

COMPARISON OF FOOD RESOURCE REMOVAL BY ANIMALS IN FOREST, OLD-FIELD, AND ECOTONE HABITATS¹

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ABSTRACT. This study was conducted at the Miami University Ecology Research Center from mid-July through late September, 1980. A 1-ha plot of forest, an adjacent 1-ha second-year old-field, an ecotone interface, and a nearby wooded fence-row ecotone served as the study site. Ten fleshy fruits of each species, red mulberry (*Morus rubra*), blackberry (*Rubus frondosus*), and wild black cherry (*Prunus serotina*) were situated on 0.5-m-high log feeding sites (3/habitat). Each trial lasted for 5 days and was replicated. Sites were observed each morning and the number of remaining fruits recorded. Visual observation for avian consumers and live-trapping for small mammal consumers were conducted to estimate their role in resource removal. *Morus* trials showed no significant differences ($p > 0.05$) in fruit removal rates from each site; *Rubus* removal from the woods ecotone was significantly less ($p \leq 0.05$) than from the fence-row ecotone or the forest on day 1; *Prunus* removal from the old-field was significantly less ($p \leq 0.05$) than from the fence-row ecotone or the forest on day 1. Small mammals (*Peromyscus* spp.) appeared to play a major role in fruit removal. Removal rate differences appeared to be a function of habitat structure.

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INTRODUCTION

Numerous investigators have noted the importance of habitat structure in determining animal species diversity and niche organization (Johnston and Odum 1956, MacArthur and MacArthur 1961, Thompson and Willson 1978). Pearson (1959) found that small mammal diversity and abundance were related to the types and amounts of vegetative cover in successional tracts in New Jersey. Willson (1974) found that the addition of a tree layer (offering increased 3-dimensional environmental patchiness) encouraged the addition of bird species with the formation of additional guilds. Her results showed that a forest edge had the highest bird species diversity of 21 areas studied. It has been observed that avian frugivores removed fleshy fruits from forest-edge and light-gap sites more

rapidly than from sites under closed canopy (Thompson and Willson 1978).

The present study compared removal rates of introduced fleshy-fruit resources in forest, old-field, and ecotone habitats. An attempt was made also to evaluate the role of small mammals in resource removal.

METHODS AND MATERIALS

The study was conducted from 14 July through 27 September 1980 at the Miami University Ecology Research Center near Oxford, Ohio. The study area consisted of a 1-ha second-year old-field, an adjacent 4-ha forest in the tree stage of secondary succession, an interface between the old-field and forest communities, and a nearby wooded fence-row. The interface between the old-field and the forest will hereafter be termed the woods ecotone. Only the 1-ha portion of the forest directly adjacent to the north edge of the old-field was included in the study area. The perimeter of the old-field was mowed periodically to maintain the habitat's discrete identity. Three log feeding sites (0.5-m-high) were situated along median east-west transects of the old-field, forest, and ecotone interface of the 2 communities; logs were 29.5 m apart. The wooded fence-row ecotone bordered the west edge of the old-field; 3 log feeding sites were located 21.5 m apart along its median

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north-south transect. All feeding sites were in place one week prior to beginning the study.

Trial periods coincided with the ripening of locally available fleshy fruits of 3 species, namely, red mulberry (*Morus rubra*) in July, blackberry (*Rubus frondosus*) in late July, and wild black cherry (*Prunus serotina*) in September; there were 2 trials per fruit species. Ten fruits were placed in a circular pattern on each feeding site at dawn at the beginning of each 5-day trial period. Sites were inspected every 24 h and the number of remaining fruits per site recorded. Observation for consumers was conducted from a 4.6-m-high platform located at the west end of the woods ecotone before dusk of day 1 and after dawn of day 2. The 2 closest sites in each habitat were observable with a 10-60X spotting scope. Each site was observed for 5 min in the following sequence: fence-row ecotone, old-field, woods ecotone, and forest. Two Sherman-type small-mammal traps were employed per site. Traps were situated 0.5 m from the site at opposite ends of a north-south transect with each entrance toward the site. Traps were baited with peanut butter on the second and fourth evenings of the second trial for each fruit species and checked the following mornings in order to minimize the impact of trapping on fruit removal. Captured animals were sexed, marked by toe-clipping, and released at the site of capture.

A one-way analysis of variance was used to determine differences in mean fruit removal values for the 4 habitats. The means were then treated with Duncan's multiple range test for separation of means. A $p \leq 0.05$ level of significance was used.

RESULTS

Morus trials yielded the most rapid fruit removal values; there were no significant differences ($p > 0.05$) among these values (fig. 1). Day 1 of the *Rubus* trials exhibited the only significant difference for this species. Significantly fewer fruits ($p \leq 0.05$) were removed from the woods ecotone than from the fence-row ecotone or the forest, whereas less fruit ($p \leq 0.05$) was removed from old-field sites than from forest sites. Fewer *Prunus* fruits ($p \leq 0.05$) were removed from old-field sites than from fence-row ecotone or forest sites on day 1. Fruits at forest sites were consistently removed the first day, except during the second *Prunus* trial when complete removal was achieved on day 2. Interestingly, the old-field exhibited consistently slower removal rates than the other habitats with the exception of day 1 of the *Rubus* trials (fig. 1). This supports the hypothesis that low-

diversity habitats (e.g., old-fields) exhibit slower resource removal.

