Linking plant mediated nutrition cycle to seed disperser activities

Seed dispersal can play important roles in how plants are spatially distributed at different scales. While some processes may remain important across scales, others may be prominent only at particular spatial scale.

Seed dispersers such as frugivorous birds or mammals can carry seeds away from their parent tree and deposit them elsewhere. How these dispersers select these resources are complex and mediated through both plant and animal traits (*I will have some question here*).

Once the seeds are dispersed, they can establish them as seedlings if both the habitat is suitable and they escape seed predation. Thus, only a proportion of seeds are likely to become seedlings. While, the rest are not successful, some of them can still contribute their nutrition to the seedlings through decomposition. Such processes are likely to happen at small spatial scales.

Seeds, once deposited are in the neighborhood of adult trees. Adult trees can impact seed mortality by attracting seed predators. As, seed disperses fail to consume fruits, they would drop near the parent tree and attract predators. However, these fruits are also rich in nutrients. As they decompose, fruits can provide essential nutrient like phosphorous to seedlings. If the neighboring adult trees are leguminous plants, seedlings may further benefit from nitrogen fixation. Such processes are likely to occur at larger scales.

Thus, seed dispersers can play important role in how plants are spatially distributed. While they can effectively carry seeds, their failure to do so can also trigger other ecological processes that can have important impacts.

I, therefore plan to study how dispersers can influence seedling recruitment by influencing both their mortality through predation and survivability from nutrient cycling.

Nutrients

Predators

Trees

Dispersers

Seedling

Seeds/Fruits

Fig: A schematic describing how seed dispersal by animal seed dispersers can influence seedling fate. Dispersers can bring seeds to the right habitat. However, not all seeds will germinate. While some are predated, others can decompose to provide soil nutrients. These are small scale processes (dashed rectangle). Dispersers can also play important role in shaping the neighborhood of seedlings. The neighboring adult trees can influence seedlings by attracting predators or influencing the nutrient cycles. One major way this can happen is through fruits that failed to disperse. These are mostly larger scale processes (solid rectangle).

I therefore predict that

1. Disperser moves searching for fruits that provide maximum reward per unit effort. Fruit rewards would be trait based, that matches disperser traits. For instance, large birds looking for larger fruits. I therefore predicted that the spatial pattern of trees on large scale would match disperser movement. (This is based on the disperser-tree interaction, the dashed arrow)
2. On contemporary time scale, disperser defecates and deposit seeds (seed rain). Such shadows can occur under roosting, nesting or feeding sites. These spatial scales are smaller. I therefore predicted that at smaller scale, pattern of seed shadow should match disperser roosting, nesting or feeding activities.
3. Some seeds would decompose and fail to germinate. Such seed pools would be replenished with fruits falling from nearby adult trees. I predict that the decomposing seeds will add important and limiting nutrient like phosphorous that can play vital roles. These processes are small scale.
4. Additional net benefits can be accrued in the neighborhood of adult plants. These benefits can be gradated. I predict that if the adult plants are conspecific, seeds are likely to be predated. If adult neighbors are mostly heterospecific, seeds can benefit from adult trees adding fruit nutrients to soil. Additional benefits can come in the neighborhood of leguminous plants. These processes happen at larger scales

**Iteration 2**

Tropical forests are rich in biodiversity, with multiple interactions like competition, mutualism and predation shaping the communities. Among, community members, there can be species that play important roles in maintaining biodiversity and ecosystem functions. Tropical trees are among the important members of tropical communities. They can provide nutrition to animals, and maintain critical nutrient cycles. Few species of tropical trees can have significant roles. For instance, tropical palm trees constitute a large portion of the plant community. Studies have shown palms limit seed recruitments under it through limiting light. But, at the same time it contributes resources to the frugivore guild. But little is known about their contribution to nutrient cycling. Palm fruits and leaves can be particularly rich in phosphorous, a limiting resource in tropical forests. Therefore, palms can create these small nutrient hotspots around them where shade-tolerant and phosphorous limited species can particularly thrive.

Likewise, leguminous plants are equally abundant in tropical forests and influence plant and animal communities through the before mentioned ways. However, not much is known on their role on light limitation or food resources to frugivores. It is likely that they may not significantly limit light if they were canopy plants. On the other hand, animals might avoid these fruits for their toxic chemical content.

In this study, I would be looking at the ecological roles of these two important tropical plant groups.

1. I particularly hypothesize that frugivores prefer palms and avoid leguminous plants relative to their abundance and habitat use. I therefore predict that the seed rain would have more palm seeds and fewer leguminous seeds than expected from disperser’s habitat use. I also predict that seed diversity around the palm trees would be higher compared to random locations. I predict the opposite for leguminous plants.

Study design:

For this, I plan to estimate habitat use by potential dispersers, and calculate if the seed rain generated by them is as expected or not. This spatial coverage potentially can inform seed rain hotspots in the entire study area.

1. Palm and legume litter will supply nutrients at small scales through litter fall. I therefore predict nutrient hotspots around them compared to random locations.

Study design:

For this study, I plan to estimate litter quality and quantity from under the palm, legumes and controls. This spatial coverage can potentially inform nutrient hotspots in the study area at a small scale.

1. Seedling will establish, survive and grow significantly in these hotspots. Therefore, I predict under controlled conditions, these responses will be higher than otherwise. I particularly predict that phosphorous limited seedlings will have better responses in controlled conditions under palm. Likewise, I predict nitrogen limited seedling will have better responses in controlled conditions under legumes.

Study design:

For this study, I plan to do green house experiments where I will simulate soil conditions under palm and legumes and random locations, controlling for light limitation and predation. This can inform, if these seed rain and nutrient hotspots are viable for some species depending on their competitive and stress enduring abilities.