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## ARTICLE



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# A dominant plant species and insects interactively shape plant community structure and an ecosystem function

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### Abstract

Dominant plants and insects both structure plant communities and determine key ecosystem functions. However, dominant plants and insects can have opposing effects on plant community structure and ecosystem function. Critically, few studies have assessed the combined effects of these two drivers of plant community structure and ecosystem function. In this study, we factorially manipulated the presence of the dominant plant species Solidago canadensis (Canada goldenrod) and insects in an old field to quantify their independent and interactive effects on the plant community. Overall, insect presence mediated the effects of S. canadensis removal on plant biomass and richness. Total plant biomass was ~32% lower following S. canadensis removal only when insects were present. In contrast, subdominant plant biomass was ~75% higher following S. canadensis removal, but only when insects were reduced. Subdominant species richness was ~37% higher following S. canadensis removal when insects were present, although the abundance of most subdominant species did not vary systematically with S. canadensis removal or insect reduction. Light availability was ~49% higher following S. canadensis removal, with no effect of insect presence on light availability. Our results emphasize the interactive role of dominant plants and insects in determining the diversity and biomass of plant communities.

#### **KEYWORDS**

diversity, goldenrod, insect herbivores, log response ratio, old field, productivity

## **INTRODUCTION**

Dominant species constitute a large proportion of biomass in a community, and as a function of their large biomass, can determine community structure and influence ecosystem functions (Avolio et al., 2019; Grime, 1998; Hernández et al., 2022). Dominant plant removal experiments find that plant diversity is often higher, but plant biomass is lower, when the dominant

species is removed (Avolio et al., 2019; Smith et al., 2020; Smith & Knapp, 2003), suggesting that highly competitive, dominant plants repress plant community diversity but increase overall productivity. For example, Solidago canadensis, a dominant plant species in many old fields in North America and an invasive species in other regions, can promote ecosystem productivity while simultaneously reducing plant diversity (Carson & Root, 2000; Eckberg et al., 2023). Additionally, S. canadensis can have

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dramatic effects on plant and insect community structure (Crutsinger et al., 2006, 2008; Eckberg et al., 2023; Hernández et al., 2022; McCain et al., 2010), suggesting that interactions between dominant plants and associated insect communities may jointly affect plant community structure. Despite the importance of dominant species, few studies have examined whether their impact on communities and ecosystems is mediated by top-down processes, such as herbivory by insects.

As plant consumers, insect herbivores can also structure plant communities. In particular, insect herbivores can have top-down effects on plant diversity and ecosystem function (Kempel et al., 2015; Smith et al., 2020). Multiple studies find that plant species richness is often lower with reduced insect abundance (Carson & Root, 1999, 2000; Smith et al., 2020), highlighting the role of insect herbivores in regulating plant diversity. Insect herbivores tend to have the opposite effect of dominant species on plant diversity in that insects rescue plant diversity (Carson & Root, 1999, 2000; Smith et al., 2020) while dominant plants reduce plant diversity (Eckberg et al., 2023; Smith et al., 2020), making the combined effects of dominant plants and insects relevant to our understanding of the factors that structure plant communities. Even at background levels of insect herbivory, insects can remove up to 15% of plant biomass and ultimately reduce aboveground plant biomass (Kozlov & Zvereva, 2018). Furthermore, many insect herbivores are specialists with a relatively narrow dietary breadth (Ali & Agrawal, 2012) and the impact of insect herbivores might be larger when they selectively feed on only one or a handful of species (Carson & Root, 2000; Kempel et al., 2015). For example, there are over 50 insect herbivores that are specialist consumers of Solidago altissima (Jobin et al., 1996), and specialist insects can reduce S. altissima biomass in a negative frequency-dependent manner and subsequently promote species coexistence and plant diversity (Carson & Root, 2000; HilleRisLambers et al., 2012). In contrast, generalist insects are those with a wide dietary breadth that tend to exhibit more flexible feeding patterns (Ali & Agrawal, 2012). Despite their wide dietary breadth, generalist insects still tend to selectively consume plants that have more palatable tissue or are of higher nutritional quality (Kagata & Ohgushi, 2011; Simpson & Simpson, 2017). As a result, generalist insects can still affect plant communities in a species-specific manner, particularly if the availability of favorable plant food resources is variable. For example, if a plant species that is selectively consumed by insect herbivores is lost from a community, a subsequent switch in generalist insects to consuming the remaining plant species could modify plant community response to species loss.

