ers visiting the trees. Qualitatively, we observed that larger birds (Clay-colored Robins, Black-cowled Orioles, and flycatchers) ate more fruits than smaller birds (warblers and tanagers). A few green fruits were consumed by Olive Tanagers, probably before the seeds were viable.

Discussion

The number of ripe fruits on the *H. patens* tree increased overnight and decreased during the day, supporting our prediction that fruits ripen continuously. The change observed overnight represents the ripening rate because only diurnal birds consume the fruit (Leck 1972). In contrast, the change during the day represents the difference between fruit ripened and fruit eaten. Therefore, during the day birds eat fruit faster than the fruit ripens.

We expected higher bird foraging activity in the morning, but activity was patchy in space and time. Such variability in foraging activity suggests that fruit availability on these trees may not be the primary factor driving patterns in bird foraging behavior. The high variability in bird visitation that we observed may also be explained by the sporadic movements of the mixed species flocks that comprised the majority of visitors.

Although February is the month of lowest fruit production (Newstrom 1994), there were ripe fruits on all of our trees. More fruits were eaten on trees with more ripe fruits. At trees with many ripe fruits, we observed that more birds visited and individual birds foraged longer.

Contrary to our second prediction, there was a slight net increase of about six ripe fruits per tree per day over the sample period. However, we did not test this statistically, and the number of ripe fruits on a tree was relatively stable over time (Fig. 3).

We were able to observe the ripening of fruits through various stages over a three-day period. There were far more unripe than ripe fruits on all trees, because fruits spend most of their time in an immature state. We saw few green fruits turn yellow, but most fruits that were initially yellow had fully ripened and turned red by the end of our observations. Flowering in every month, together with a one month ripening period (Croat 1978), allows *H. patens* trees to supply ripe fruits continuously to the birds that consume them. This helps ensure that the tree does not swamp dispersers. If the tree produces too many fruits at one time, birds may stay at the tree longer and defecate more of the seeds directly under the parent, rather than dispersing them. On the other hand, if a tree does not consistently produce enough fruits to attract dispersers, birds may not visit on a regular basis and fruits may not be eaten and dispersed.

Plants must supply enough fruit to attract dispersers but not so much that fruits go uneaten and energy is wasted. We observed a variety of bird species consistently returning to *H. patens*, suggesting that the species is producing fruit fast enough to maintain reliable seed dispersers.

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Rapid colonization of artificial phytotelmata containing fresh and dead leaves

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Abstract: Phytotelmata, or tree-holes, are among the big offenders when it comes to raising mosquitoes. Mosquitoes are often among the first colonizers of these ecosystems, but the community can include multiple trophic levels and many species. I hypothesized that the size and diversity of the community that colonizes such habitats would depend on resource quality. I tested this hypothesis with a series of artificial phytotelmata containing old leaves, fresh leaves, and a mix of both. I found that colonization (mainly by mosquitoes) depends on resource presence or absence, and that the community composition is influenced by resource type.

Key Words: Aquatic invertebrate, malaria, mosquitoes, tree-hole

Introduction

The construction of the Panama Canal was given up by French engineers after many workers died of malaria and yellow fever. When the United States took the project over, their first priority was the destruction of the small pools of water where potentially deadly mosquito species bred. Their solution was to coat every standing pool of water with a film of kerosene that suffocated mosquito larvae, but they had little interest in the factors that made good habitats for the mosquitoes.

I set up artificial phytotelmata to study their colonization by mosquitoes and other invertebrates. I hypothesized that colonization rate would be affected by the type of resource available in the phytotelmata. I predicted that mosquitoes would be the main colonizers of all treatments, and that they would comprise an even higher proportion of the abundance in green leaf treatments, due to the fast pulse of resources that leach out of fresh detritus. I also predicted that higher species richness would seen in dead leaf treatments because of the diversity of organisms associated with dead leaves and the range of textures resulting from various stages of leaf decomposition.

Methods

I conducted my experiment along the Sura trail at La Selva Biological Station, near Puerto Viejo, Costa Rica. Artificial phytotelmata consisted of round plastic bowls (16 cm x 5 cm). The four treatments consisted of a leafless control, one with a single green leaf cut in half, one with a single dead leaf cut in half, and a final treatment with half of a green leaf and half of a dead leaf. The green leaves, all of the same approximate size, were collected from a single individual (species unknown) from new growth on a secondary growth species. The tree showed some signs of herbivory, suggesting there may not have been high concentrations of secondary compounds. Dead leaves, all approximately the size as the green leaves, were collected from a single species as well, and were in early stages of decomposition in a pile before collection. Each bowl was stocked with the proper leaves, then filled halfway (~500 ml) with tap water. The bowls were then placed at seven locations along the first 250 m of the trail, between the buttresses of large trees. One replicate of each treatment was placed under each of seven trees, in a blocked design. After three days I collected the bowls, removed the leaves, and filtered the water. Invertebrates in each bowl were then counted and identified to morphotype.

the green leaf treatment was not significantly different from control. However, the combination of dead and green leaves was much more conducive to a rich community than either one alone. Species richness was higher in the treatment with both green and dead leaves than it was in the control, probably due to the nutrient input of the green leaf, and possibly the diversity of resources and microhabitat structures provided by the dead leaves.

In a tropical rainforest like La Selva, nutrient inputs from canopy throughfall are abundant and facilitate fast colonization by mosquito larvae. All of my experimental bowls trapped substantial fine organic matter in addition to the leaves I placed in them. Any phytotelmata in the forest are bound to have mosquitoes unless predation or competition keeps their numbers down. The widespread destruction of habitats employed by the Army Corps of Engineers in Panama was probably apt.

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