INVASION OF MAUI, HAWAII, BY THREE SPECIES OF *FICUS* (MORACEAE): BIOTIC INTERACTIONS AND CONSEQUENCES

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ABSTRACT

A desire to enhance forest cover of watersheds in Hawaii resulted in numerous tree introductions in the first half of the 20th century. In order to assure the spread of introduced *Ficus* spp., successful efforts were made in the 1920s-1930s to establish the specific wasp pollinators for *Ficus microcarpa* (Chinese banyan), *F.* cf. *platypoda* (Port Jackson fig), and *F. macrophylla* (Moreton bay fig) (Wagner et al. 1999). Vehicle surveys of roads in conjunction with walk-through surveys of known infestations resulted in detailed distribution maps for *Ficus* on the island of Maui. *F. microcarpa* and *F.* cf. *platypoda* have now become widespread invaders at low elevations on Maui, and *F. macrophylla* is starting to spread. Effects to date include damage to water-transporting infrastructure, displacement of lowland vegetation, and smothering of host trees (e.g. *Acacia koa*) after epiphytic establishment. Incipient establishment of non-native birds, including mitred conures (*Aratinga mitrata*), on Maui is likely to accelerate invasion of *Ficus*. Moreover, establishment and spread of *Ficus* may facilitate further invasion of non-native frugivores.

MATERIALS AND METHODS

All of the roads of Maui were driven at about five mph taking GPS points every time we came across a target species. Also recorded are notes about the particular point and whether the plant is naturalized, cultivated, or uncertain. Knowledgable individuals were also interviewed about location and extent of known infestations. These locations were then surveyed. We also collected wasps from semi-ripe fruit to determine whether the associated species were present or not, and made observations on birds eating fruit.

RESULTS

We surveyed 1,128 miles of roads over the last year and recorded 3,845 occurrence locations for 14 *Ficus* species. Three species of *Ficus* (*F. macrophylla*, *F. cf. platypoda*, *F. microcarpa*) and their associated wasps (*Pleistodontes froggattii, Pleistodontes imperialis, Parapristina verticillata*) were found to be naturalized on Maui. Driving the roads allowed us to have repeatable transects over time, to cover a lot of area with minimum effort, to provide an island view of distribution for each species, and to monitor "human" habitat which is often where most weeds are introduced and yet is often not surveyed by natural area managers.

Figure 2. Large spread of mature *Ficus microcarpa* trees.

Figure 1. Fruit set of *Ficus* cf. *platypoda*.

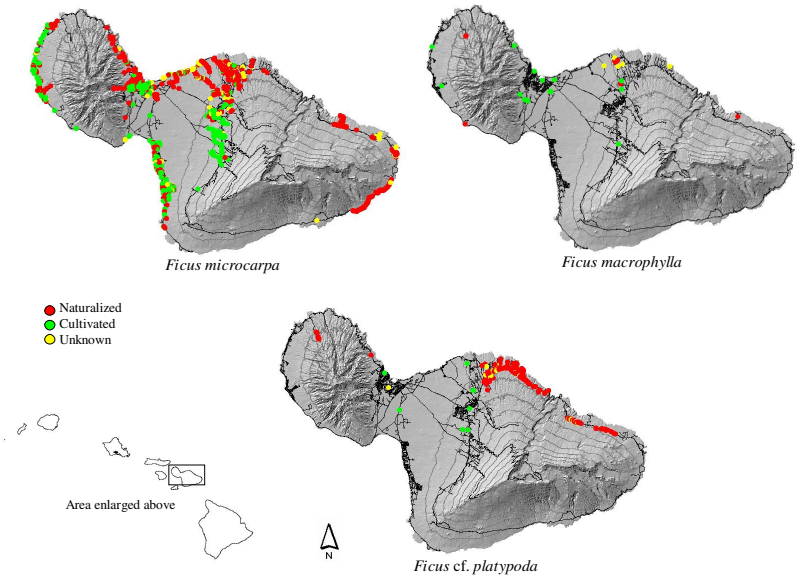

Figure 3. Maps of known distribution of naturalized *Ficus* spp. on Maui.

DISCUSSION: INTERACTION & CONSEQUENCES

Ficus trees are widely cultivated, produce a large seed set, are long lived, can grow to enormous sizes, are readily dispersed by frugivores, can germinate and grow almost anywhere, and are difficult to control. Existing non-native birds eat and spread *Ficus* and will likely increase naturalization of *Ficus*, which may lead to increased invasion by these non-native frugivores, which could in turn accelerate the *Ficus* invasion. Infrastructure such as bridges, water delivery systems, buildings, and historical sites are all at risk from being broken apart by the penetrating roots of *Ficus* trees. *Ficus* trees also threaten the dominant native canopy tree species in both the wet and dry forests of Hawai'i by germinating on and then smothering host trees such as koa (*Acacia koa*) and wiliwili (*Erythrina sandwicense*). On West Maui (Oppenheimer & Bartlett 2000) report control methods are being considered for *F. macrophylla*, but its epiphytic habit, preference for native trees as hosts, and ability to germinate on sheer cliffs makes control options limited.

CONCLUSION

Three species of *Ficus* are invasive on Maui. They have scarcely begun to thoroughly invade natural areas, but as McKey (1989) put it *Ficus* "seems poised to join the ranks of human transported plants that threaten to homogenize the tropics into a ragtag assembly of pantropical invasive species."

LITERATURE CITED

McKey, D. 1989. Population biology of figs: Applications for conservation. In: The comparative biology of figs. Experientia 45: 661-673.

Oppenheimer, H.L. & R.T. Bartlett. 2000. New Plant Records from Maui and Hawai'i Islands. Bishop Mus. Occas. Pap. 64: 1-10.

Wagner, W.L., D.R. Herbst & S.H. Sohmer. 1999. Manual of Flowering Plants of Hawaii. 2 vols. University of Hawaii Press & Bishop Museum Press, Honolulu.

Figure 4. Strangling habit of *Ficus microcarpa* roots.