Both dominant species and insect herbivores independently affect plant community structure and ecosystem function; however, their combined and potentially interactive effects are less understood. By reducing the degree of dominance of the dominant species, insect herbivores can rescue plant diversity (Agrawal & Maron, 2022; Allan & Crawley, 2011; Carson et al., 2004), highlighting the potential for interactive effects of dominant species and insects on plant community structure. In one study, reducing insect abundance resulted in higher biomass of the dominant plant species, which in turn reduced subdominant species abundance (Carson & Root, 2000), suggesting that interactive effects of dominant plants and insects may ultimately alter ecosystem functions like productivity. While most research has focused on the effects of dominant species and insects on communities and ecosystems in isolation, dominant plants and insects typically co-occur, so they likely structure communities and alter ecosystem function in conjunction with one another. In particular, we expect that the presence of insects will mediate subdominant community response to dominant species removal. For example, insects may limit the compensatory response of subdominant plants to dominant species removal, leading to lower subdominant plant biomass when insects are present relative to when insects are reduced. We expect the opposite pattern in subdominant species richness because insects typically increase plant richness, so the presence of insects will further promote plant richness following dominant species removal. In order to address this gap in our understanding of the interactive effects of dominant plants and insects on communities and ecosystems, we factorially manipulated dominant species and insect presence and quantified removal effects on plant community structure and aboveground biomass. Specifically, we ask two interrelated questions:

- 1. What are the relative and combined effects of dominant plant species and insects on aboveground plant biomass, subdominant plant diversity, and light availability?
- 2. Do subdominant plant species respond differently to dominant plant species removal and insect reduction?

#### **METHODS**

#### Site description

We conducted this experiment in an old field at Matthaei Botanical Gardens in Ann Arbor, Michigan (42.30° N, 83.66° W). Mean annual precipitation is 954 mm (U.S. Climate Data, 2024). In 2023, the average January minimum temperature was  $-2.8^{\circ}$ C and the average July maximum temperature was 28.1°C (D. Kahlbaum, personal communication). Old-field ecosystems are abandoned croplands with plant communities that primarily consist of perennial herbaceous species, and in the United States, old fields constitute about 10% of the land area (Zumkehr & Campbell, 2013). The old field we worked in is dominated by the herbaceous plant species S. canadensis (Canada goldenrod), which constitutes ~50% of the aboveground plant biomass on average (Eckberg, unpublished data). S. canadensis, like other Solidago spp., is a perennial plant commonly found in old fields across North America (Abrahamson & Weis, 2020) and has become a widespread invasive species throughout Europe and Asia (Szymura et al., 2016; Zhu et al., 2022). Species in the genus Solidago have been extensively studied in both their native (Abrahamson & Weis, 2020; Carson & Root, 2000; Eckberg et al., 2023) and invasive (Abhilasha et al., 2008; Fenesi et al., 2015; Zhang et al., 2009) ranges, with a large body of work specifically investigating interactions between Solidago spp. and associated arthropod communities (Abrahamson & Weis, 2020; Carson & Root, 2000; Crutsinger et al., 2008; Eckberg et al., 2023). Given the well-documented interactions between Solidago and insect herbivores, and the effects of Solidago on other plant species, our study site is an effective system in which to study the interactive effects of a dominant plant and insects on plant community structure and ecosystem function. Notably, there is some dispute surrounding the taxonomy of S. canadensis. While some researchers argue that S. canadensis and S. altissima are distinct species (Semple et al., 2015), others argue that S. canadensis and S. altissima are a single species (Weber, 2000) or that S. altissima is a variety of S. canadensis (Mei et al., 2006). While we acknowledge the challenges in identifying S. canadensis, we have concluded that the dominant species at this site is S. canadensis. In addition to S. canadensis, there are 46 subdominant plant species present at this site that include grass, forb, shrub, legume, and sedge species (Appendix S1: Table S1). The four most common subdominant plant species include Monarda fistulosa, Poa pratensis, Hypericum perforatum, and Pilosella longifolia. This old field is mowed semiannually to maintain it in an early-successional state.

