~~Disruption to functional interactions within ecological communities alters ecosystem assemblage, threatens biodiversity, and diminishes resource richness in ecosystems (Camargo et al., 2020; Donoso et al., 2020; Jordano et al., 2007; Lorts et al., 2008; Monteiro et al., 2021; Pigot et al., 2016).~~

~~Plants considerably affect resource availability to animals, making plant communities an influential characteristic of an ecosystem (Bascompte & Jordano, 2007; Sebastián-González et al., 2020) Plant community assembly and succession is influenced by abiotic factors, such as soil nutrient content (Aerts, 1999; Coomes & Grubb, 2000), and biotic factors, such as seed dispersal (Carlo & Morales, 2016; González-Varo et al., 2013; Levine & Murrell, 2003; Nathan & Muller-Landau, 2000; Olden et al., 2004; Tylianakis et al., 2010). Manipulating these factors can create drastically different plant communities from the same starting points (Bakker, 1998; González-Castro et al., 2019). Dramatic shifts in ecosystem assemblages over recent centuries increases the need to study functional interactions within ecological communities for conservation efforts, including interactions between seed vectors and plant assemblage (Camargo et al., 2020; Emer et al., 2019; García et al., 2018; Monteiro et al., 2021; Morán-López et al., 2019; Ribeiro da Silva et al., 2015).~~

~~There is an asymmetric skew in the loss of biodiversity, with animals at higher trophic levels and lower population sizes being lost first due to abrupt environmental disruptions, such as habitat fragmentation (Davies et al., 2000; Duffy, 2003) Animals play a large role in shaping their ecosystems through processes, including: seed dispersal, changing plant biomass, recycling nutrients, and altering physical structures (González-Castro et al., 2019; Hempson et al., 2017; McAfee et al., 2018; Parr et al., 2018). The well documented decline of animal populations and species richness worldwide has raised concerns on how this decline will impact the assembly and sustainability of ecosystems (Powers & Jetz, 2019; Spooner et al., 2018; Wang & Loreau, 2016).~~

~~The decline of frugivore populations around the globe has garnered much attention due to the implications losing seed vectors is theorized to have on seed dispersal across landscapes (Caves et al., 2013; Mokany et al., 2014; Rumeu et al., 2017)~~. ~~Large frugivores in particular have become a conservation focus due to their ability to eat a wider variety of seed sizes and transport seeds farther distances than their smaller counterparts (Jordano et al., 2007; Naniwadekar et al., 2019). Similarly, specialized frugivores, such as New Zealand’s Weka,~~ *~~Gallirallus australis~~*~~, that have been displaced by non-native competitors or extirpated from their home ranges raise concerns about the loss of specialized dispersal (Carpenter et al., 2018; Case & Tarwater, 2020; Caves et al., 2013).~~

~~However, many of these studies examine specialized mutualisms in specific systems that perhaps should not be used to make inferences about the plethora of diffuse mutualisms in ecosystems (Estrada & Fleming, 1986; Herrera, 1985). More specialized dispersal relationships should be sensitive to declining frugivore diversity, but it is less clear how the diminishment of seed vector diversity might influence dispersal in diffuse mutualisms (Davies et al., 2000, 2004; Herrera, 1985). Furthermore, there is a heavy bias within frugivore seed dispersal research due to the high volume of studies being conducted in tropical ecosystems (Escribano-Avila et al., 2018). Results from these studies have not produced uniform conclusions either. Some projects have found seed vectors to be a key component to maintaining dispersal networks (Camargo et al., 2021), while others have concluded seed vectors are not the driving force in dispersal network cohesion (Farwig et al., 2017). Additionally, pervasive characteristic differences in tropical plant communities from temperate hardwoods, such as: plant heights, fuit body size,\_\_, have been documented to influence seed dispersal ranges, also known as seed shadows. This calls into question whether tropical dispersal research should be applied to systems worldwide and underscores the need to study dispersal pattens outside of the tropics to better understand how global change affects seed dispersal relationships (Escribano-Avila et al., 2018).~~

In other systems there is more overlap and redundancy in seed vectors. *Mention examples of diffuse mutualisms in North America*. These differences underscore the need for more research on seed dispersal ecology in the temperate hardwoods.