During 14 h of observation, only a cardinal (*Cardinalis cardinalis*), was observed feeding at a woods ecotone site. Twenty-two *Peromyscus* were marked after 142 trap-nights. Six animals were recaptured; 5 were males. Ten *P. maniculatus* were caught in the old-field and 2 in the woods ecotone. Seven *P. leucopus* were caught in the forest and 3 in the fence-row ecotone. Only one animal was known to have travelled between habitat types; this was a male *P. maniculatus* initially captured in the woods ecotone and subsequently recaptured 3 times in the old-field. All except one feeding site (a woods ecotone site) were visited by *Peromyscus*.

DISCUSSION

Peromyscus were involved in removal of all fruit species. This was evidenced by trapping data and observation of fecal pellets on several feeding sites. The 2 species of *Peromyscus* in western Ohio, *P. leucopus* and *P. maniculatus*, have different habitat preferences, with *P. leucopus* preferring the shrub and tree seral stages and *P. maniculatus* choosing the annual-biennial stage (Baker 1968, Dice 1968). *P. leucopus* is semi-arboreal (M'Closkey and Fieldwick 1975) and fleshy fruits constitute the bulk of its food during summer months in the eastern United States (Hamilton 1941). Baker (1968) also noted that *P. maniculatus* population densities have been found to decrease markedly near forest or brushy ecotones, indicating active avoidance of such habitats. In the present study, *P. maniculatus* was associated primarily with the old-field and *P. leucopus* with the forest. Interestingly, the fewest mice were trapped in the ecotone habitats. This distribution pattern appears to have been associated with slower fruit removal rates in the woods ecotone.

Willson (1974) found a correlation between low foliage height diversity and low bird species diversity in early old-fields and grasslands. Birds find it difficult in such

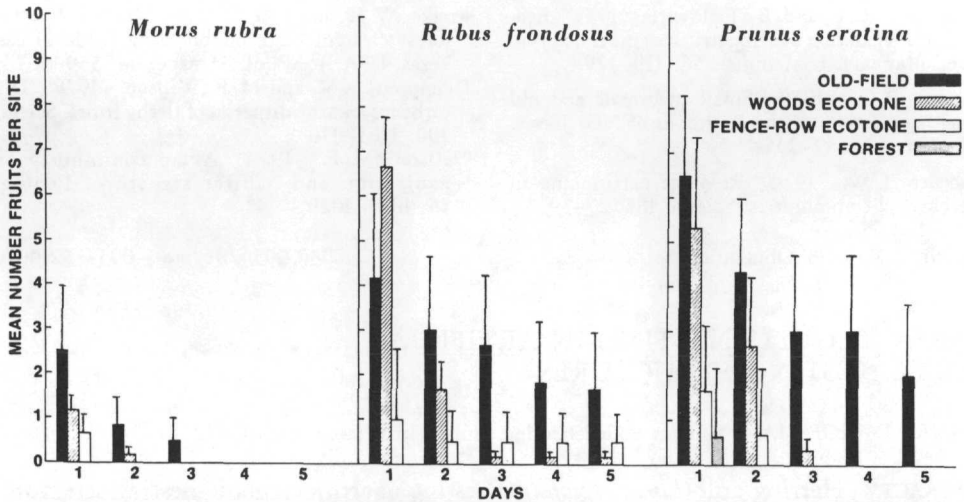


FIGURE 1. Mean number of fruits remaining per site in each habitat. Each bar represents a mean of replicate values. Each line represents one standard error.

areas to vertically partition the habitat, which increases competition and encourages low density and low diversity (Cody 1968, Schoener 1974, Willson 1974). This could have been a contributing factor to slow fruit removal in the old-field. Forest edge habitats, however, frequently harbor relatively high densities and diversities of bird species (Johnston and Odum 1956, Willson 1974, Strelke and Dickson 1980). Furthermore, frugivorous birds typically frequent such habitats since food sources (e.g., *Rubus*, *Prunus*, *Phytolacca*, *Morus*, and *Vitis*) are forest-edge and advanced old-field species (Bond 1957, Thompson and Willson 1978). Therefore, one would have expected the 2 ecotone habitats to have exhibited the most rapid rate of fruit removal of the 4 habitats studied. This was not observed.

In summary, our study illustrates the importance of habitat structure in relation to removal of fleshy fruit resources. *Peromyscus* played a more important role than birds in the removal of fruits and may have a significant effect on seed dispersal. Thompson and Willson (1978) commented on the evolutionary relationship between temperate fruits and birds concerning community organization. The evolutionary

role of small mammals concerning the distribution of fleshy fruit-bearing plants merits future investigation.

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