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ARTHROPOD ABUNDANCE AND COMMUNITY STRUCTURE ASSOCIATED WITH OHIA CANOPY FOLIAGE (*METROSIDEROS POLYMORPHA*) FROM THE HAWAIIAN ISLANDS: DATA FROM TWO STUDIES

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INTRODUCTION

Recent work in tropical forest canopies has revealed that most arthropod communities are highly diverse, with many species showing host-tree specificity, and maintaining restricted geographic and ecological ranges. Little information exists regarding the mechanisms that form and maintain these communities, although it has been suggested that patterns of community structure, such as guild organization, may exist (Moran & Southwood 1982). The structure and patterns of arthropod communities within insular faunas are even less well known. Two factors suggest that arthropod communities in island forests, such as those of the Hawaiian Islands, may differ. First, the extreme isolation of the islands has resulted in a disharmonic fauna, differing greatly in high-level taxonomic diversity. Approximately 50% of the world's insect orders and 15% of the families are native to the archipelago. Second, Hawaiian wet forests tend to be dominated by a small number of canopy-forming tree species. Over large areas, one or two species may comprise the canopy. How these factors have influenced the composition of Hawaii's arthropod community is not yet fully understood.

This paper summarizes data on the structure of the arthropod community associated with the dominant wet forest canopy tree in Hawaii, ohia (*Metrosideros polymorpha*). Two studies are presented. First, my recent study compared the foliage community within two nearly contiguous areas differing in extent of canopy cover, forest structure, and tree growth morphology. The second study was from the work of the late Dr. Wayne Gagné (Gagné 1979, Gagné & Howarth 1975), and allows comparison of two relatively pristine forests, similar in structure, but differing in elevation.

METHODS

Both studies took place within mid-elevation wet forests (1,900–3,000 mm rain/year) on the Island of Hawaii. The influence of habitat structure on arthropod communities was investigated within Hakalau Forest National Wildlife Refuge (NWR), at 1,900 m, on the windward slope of Mauna Kea. Here, ohia varies markedly in its growth form depending upon the extent of canopy cover. In closed canopy areas, trees have a straight, pole-like form, with foliage concentrated at the top, and form a nearly continuous forest canopy. In open canopy areas, where ohia are widely spaced, trees become massive, with foliage extending from the top to more than half way to the ground. These differences in forest structure, which may have arisen from events such as natural gap formation, logging, and cattle grazing, have led to a mosaic of forest types. Between May 1991 and March 1992, foliage was sampled and arthropods collected from both forest types via a pole-mounted branch clipper. This study, which also looked at habitat-limiting factors for insectivorous birds, concentrated on biomass differences of arthropods between the two areas.

Gagné's work took place within and adjacent to Hawaii Volcanoes National Park, on Mauna Loa. His sites were relatively undisturbed, closed canopy forests, that differed in elevation. The lower elevation site (Thurston lava tube; 1,195 m) was located eight miles south of a higher elevation site (Kilauea Forest Reserve; 1,600 m). Between March 1971 and May 1973, ohia canopies were fogged using synergized pyrethrum, approximately every other month.

RESULTS AND DISCUSSION

Within Hakalau Forest (NWR), ohia foliage from the open canopy area supported a greater arthropod biomass than an equal amount of foliage in the closed canopy area. Although all taxa followed this trend, only spiders and overall biomass were found to differ significantly. Spiders contributed the greatest biomass in both areas, followed by caterpillars, hemipterans, psocopterans, and homopterans. The pattern of community structure is similar in both areas, with no difference in the relative abundance of the arthropod groups. These data suggest that canopy cover, understory structure and ohia growth

morphology have little effect on the composition of the fauna, but do influence the biomass of arthropods the foliage supports.

Canopy fogging data from Mauna Loa revealed between-elevation similarities as well as differences. Psocopterans, hemipterans, and homopterans were numerically important at both elevations, while caterpillars, neuropterans and orthopterans were least numerous. However, collembola ranked second in abundance at the lower elevation site, but were rare at higher elevations; spiders were more common at higher than lower elevations. When taxa were placed into feeding guilds, between-site similarities and differences reflected the distribution of the dominant groups. At both sites, detritivores were numerically dominant, followed by sap-suckers (see Gagné 1979, Gagné & Howarth 1975 for guild assignments). Predators were important at both areas, but much more so at higher elevation, with spiders contributing greatly to this difference. Fungivores and tourists were few at both sites.

Many of Hawaii's unique forest ecosystems have been highly modified or destroyed, particularly at lower elevation. Major contributing factors include land use practices and competition and predation from alien species. Data from the Kilauea Forest Reserve site (selected for study due to its pristine nature) revealed that all but the tourist guild have been invaded by alien arthropod species. Their impact on the native community is unknown.

To compare patterns of Hawaii's insular arthropod community with other areas, a guild comparison of the fogging data was made to forests in Borneo (Stork 1987) and Australia (Basset & Arthington 1992). More differences than similarities were found, but the Kilauea Forest Reserve did show similarities to the Australian forests with the dominance of sap-suckers and spiders, and the relative insignificance of chewers. Although caution is necessary when comparing studies where slight differences in methodology or guild placement can have a large effect, these data suggest that the guild structure of arthropods associated with ohia foliage may be unique among tropical forest canopies.

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