier 2019). Even if the chances are that none of these techniques will become a panacea, they will likely complete the toolbox for managers to help them build more efficient adaptive strategies against knotweeds. To conclude, we also would like to note that not controlling established knotweed populations might sometimes be a good management option when these populations do not present a problem or a threat locally and to focus instead on the monitoring and EDRR against newly-dispersed individuals to prevent further expansion or densification (e.g. Colleran and Goodall 2015; Barthod and Boyer 2019).

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