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PLANT-ANT RELATIONSHIPS AND INTERACTIONS: *TILLANDSIA* AND *CREMATOGASTER*

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ABSTRACT

In the Bahamas several vegetational zones are frequently flooded by tidal conditions and intense periods of rain. A restricted number of tree species occur in these areas where they serve as sites for various epiphytic orchids and bromeliads. In this circumstance certain species of the bromeliad genus *Tillandsia* function as home sites for ants of the genus *Crematogaster* while receiving nutrients from the ant colony.

INTRODUCTION

A number of plant communities have been recognized as comprising the vegetation of the Bahamian Archipelago. Correll (1979) recognizes nine distinct vegetational types for the entire island assemblage, while Gillis (1977) details fourteen communities on Abaco, and Northrop (1902) lists five distinct plant communities in her *Flora of New Providence and Andros.* Northrop (1902) recognizes two communities that frequently have standing water. The first is termed the Swash and is described as a region where the scenery is monotonous and desolate and the land is flat and covered with widely spaced dwarfed mangroves including *Rhizophora mangle* (Red Mangrove), *Avicennia germinans* (Black Mangrove), and *Conocarpus erectus* (Button Mangrove). The ground is a soft calcareous mud which is often covered with algal mats (Gillis, 1977). Correll (1979) includes the Swash as a part of his mangrove community which comprises much of the western half of Andros Island. Perhaps Northrop's (1902) Swash also embraces Correll's (1979) Tidal Flats and Salt Marshlands community, at least in part. The second, frequently inundated community is the Savanna. The Savanna is an extensive series of level prairie - like zones interspersed between Swash and Pineland communities. The typical Savanna landscape includes the palms *Thrinax morrisii* (Thatch Palm), *Cocothrinax argentata* (Silver Top Palm), *Cladium jamaicensis* (Saw Grass), and scattered *Bucida spinosa* (Tear Coat) (Figs. 1 & 2).

Both the Swash and Savanna represent extensive wetland areas. In part, the Swash is inundated daily by tidal action while the Savanna is subject to wet and dry periods based on seasonal rainfall fluctions. The several mangrove species and patches of *Bucida spinosa* are frequently hosts to epiphytic members of the Bromeliaceae. In the Bahamas the Bromeliaceae includes the four native genera *Aechmea, Catopsis, Guzmania,* and *Tillandsia.* Two species of *Catopsis* and eight species of *Tillandsia* are found on Andros Island but not all of these occur in the Swash and Savanna. Some of those species that do inhabit the Swash and Savanna are not always suitable home sites for ants. For example, *Catopsis* has inflated basal leaves that act as water traps and better serve the different terrestial frogs that inhabit Andros incuding the Cuban Tree Frog. On the other hand, several species of *Tillandsia* are ideally designed and adapted as home sites for ants. One species, *Tillandsia balbisiana* J. A. & J. H. Schut. (Figs. 3 & 4) is a stemless plant 16 - 35 cm high. The leaves are arranged in a dense bulbous rosette which may exceed the inflorescence with recurved leaf tips. The leaf bases or sheathes are large and inflated typically forming a hollow ovoid to ellipsoid "psuedo bulb" (Correll & Correll, 1982). In the frequently flooded Swash and Savanna communities the inflated leaf bases provide one of the few dry environments in which ants can carry out their life cycle. *Tillandsia flexuosa* Sw. is another species well adapted to meet the ant's needs. These stemless plants, 2 - 15 dm high possess 10 - 20 leaves arranged in a dense often subbulbous rosette, 2 - 5 dm long.

OBSERVATIONS AND DISCUSSIONS

Nine field seasons on Andros Island, Bahamas, in addition to laboratory studies at Miami University, have confirmed that ants of the genus *Crematogaster* (Figs. 5 & 6) regularly inhabit the cavities provided by the inflated leaf bases of both *Tillandsia bulbisiana* and *T. flexuosa.* Plants and ants have been observed in May and June during two week intervals from 1976 through 1987. Random samples indicate that approximately 25 percent of these two *Tillandsia* species are inhabited by ant colonies where the plants occur in the Swash and Savanna plant communities. Typically, an ant colony is comprised of 100 to 300 individuals. Careful dissection and leaf removal from a *Tillandsia* plant reveals eggs, pupae, and dead adults as well as the detritus and debris of long established colonies. Ants normally enter a colony along the overlapping leaf blade channels (Figs. 4 & 7). No specially excavated entry holes are found in *Tillandsia bulbisiana* and *T. flexuosa* as reported by Benzing (1970) for *T. butzii* and *T. caput-medusae.* Disturbance of the *Tillandsia* plants brings an immediate aggressive response from an ant colony. Ants swarm from the leaf bases over the *Tillandsia* onto the neighboring leaves and twigs of the host plant searching for the source of the disturbance.

