# Diptera Community Composition and Succession Following Habitat Disturbance by Wildfire[1]

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## Extended Abstract

## Introduction

Both biogeographic (for example, latitude) and local (for example, soil) processes determine composition and succession of biotic communities. Postfire succession of vegetation has been studied intensively in chaparral and coastal sage scrub. Fewer studies have examined postfire succession of animals, even though fires can drastically alter their abundance and diversity (Ahlgren and Ahlgren 1960, DeBano and others 1998). Work on response to fire has focused on vertebrates, with few studies on insects, several yielding conflicting results. Little is known about community ecology of Diptera. Flies exhibit high alpha-diversity, show remarkable variation in foods and habitats (occupying every trophic level), and are highly vagile (recolonization is likely to occur quickly). Studies of arthropod succession are important for understanding mechanisms that determine community structure, which can be critical to land management, conservation, and reserve design (Kremen and others 1993).

We examined Diptera community differences between burned and unburned sites at family and guild levels. We focused on a mid-successional period (2.5 to 4 yr after a burn). Full recovery of burned sage scrub requires 5–10 yr and may never equal the preburn state (Westman 1981). We hypothesized that (1) Diptera communities differ qualitatively between burned and unburned plots; (2) recolonization occurs in a predictable order of scavengers, animal feeders (predators, parasitoids, and hematavores), plant feeders (pollinators and herbivores), and detritivores; (3) local-scale processes drive short-term vegetation recovery because many sage scrub shrubs reestablish from rootstock and seeds that survive fire; and (4) geographic-scale processes drive Diptera community reestablishment because flies recolonize from surrounding intact areas, not from the disturbed site itself.

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## Methods

We sampled 12 burned and 12 unburned plots (50-m diameter) in coastal sage scrub at the Southwestern Riverside County Multispecies Reserve at Lake Skinner, California, following a 1993 fire. We quantified vegetation using standard point-intercept and line-transect methods. We sampled arthropods at 3-month intervals from March 1996 to December 1997 using malaise traps (1 trap/plot/sampling period), vacuums (5 transects/plot/period), and pitfalls (7 traps/plot/period). Specimens were identified to family and classified into foraging guilds.

Fluctuations in family richness over time did not differ between unburned and burned plots (profile analysis; $P > 0.15$, $n = 8$ samples), so data were pooled by site across sampling periods. Differences between unburned and burned plots in vegetation and Diptera were tested with MANOVA (multiple analysis of variance)**.** The association between vegetation and Diptera abundance was determined with Mantel tests. The pattern of Diptera recolonization was inferred using isotonic regression of mean percent correct classification from discriminant function analyses (DFA) for each family ($n = 36$). Means and SEs were calculated by guild ($n = 7$). Our $H_0$ was *discrimination of plots is equal across guilds;* our ordered expectation $H_A$ was *detritivores ≥ pollinators ≈ herbivores ≥ predators ≈ parasitoids ≈ hematavores ≥ scavengers, with at least one strict inequality.*

## Results

A total of 12,437 individual flies in 46 families were collected, with Chironomidae by far the most abundant family collected. Because of potential swamping, malaise-collected Chironomidae were excluded from analyses. The next best represented families were Cecidomyiidae, Anthomyiidae, Tipulidae, Empididae, Chloropidae, and Phoridae.

Burned and unburned plots differed significantly in vegetation structure and composition (MANOVA, Wilks' $\Lambda = 0.12$, $P < 0.01$), but community composition of Diptera did not differ between plots at the level of family (Wilks' $\Lambda = 0.07$, $P > 0.5$) or guild (Wilks' $\Lambda = 0.48$, $P > 0.05$). Nevertheless, there was a strong association between vegetation and Diptera families (Mantel standardized $r = 0.28$, $P < 0.02$) and guilds ($r = 0.22$, $P < 0.05$). Scavengers occupied burned sites with roughly equal frequency as unburned, so their abundance was a poor discriminator of plot type; detritivores were much more abundant on unburned sites and were better discriminators of plot type (*table 1*). Our data supported the recolonization sequence we predicted for Diptera guilds ($S = 6.38$, $P < 0.05$), underscoring the unequal (but predictable) recovery rates.

## Discussion

Dipteran communities recovered quickly from impacts of fire, consistent with previous studies of overall insect abundance (Force 1981, Moya-Raygoza 1995) and Diptera in particular (Delettre 1994). Burned sites were indistinguishable from unburned sites in overall community, with common generalist feeders and scavengers equally represented; Lomonaco and Almeida (1995) reported the same pattern. Similarity across plots resulted from similarity in abundance of dominant fly

families; presence/absence data may yield different interpretations of community equality (Patten and Rotenberry 1998) but an ordination with such data produced comparable results in our case.

We detected a distinct, predictable pattern of guild recolonization following a successional sequence from scavengers to animal-feeders to plant-feeders to detritivores. Our results support the hypothesis that the key to community structure is extrinsic biogeography rather than intrinsic local processes (Cornell and Lawton 1992). Local processes play an important role (abundances of some families differed markedly). These processes probably include microhabitat (Tolbert 1975) and relative amounts of shrubs and herbs (Bährmann 1984), which affect guilds (and thus families) differently.

**Table 1—***Percent correct classification of burned and unburned plots using discriminant function analysis. Means were calculated across families within each guild (thus the different sample sizes for each guild). The ordered expectation of isotonic decrease is significant (0.01 < P < 0.05).*

| Diptera guild | Mean % (± SE) correctly classified | Sample size per guild ($n_i$) |
|---|---|---|
| detritivore | 60.1% ± 2.6 | 14 |
| pollinator + herbivore | 54.2% ± 3.0 | 9 |
| predator + parasitoid + hematavore | 50.4% ± 4.7 | 12 |
| scavenger | 45.1% ± 6.8 | 11 |

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