## **Experimental design**

We organized twenty-four  $5 \times 5$  m experimental plots into three blocks that each contain eight  $5 \times 5$  m plots in the summer of 2021. In summer 2021 and 2022, we intermittently mowed paths among plots to maintain a 1-m

margin between each plot. Within each  $5 \times 5$  m plot, we manipulated dominant species presence in two 1-m<sup>2</sup> subplots at two levels: (1) S. canadensis removal and (2) control. In S. canadensis removal subplots, we first removed all S. canadensis stems in August 2021 by clipping all S. canadensis stems in each 1-m<sup>2</sup> removal subplot at the soil level. To maintain the S. canadensis removal manipulation in 2022 and 2023, we removed all new S. canadensis stems present in S. canadensis removal subplots every three weeks during the growing season starting in May. In control subplots, we did not remove any plant biomass. In addition to S. canadensis removal and control subplots, we established one 1-m<sup>2</sup> random biomass removal subplot within each  $5 \times 5$  m plot starting in May 2022 to account for potential biomass removal-induced bias (Monteux et al., 2024). In each  $5 \times 5$  m plot, whenever we removed biomass from S. canadensis removal subplots, we removed an equivalent amount of biomass in the paired random biomass removal subplot, but we removed plants in a non-species-specific manner (Monteux et al., 2024). As in S. canadensis removal subplots, we removed plant biomass in random biomass removal subplots by clipping plants at the soil level. Total plant biomass was higher in random biomass removal subplots than in S. canadensis removal subplots ( $t_{\text{paired}} = 2.71$ , df = 23, p = 0.01), suggesting that our results are not biased by an artifact of S. canadensis removal. All biomass removal subplots were  $1-m^2$  and at least 1 m apart. Furthermore, there was no pulse in soil carbon or nitrogen following S. canadensis removal (Eckberg, unpublished data), suggesting that clipping S. canadensis aboveground did not modify soil properties.

To study the role of insects in shaping plant communities, we manipulated insect presence at two levels in 2023: (1) insects reduced and (2) insects present. We reduced insects from May to August in 12 of the  $5 \times 5$  m plots by spraying a synthetic pyrethroid insecticide, lambda-cyhalothrin (LambdaStar UltraCap 9.7%; FarmHannong America, Inc.), every three weeks at a rate of  $0.002 \text{ L/m}^2$  with a backpack sprayer starting in May. We calculated the insecticide spray rate based on the label instructions for reducing insects in herbaceous plant communities. Pyrethroid insecticides are effective against a broad selection of insect orders including Coleoptera, Diptera, Hemiptera, Hymenoptera, Lepidoptera, Orthoptera, and Thysanoptera (Gajendiran & Abraham, 2018; Wendeborn et al., 2012), all of which include herbivorous species. There is a large body of work showing that pyrethroid insecticides reduce insect abundance (Blue et al., 2011; Cain et al., 1991; Carson & Root, 2000; Gajendiran & Abraham, 2018; Schmitz, 2006; Smith & Stratton, 1986) with minimal effects on nontarget terrestrial

taxa (Brunk et al., 2019; Gajendiran & Abraham, 2018; Kaneko, 2011; Smith & Stratton, 1986). Lambda-cyhalothrin specifically can be toxic to nontarget organisms such as bees at high concentrations, but the concentration of lambda-cyhalothrin that we sprayed is far below that toxic threshold (Gajendiran & Abraham, 2018). When we sampled insects using a leaf blower modified to collect insects, insect abundance was 81% lower in plots sprayed with insecticide ( $3 \pm 2$  individuals per m<sup>-2</sup>) than in adjacent plots that were not sprayed with insecticide ( $16 \pm 4$  individuals per m<sup>-2</sup>; t = 8.49, df = 16.79, p < 0.001; Appendix S2: Figure S1). In the other 12  $5 \times 5$  m plots where insects were present, we sprayed an equivalent amount of water at the same time as insecticide applications.

## Data collection

To assess the combined and interactive effects of dominant species removal and insect reduction on the plant community, we first identified all plant species present in S. canadensis removal and control subplots at the end of the growing season in 2023. We then visually estimated the percent cover of each plant species in each subplot. We quantified aboveground plant biomass by clipping all plant species at the soil level in a  $50 \times 20$ -cm section of each 1-m<sup>2</sup> subplot. We separated plant biomass from each subplot into dominant species biomass (S. canadensis) and subdominant species biomass (all plant species except S. canadensis). After separating plant biomass, we oven-dried the plant biomass at 60°C for at least 48 h and weighed it. We summed S. canadensis biomass and subdominant plant biomass to determine total plant biomass in each subplot and then scaled up measurements to estimate full 1-m<sup>2</sup> subplot plant biomass.