What is the meaning of these observations? In a classic paper (1955) van der Pjil detailed the several relationships of ants and plants. Some of these relationships included 1) myrmecochory as seed dispersed by ants, 2) myrmecophily as ant pollination, and 3) myrmecotrophy as the feeding of ants by plants via extrafloral nectaries. None of these particular ant-plant interactions apply to *Tillandsia. Tillandsia* seed is wind dispersed while no evidence exists for ant pollination. Extrafloral nectaries do not occur in the Bromeliaceae (Bently, 1977). van der Pjil (1955) did not consider another ant-plant interaction which has become more important as we have gained a better understanding of such relationships. Beattie (1985) indicates that not only do plants feed ants but ants feed plants. This phenomenon has been especially well documented by Benzing (1970) where he demonstrates that the nitrogen resource produced by ants has the potential "for nutrient flux from ants to the plant". Benzing cites the presence of animal produced nitrogen, uric acid, and amino acids as compounds that may be rapidly absorbed by bulb surfaces. authors (Benzing, 1970; Janzen, 1974; Huxley, 1978; and Thompson, 1981) have noted that ant-fed plants are usually restricted to nutrient deficient environments. Thompson (1981), in a comparison of insectivorous and ant-fed plants reports that ant-fed plants are primarily tropical, perennial, nitrogen deficient and exist in a substrate that is nutrient depauperate. If we consider *Tillandsia bulbisiana* and *T. flexuosa* in the Swash and Savanna communities of the Bahamas, we have a system that duplicates the model observed and developed by Benzing (1970) for *Tillandsia* in Mexico and Central America. In the Bahamas, the two *Tillandsia* species occur in what is clealy a nutrient deficient habitat. *Tillandsia* provides the ants with the only permanently dry place in which to carry out their life cycle. *Tillandsia bulbisiana* and *T. flexuosa* provide shelter and protection for the ant colony. At the same time the *Tillandsias* are the recipients of a nutrient pool that would not be available without the life activities of the ant colony. Benzing (1970) suggests that this mutualistic relationship and its many facets has allowed the genus *Tillandsia* to survive in nutrient deficient habitats where it might not otherwise exist.

An entirely different question on the role of *Crematogaster* in protecting the host plants on which *Tillandsia* grows remains to be investigated. Disturbance evokes aggressive and hostile ant behavior. These biting ants drive away any territorial invader. However, the importance of keeping plant herbivores off the host plants is not yet well documented or understood, at least for the particular situation on Andros Island.

