Volatiles and Predators

Evidence of vertebrate dispersal mechanisms in the fossil record is often unclear and occasionally rudimentary, but results from Tiffney (2004) suggest that plant morphological features have evolved to favor vertebrate dispersal as early as the Pennsylvanian. Herbivore diversification and subsequent dominance of vertebrate dispersal mechanisms, along with establishment of specific vertebrate-plant associations occurred in the Permian period and Mesozoic era, respectively. Later diversification of small mammals and birds established the basis for widespread occurrence of vertebrate dispersal. Based on this study fruit dispersal mechanisms have been able to evolve through the last two eras, however fruits still have limitations and tradeoffs to predation and herbivory. Volatile compounds are present in over 50 species of plants and are emitted following tissue damage that can be distinguished and chosen to fit herbivore enemy diet (Clavijo McCormick et al. 2012). Despite the length of time plants have evolved fruit dispersal mechanisms, they are still susceptible to the antagonistic effects of predation. Especially in isolated ecosystems where invasive predators can disrupt the dispersal mechanisms (Rogers et al. 2017).

Damage of the plant stem, leaves, flowers, or fruit by herbivores can cause the emission of volatile compounds as a defense mechanism from further predation and as a chemical cue to nearby herbivore enemies. Clavijo McCormick et al. (2012) showed that plant volatile blends provide herbivore enemies with valuable information on the health of the plant, enemy prey and their feeding guilds, and the presence of other herbivores or pathogens in the plant. In this study, herbivore enemies - arthropods and parasitoids - can differentiate between the phenological states and species of plants and plant varieties based on the blend of volatile compounds emitted. This study is evidence of a co-opted mutualism between the fruit bearing plant and its herbivore enemies, in which, the plant benefits from less predation by herbivores at the expense of not being selected or greater damage by larger herbivore enemies. The herbivore enemies benefit through a reliable source of prey and a host plant at little to no cost to themselves. Although this mutualism can be more beneficial than costly, Clavijo McCormick et al. (2012) ultimately found the efficiency of the volatile blend to attract enemies is limited by enemy dietary needs and choice. This imposes a trade-off between the survival needs of the plant and the nutritional needs of the enemy.

Invasive species are a common occurrence in today’s world and the biodiversity ramifications are often overlooked. For instance, an invasive predator has caused the disruption of a fruit-frugivore dispersal mechanism on the island of Guam leading to the extirpation of ten of the native bird species and functional extirpation of the remaining two species (Rogers et al. 2017). This predator has negatively affected the fruit-frugivore dispersal mechanism of two tree species in Guam in contrast to three nearby islands with intact bird and tree populations and an absence of invasive predators. In this study predation disrupts the fruit-frugivore dispersal mutualism by decreasing germination success and species distribution of the two tree species. A tradeoff between an invasive predator and a fruit-frugivore dispersal mechanism in this scenario and in the previous, the efficiency of volatile blends to illicit rescue by herbivore enemies. In either case the coevolutionary interactions between them are an ongoing process presenting many avenues for research. In the former scenario more research can be conducted on enemy behaviors in response to volatile blends with a background of other odors. In the latter scenario, more research could be done towards species restoration through invasive species management. Both avenues could lead to greater understanding of coevolutionary interactions between fruit and their dispersal agents.

# References

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