To assess the relative and interactive effects of dominant species removal and insect reduction on light availability, we measured light intensity at three points above the tallest plants prior to removing any plant biomass within each  $1\text{-m}^2$  subplot. We then measured light intensity at three points 20 cm above the soil within each  $1\text{-m}^2$ subplot. For each subplot, we calculated light availability as the mean light intensity at 20 cm above the soil divided by the mean light intensity above the tallest plants. We measured light intensity using the iOS app Lux Light Meter Pro version 2.1.1 (Polyanskaya, 2021).

#### Data analysis

We calculated the log response ratio of plant community variables (total plant biomass, subdominant plant biomass, subdominant species richness), light availability, and species percent cover between paired  $1\text{-m}^2$ *S. canadensis* removal and control subplots within each  $5 \times 5$  m plot as follows:

$$\ln RR = \ln \left( \frac{Solidago \ canadensis \ removal}{Control} \right).$$
(1)

We then calculated the mean log response ratio and 95% CIs of each variable for insects-reduced and insects-present plots using the *qnorm* function in the "stats" R package (R Core Team, 2022). Log response ratios are a powerful statistical tool that allows us to account for the paired design of our experiment wherein *S. canadensis* removal and control subplots were paired within each larger  $5 \times 5$  m plot. Additionally, log response ratios are frequently used to detect the interactive effects of experimental conditions on plant communities and ecosystems (e.g., Gao & Carmel, 2020; Midolo et al., 2019; Shi et al., 2022; Toledo et al., 2023; Zhang & Xi, 2021). We conducted all statistical analyses using R version 4.1.3 (R Core Team, 2022).

#### RESULTS

The effect of S. canadensis removal on aboveground plant biomass and subdominant diversity depended on whether insects were present. Total plant biomass was higher in control subplots where S. canadensis was present, but only when insects were present (Figure 1). When insects were present, total plant biomass was ~32% higher in control subplots  $(386.7 \pm 109 \text{ g m}^{-2} \text{ [mean} \pm \text{SD]}; \text{ Appendix } \text{S3:}$ Figure S1) than in S. canadensis removal subplots (262.1  $\pm$  84.9 g m<sup>-2</sup>). Subdominant plant biomass showed the opposite pattern wherein S. canadensis removal resulted in higher subdominant plant biomass when insects were reduced (Figure 1). When insects were reduced, subdominant plant biomass was on average ~75% higher in S. canadensis removal subplots  $(334.6 \pm 204.2 \text{ g m}^{-2})$  than in control subplots  $(191 \pm 69.1 \text{ g m}^{-2}; \text{ Appendix } \text{S3:}$ Figure S2). S. canadensis removal resulted in higher subdominant species richness when insects were present (Figure 1). When insects were present, subdominant plant species richness was on average ~37% higher in S. canadensis removal subplots  $(15.4 \pm 3.3 \text{ species/subplot})$ than in control subplots  $(11.3 \pm 3 \text{ species/subplot};$ Appendix S3: Figure S3). S. canadensis removal resulted in higher light availability independent of insect presence (Figure 1). When insects were reduced, light availability was on average ~55% higher in S. canadensis removal subplots  $(0.88 \pm 0.13 \text{ percent})$  than in control subplots (0.52 $\pm$  0.21 percent; Appendix S3: Figure S4). When insects were







FIGURE 2 The effect of Solidago canadensis removal and insect reduction on the percent cover of subdominant plant species. A negative mean log response ratio (lnRR) indicates greater percent cover in control subplots than in S. canadensis removal subplots. Points indicate mean lnRR, and lines indicate the 95% CI. Purple points and lines represent mean lnRR and 95% CI for subplots where insects are present; green points and lines represent mean lnRR and 95% CI for subplots where insects are reduced.

present, light availability was on average ~42% higher in *S. canadensis* removal subplots ( $0.8 \pm 0.1$  percent) than in control subplots ( $0.61 \pm 0.16$  percent; Appendix S3: Figure S4).

