**<A>Introduction**

* **Biodiversity is declining because of global change causing asymmetry in the loss of biodiversity.**

We live in a world amidst accelerating erosion of resource diversity in ecosystems (Grime 1998, Worm et al. 2006, Srivastava et al. 2012). Anthropogenic disruption to functional interactions within ecosystems alters assemblage, threatens biodiversity, and diminishes resource richness (Camargo et al., 2020; Donoso et al., 2020; Jordano et al., 2007; Lorts et al., 2008; Monteiro et al., 2021; Pigot et al., 2016). Animals play a key role in shaping their ecosystems through fundamental ecological processes such as seed dispersal, changing plant biomass, nutrient recycling, pollination, and physical structure alteration (González-Castro et al., 2019; Hempson et al., 2017; McAfee et al., 2018; Parr et al., 2018). However, due to the persistent progression of human activities causing abrupt environmental disruptions via habitat loss or fragmentation, we have created an asymmetric skew in the loss of biodiversity, with the extinction of animals at higher trophic levels and smaller populations sizes occurring first (Davies et al., 2000; Duffy, 2003) (Cramer et al. 2007). This decline of animal populations and species richness is well documented worldwide and has raised concerns on how this will impact the assembly and sustainability of ecosystems (Powers & Jetz, 2019; Spooner et al., 2018; Wang & Loreau, 2016).

* **Plants importance to ecosystems connected to animals**

Animal resource availability is considerably affected by plants, making plant communities an influential ecosystem characteristic (Bascompte & Jordano, 2007; Sebastián-González et al., 2020). Plant community assembly and succession is influenced by abiotic (e.g., soil nutrients [Aerts, 1999; Coomes & Grubb, 2000]) and biotic (e.g., 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) factors. Manipulating these factors creates drastically different plant communities from the same starting points (Bakker, 1998; González-Castro et al., 2019). Due to this variability, recent dramatic anthropogenic shifts to ecosystems have increased the need to study functional interactions within ecological communities for conservation efforts, specifically interactions between seed vectors (i.e., animals that transport seeds) 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 increasing concern with seed vectors (which are animals, our connection with the previous paragraph; e.g., frugivores) because they play a vital role in dispersing seeds in the environment; however...**

The decline of seed vector populations (e.g., frugivores) across landscapes has garnered much attention due to vector influence on seed dispersal (Jordano et al., 2007; Naniwadekar et al., 2019; Carpenter et al., 2018; Case & Tarwater, 2020; Caves et al., 2013; Mokany et al., 2014; Rumeu et al., 2017). Many studies investigate these diffuse mutualisms, a mutually positive relationship in which a species depends on multiple other species, all of which positively interact; for example, pollination, seed dispersal, and plant protection (Rico-Gray 1993, Zamora 2000, Stanton 2003, Gove et al. 2007). However, tropical ecosystems represent a disproportionate amount of these studies and hence a more limited understanding of vector influence on seed dispersal diffuse mutualisms (Escribano-Avila et al., 2018; Estrada & Fleming, 1986; Herrera, 1985). Thus, in Nearctic diffuse mutualisms, it is less clear how diminishment of seed vector diversity might influence seed dispersal (Davies et al., 2000, 2004; Herrera, 1985). This uncertainty is due to tropical and temperate hardwood plant community differences (e.g., plant height, seed structure), influencing seed dispersal ranges (XXXX; XXXX). Perhaps we should not use tropical seed dispersal research to make inferences about diffuse mutualisms worldwide. This underscores the need to study seed dispersal ecology outside the tropics for a more robust understanding of available resource effects on diffuse mutualisms. (Escribano-Avila et al., 2018).

* **In diffuse mutualisms with functionally redundant seed disperser assemblages, resource diversity may modulate seed dispersal more than the loss of individual species. (Resources end last to begin this)**

It is important to define resources as a substance or object in the environment required by an animal for growth, maintenance, and reproduction (Borah & Beckman, 2021; Gleditsch et al., 2017; Howe & Smallwood, 1982). A general underlying theme in dispersal ecology is that seeds are dispersed towards resources (XXXX, XXXX) because resource abundance and diversity influence animal behavior and seed deposition sites (Saracco et al. 2004; García et al., 2011; Carpentar et al. 2018; Schupp et al., 2019). However, resource diversity in ecosystems is declining (XXXX), and there is a need to understand better how this impacts diffuse mutualisms. In systems with great functional redundancy (i.e., multiple species share similar roles within the ecosystem), declining resource diversity may have a more substantial impact than declining seed vector diversity. We know declines in plant diversity can impair seed dispersal (XXXX). Still, reductions in seed vector (e.g., bird) richness may not have as robust of an effect if there is functional redundancy in most seed dispersal relationships.

* **More specifically, birds and their ...**

Declining bird populations and community richness raise concerns on how decreasing abundance and diversity of seed vectors will impact seed dispersal throughout ecosystems (Camargo et al. 2020, Wesely et al. 2020). We know 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), and bird size has been linked to seed dispersal distance, highlighting bird richness importance (Godínez -Alvarez et al. 2020). We need more information on how depauperate bird assemblage impacts ecosystem plant diversity (i.e., seed richness). Considering birds are prominent seed vectors in temperate forest diffuse mutualisms (XXXX, XXXX), we examined how a depauperate bird community influence the diffuse mutualism relationship between seed rain richness (dispersal potential) and resource diversity.

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. We selected this model system because bird feeders provide a convenient approach to manipulate resource availability, are known to influence bird behavior as resources do, 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, we stocked bird feeders 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.

Cramer et al. 2007 – Forest fragmentation differentially affects seed dispersal of large and small-seeded tropical trees

Grime 1998 – Benefits of plant diversity to ecosystems: immediate, filter, and founder effects

Grove et al. 2007 – A keystone ant species promotes seed dispersal in a “diffuse” mutualism

Rico-Gray 1993 – Use of plant-derived food resources by ants in the dry tropical lowlands of coastal Veracruz, Mexico.

Srivastave et al. 2012 – Phylogenetic diversity and the functioning of ecosystems

Worm et al. 2006 – Impacts of biodiversity loss on ocean ecosystem services