**An underlying theme in dispersal ecology is that seeds are dispersed towards resources**, ~~with resources defined as: a substance or object in the environment required by an organism for normal growth, maintenance, and reproduction (Borah & Beckman, 2021; Gleditsch et al., 2017; Howe & Smallwood, 1982). Three noteworthy characteristics of resources that have been documented to influence animal behavior are: abundance, quality, and diversity of resources (García et al., 2011; Schupp et al., 2019). All three of those resource characteristics are playing a role in interspecies interactions among plants and animals, but resource diversity is particularly relevant to diffuse mutualisms.~~ We know declines in plant richness can impair seed dispersal, but declines in bird richness may not have as robust of an effect if there are functional redundancies in most seed dispersal relationships.

In a world with declining resource diversity in ecosystems, there is a need to better understand how declining resource diversity impacts diffuse mutualisms. In systems with a lot of functional redundancy, declining resource diversity may have a more robust impact than declining seed vector diversity. Considering that birds are prominent seed vectors in temperate forest diffuse mutualisms, we examined how depauperate bird communities influence the relationship between seed rain richness and resource diversity.

Our project examines how systems with depauperate seed vector communities influence the relationship between seed rain richness and resource richness. We utilized bird feeders as a tool to examine how manipulating the richness of food resources available to bird communities influenced: 1) the richness and observations of birds visiting feeders and 2) the richness and observations of seeds deposited beneath feeders through bird excrement. This model system was selected because bird feeders provide a convenient system to manipulate resource availability, are known to influence bird behavior, and are ubiquitous in the United States (Cowie and Hinsley 1988, Lepcyzk et al. 2004, Fuller et al. 2008, Galbraith et al. 2015). To represent variation in resources, bird feeders were stocked with varying compositions of seeds, nuts and insects of various sizes and nutritional content. Experiment results were hypothesized to exhibit a positive relationship between resource, bird and seed richness and observations.

Birds are common and effective seed vectors in terrestrial ecosystems (Howe

1997, Naniwadekar et al. 2019, Subalusky & Post 2019, Whelan et al. 2008, Wotton and Kelly 2012). Resources that attract birds likely influence movement patterns and seed deposition sites (Carpentar et al. 2018, Saracco et al. 2004). Birds also show variation in resource preference, resulting in differing seed dispersal patterns (Stiles 1980, Howe 1986). Passing through bird digestive tracts has also been shown to influence germination of seeds (Traveset et al. 2001). Bird size has been linked to seed dispersal distances, indicating bird community assemblages impact seed vector patterns on landscapes (Godínez-Alvarez et al. 2020).

Declining bird populations and community richness worldwide raise concerns on how decreasing abundance and diversity of seed vectors will impact seed movement throughout ecosystems (Camargo et al. 2020, Wesely et al. 2020). More information is needed on how seed richness in communities is impacted by depauperate seed vector assemblage. Previous studies have examined \_\_\_\_ (---). Our experiment examines how food resources richness influences seed dispersal in areas with depauperate avian communities.

This experiment utilized bird feeders as a tool to examine how manipulating the richness of food resources available to bird communities influenced: 1) the richness and observations of birds visiting feeders and 2) the richness and observations of seeds deposited beneath feeders through bird excrement. This model system was selected because bird feeders provide a convenient system to manipulate resource availability, are known to influence bird behavior, and are ubiquitous in the United States (Cowie and Hinsley 1988, Lepcyzk et al. 2004, Fuller et al. 2008, Galbraith et al. 2015). To represent variation in resources, bird feeders were stocked with varying compositions of seeds, nuts and insects of various sizes and nutritional content. Experiment results were hypothesized to exhibit a positive relationship between resource, bird and seed richness and observations.

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