Individual plant species varied in their response to S. canadensis removal and insect reduction. The percent cover of 12 out of the 17 subdominant plant species was unaffected by S. canadensis removal, insect reduction, or their combined manipulation (Figure 2). The percent cover of some species, such as *Hypericum perforatum*, did not vary with either S. canadensis removal or insect reduction (Figure 2). Other species, such as Origanum vulgare, had higher percent cover with S. canadensis removal only when insects were present (Figure 2). When insects were present, O. vulgare percent cover was on average ~282% higher in S. canadensis removal subplots  $(7\% \pm 5.7\%)$  than in control subplots  $(2\% \pm 3\%)$ . Only one species, Cornus racemosa, had higher percent cover in control subplots than in S. canadensis removal subplots when insects were present (Figure 2). When insects were present, C. racemosa percent cover was on average ~38% higher in control subplots  $(4\% \pm 7.8\%)$  than in S. canadensis removal subplots  $(2.5\% \pm 3.6\%)$ . M. fistulosa was the only species with higher percent cover in S. canadensis removal subplots independent of insect presence (Figure 2). When insects were reduced, M. fistulosa percent cover was on average ~155% higher in S. canadensis removal subplots  $(15.1\% \pm 8.4\%)$ than in control subplots  $(5.9\% \pm 3.2\%)$ . When insects were present, M. fistulosa percent cover was on average ~136% higher in S. canadensis removal subplots  $(16.3\% \pm 6.2\%)$ than in control subplots  $(6.9\% \pm 3\%)$ .

#### DISCUSSION

Here, we find that the direction and magnitude of the effect of a dominant plant species on an old-field plant community depends on whether or not insects are present. Specifically, total plant biomass was higher in control subplots where S. canadensis was present only when insects were present. Given that dominant plant species tend to have the largest biomass of any species in a community (Avolio et al., 2019; Grime, 1998), it follows that total plant biomass would be higher where S. canadensis is present than where S. canadensis is removed. Notably, other work with Solidago shows that insects will often selectively consume dominant Solidago species (Agrawal & Maron, 2022; Stastny & Agrawal, 2014), potentially reducing their degree of competitive dominance. Solidago spp. are also targeted by many specialist insects (Jobin et al., 1996), and as such, the consumptive effects of specialist insects on S. canadensis likely further facilitate reduced competitive dominance of S. canadensis

in our study. Reduced competitive dominance of Solidago could subsequently facilitate increased subdominant plant productivity, such as in a previous study at this site where we found that when S. canadensis biomass was lower, subdominant plant biomass was higher (Eckberg et al., 2023). That is, if insects target and consume S. canadensis, insect herbivory may reduce S. canadensis dominance and lead to increased subdominant plant biomass, which could ultimately result in higher total plant biomass. Another experiment in an old field found that reducing insects when an aggressive invasive plant species was present led to lower subdominant plant biomass (Blue et al., 2011), further suggesting that insects may facilitate minor increases in subdominant biomass by reducing the dominance of the dominant species. Notably, in our experiment, we studied the effect of S. canadensis in  $1-m^2$ subplots, similar to other experiments (e.g., Crutsinger et al., 2008; Ledger et al., 2015). However, experimentally manipulating the presence of S. canadensis at larger spatial scales would improve our understanding of the broader impacts of Solidago spp. on communities and ecosystems.

In contrast to the interactive effects of dominant species removal and insect reduction on total plant biomass, S. canadensis removal resulted in higher subdominant plant biomass when insects were reduced. When S. canadensis is removed, generalist insects may switch to consuming subdominant plant species (Corcket et al., 2003; Maoela et al., 2019; Simpson & Simpson, 2017) leading to higher subdominant plant biomass in S. canadensis removal subplots only when insects, and their consumptive effects, are reduced. If insect herbivores switch to consuming subdominant plant species when S. canadensis is removed, herbivore pressure on subdominant plants would increase and subsequently constrain subdominant plant response to dominant species removal. Alternatively, the presence of S. canadensis may provide subdominant species with associational resistance to insect herbivores, wherein growing in close proximity to S. canadensis reduces the likelihood of subdominant plants being detected and targeted by insect herbivores (Barbosa et al., 2009). Another experiment in an old field found that insect damage was lower on plants growing in mixture with S. altissima (Stastny & Agrawal, 2014), suggesting that Solidago spp. can in fact provide associational resistance to subdominant species. When we remove S. canadensis, subdominant plants may become more vulnerable to insect herbivores, leading to lower subdominant plant biomass unless insects are also reduced.