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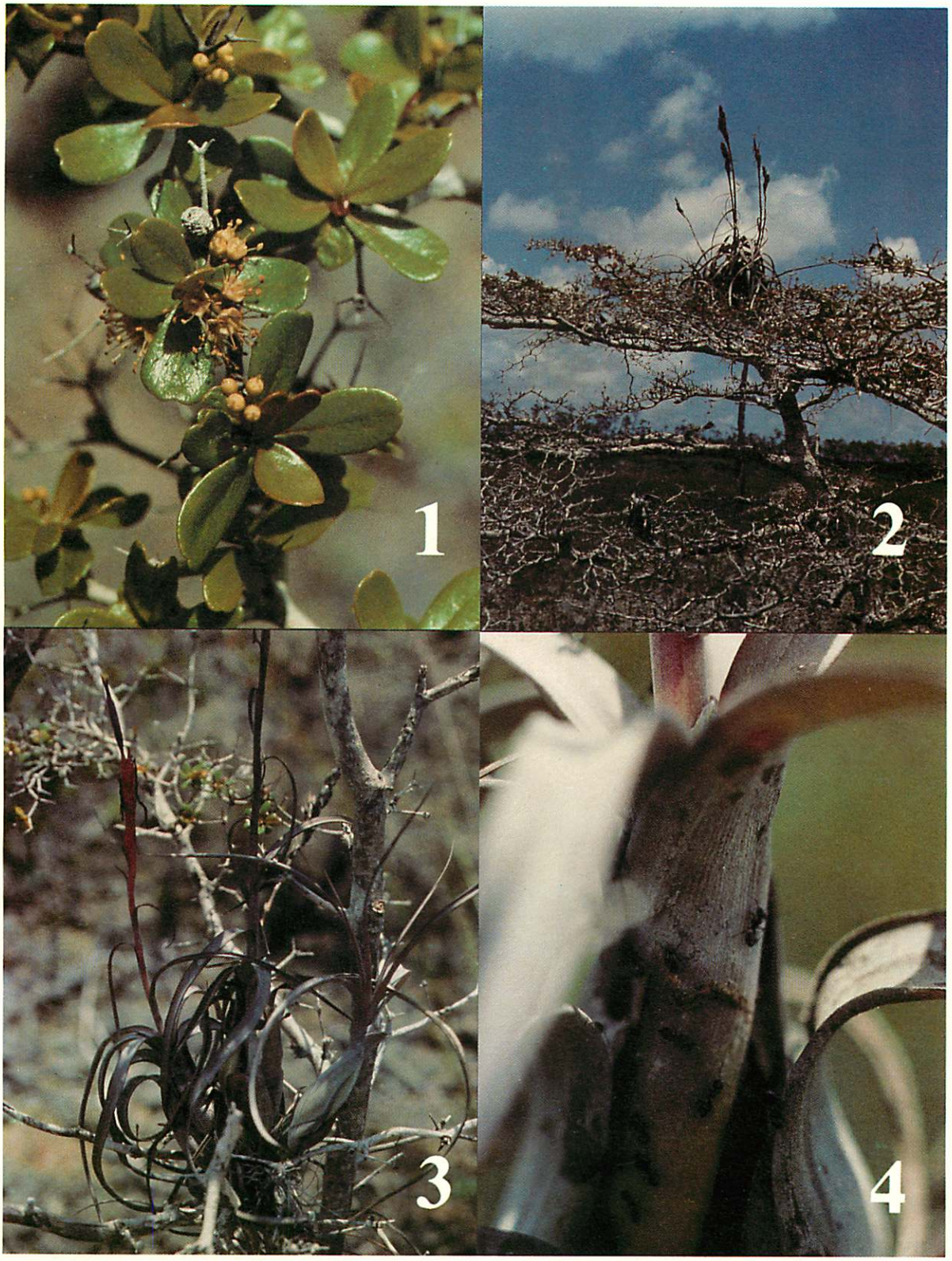

Fig. 1. *Bucida spinosa* (Combretaceae), close up of flowers.
Fig. 2. Tree with clump of *Tillandsia bulbisiana* growing as an epiphyte on the edge of the Swash.
Fig. 3. *Tillandsia bulbisiana*, as an epiphyte.
Fig. 4. Leaf bases with emerging ants.

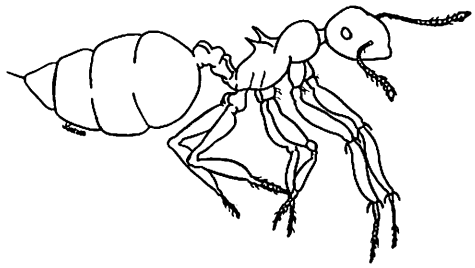

Fig. 5. *Crematogaster*, side view.

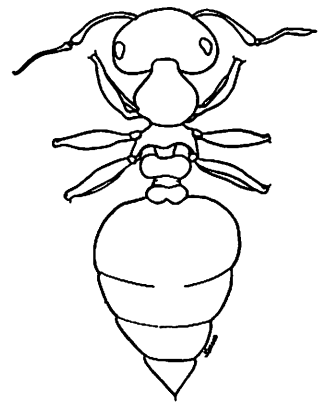

Fig. 6. *Crematogaster*, top view.

Fig. 7. *Tillandsia bulbisiana* - overlapping leaf bases providing entry channels for ants.

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