Dominant plant species and insects also interactively affected plant species richness, where *S. canadensis* removal resulted in higher subdominant species richness when insects were present. The relative fitness differences between dominant species and the rest of the species in the community can lead to competitive exclusion and overall reduced diversity, as predicted by coexistence theory (HilleRisLambers et al., 2012). For example, dominant plant species tend to outcompete other plant species for aboveground and belowground resources, and as a result suppress species richness (Avolio et al., 2019; Smith et al., 2020). Other field experiments find that when dominant plant species are removed, plant species richness is higher (Smith et al., 2020; Souza et al., 2011), further highlighting the negative effect of dominant species on biodiversity. Insect herbivores have the opposite effect in that insects typically rescue species richness (Smith et al., 2020) such that when insects are reduced, plant diversity is lower (Allan & Crawley, 2011; Carson & Root, 2000; Souza et al., 2016). Interactions with insects can modify fitness differences between plant species, and if insects reduce the fitness of abundant and more competitive species in particular, insects can promote species coexistence and maintain plant diversity (HilleRisLambers et al., 2012; Schmidt et al., 2020). Given that dominant plant species suppress plant species richness while insects promote it, future studies should not consider their impacts in isolation.

We investigated light availability as a potential mechanism by which dominant species and insects structure plant communities and alter productivity. S. canadensis removal resulted in higher light availability, but reducing insects had no effect on light availability. It is well established that dominant species can shape plant community structure and productivity by reducing light availability (Eckberg et al., 2023; Emery & Gross, 2007; McCain et al., 2010). In contrast, despite the large body of work showing that vertebrate herbivores structure communities and ecosystems by increasing light availability (Borer et al., 2014; Eskelinen et al., 2022; Seabloom et al., 2015), there is comparatively less work investigating the effect of invertebrate herbivory on light availability (but see Carson & Root, 2000). Given that insect reduction had no effect on light availability, our results suggest that insects shape plant biomass and richness by an alternative mechanism that we did not account for in this study. For example, when insects selectively consume plant tissue, they can alter competitive interactions among plant species (Agrawal & Maron, 2022), leading to the direct effects of insect herbivory on species persistence and community structure. Insects can also affect plant persistence when leaf tissue consumption alters plant physiology and water flux (Prather et al., 2013). By modifying the quality of leaf litter (Belovsky & Slade, 2000; Butenschoen & Scheu, 2014), insects may indirectly affect decomposition, nutrient cycling, and productivity (Belovsky & Slade, 2000; Hartley & Jones, 2008). Considering that insects can shape plant community structure and ecosystem functions via multiple mechanisms, investigating these other potential

mechanisms may improve our understanding of how insects are driving these interactive effects with dominant plant species.

Interestingly, the majority of subdominant plant species did not respond systematically to the removal of dominant species, insect reduction, or their combined manipulation. Similar to other field studies (Jiang et al., 2017; Maschler et al., 2022; Schweiger et al., 2015), our observed experimental effects were scale-dependent, as individual species showed relatively little variation in response to dominant species removal or insect reduction but with clear interactive effects at the community level. Although the majority of species were unaffected by S. canadensis removal or insect reduction, C. racemosa (Gray dogwood) cover was higher in control subplots when insects were present. One study found that the expansion of C. racemosa into an old field was unaffected by competition with local herbaceous communities (Austin, 1992), suggesting that competition with S. canadensis may similarly not affect C. racemosa at our site. In contrast, the cover of *M. fistulosa* (Wild bergamot) was higher in S. canadensis removal subplots independent of insect presence. M. fistulosa is a forb with resource-acquisitive traits (Khalil et al., 2019), potentially making M. fistulosa capable of enhanced resource acquisition and growth following dominant species removal. A comprehensive functional trait analysis would improve our understanding of how species functional traits may drive the patterns we see in species responses to S. canadensis removal and insect reduction.

Overall, our study underscores the interactive role of dominant plant species and insects in structuring plant communities and altering a key ecosystem function. The response of plant biomass and diversity to S. canadensis removal was dependent on insect presence, highlighting the importance of insect herbivores in shaping plant communities, which is particularly relevant given the decline of insects worldwide (Goulson, 2019). Although previous work both at this site and in other systems shows that light availability is one mechanism by which dominant species affect plant diversity and biomass (Eckberg et al., 2023; Hernández et al., 2022), the lack of effect of insects on light availability here suggests that the mechanisms by which insects affect plant communities and productivity are more idiosyncratic. Nevertheless, our work highlights the need to consider the relative and combined effects of dominant plant species and insect herbivores in order to understand the drivers of plant community structure and ecosystem function.

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## CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

## DATA AVAILABILITY STATEMENT

Data (Eckberg et al., 2025) are available from Dryad: https://doi.org/10.5061/dryad.2ngf1vj0d.

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