A COMPARISON OF UNDERSTORY BIRD COMMUNITIES IN SUCCESSIONAL STAGES OF A TROPICAL WET FOREST

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ABSTRACT (DBZ)

We compared understory avian abundance and diversity, and food resource availability among three secondary growth habitats (0-2 years old, 3-5 years old, and 35 years old). We used mist nets to sample bird populations and visual observation to count food resources (arthropods, fruit, flowers, and seeds). The number of birds captured per net hour was highest in the 3-5 year old habitat, relatively high in the 0-2 year old habitat, and very low in the 35 year old habitat. Avian biomass, species richness and diversity followed this trend as well. Food resource levels were high in 0-2 year old habitat, moderate in the 3-5 year old habitat, and low in 35 year old habitat. The incongruity between bird abundance and resource availability suggests that other factors also influence avian habitat selection.

Key Words: foraging guilds, oscines, sub-oscines, secondary forest, mist nets, resource abundance.

INTRODUCTION (DJG)

Tropical, lowland wet forests support some of the richest avifauna in the world (Karr, 1990). Within this ecosystem avian communities vary with changing forest structure. This variation could be due to differences in resource availability among different forest age-classes.

Previous studies have shown that understory bird abundance and diversity are greater in early successional forest habitats than in older growth (Field et al., 1993 FSP; Berry et al., this volume). This difference in community structure could reflect the resource availability within a given forest habitat. For example, Berry et al. (this volume) found that herbivorous arthropods were more abundant in early successional gap habitats than in adjacent late secondary growth. Similarly, other resources, such as fruit and nectar, may vary along this gradient and affect the relative abundance of birds in a given habitat.

This study investigated the relationship between understory bird abundance, diversity, and resource levels within three different successional habitats. If bird populations are responding to resource levels, than one would expect habitats with more food to support more birds. In addition, one would expect the relative abundance of individuals in a particular foraging guild to correspond to the abundance of that guild's food resource.

METHODS (PDH)

This study was conducted 12-15 February, 1994, in the vicinity of the successional plots at La Selva Biological Station, Costa Rica (Figure 1). We sampled understory bird communities in three habitat types: zero to two year old second growth, three to five year old secondary growth, and 35 year old secondary growth. The youngest habitat was characterized by dense tangles of vines, Heliconia, and saplings, with maximum canopy height of 2-4m. Three to five year old forest reached a height of 5-15m, and had the beginnings of a canopy. Understory vegetation in this habitat consisted of larger woody stems and a less dense herbaceous layer. Old, secondary forest had a definite canopy layer at 20-30m, but the understory was sparse, consisting of small palms.

Understory bird populations were sampled using ten 12 x 2.5m mist nets. Nets were left open from roughly 07:00 to 12:00 and checked every half hour for the presence of birds. Distribution of nets and sampling times varied among habitats on days of the study (Table 1). All nets were moved between sampling periods. A tail feather was clipped on each captured bird before release to allow us to recognize recaptures later in the study.

Bird capture data was prepared for analysis by dividing numbers of birds by the number of hours that nets were open and intercepting birds. The resulting value, individuals per net hour, is a standard measure of avian abundance in studies using mist nets (Wunderle et al., 1987). Captured species were assigned a mass and foraging guild (frugivore, nectarivore, insectivore, omnivore) based on Stiles and Skutch (1989). Biomass and guild abundance were also standardized per net hour for comparisons among habitats. The Shannon-Wiener diversity index was calculated for each habitat.

Resource abundance was sampled along five 10m transects in each habitat. Fruit, seeds and flowers potentially usable by birds were counted in a 1m strip along these transects. Arthropods were counted by examining foliage for one and a half minutes at each of 10 stations spaced 1 meter apart along the transect. These samples were summed to yield an estimate of arthropod abundance for the transect.

All inter-habitat comparisons were analysed with Kruskall-Wallis tests. Mann-Whitney U-tests were used if only two habitats were being compared.

RESULTS (MEB)

We captured significantly more birds per net hour in the early second growth habitats than in old secondary growth habitats (Kruskal-Wallis $H_2 = 8.00$, $p = 0.018$; Table 2).

Table 1. Mist net sampling effort.

	12 Feb	13 Feb	14 Feb	15 Feb	Total
Time nets opened	06:50	07:15	07:00	07:15	
Time nets closed	11:20	11:30	13:00	12:15	
0-2 year old forest					
# nets	2	3	3	3	
# net hours	8.5	10.25	16.5	13	48.25
3-5 year old forest					
# nets	1	3	3	3	
# net hours	4.4	12.5	16.5	14	47.4
old second growth					
# nets	7	4	4	4	
# net hours	30.9	13.5	22.5	19.25	86.15
Total Net Hours	43.8	36.25	55.5	46.25	181.8

Table 2. Abundance and diversity of understory avifauna.

	Successional Stage		
	0-2 Year	3-5 Year	Old Secondary
Mean # of birds captured/net hour	0.74	0.99	0.25
Mean biomass(a) capture/net hour	18.5	23.6	5.7
Species richness (total # of species captured)	16	22	10
Shannon-Wiener * diversity index	2.42	2.84	2.17

$$*H' = -\sum_{i=1} [Pi * \ln Pi], \quad Pi = \frac{\text{\# of individuals of species i}}{\text{Total \# of individuals}}$$

Capture rates were highest in 3-5 year old secondary growth, slightly lower in 0-2 year old secondary growth ($U = 4.0$, $p = 0.248$), secondary growth. This general trend was also followed by avian biomass, species richness, and diversity, with highest values in 3-5 year old secondary growth, slightly lower values in 0-2 year old secondary growth, and very low values in old secondary growth (Table 2).

Of 30 total species captured, 20 were found only in young (0-5 year old) secondary growth, five only in old secondary growth habitats and five were captured in both young and old habitats. Eleven species were captured in both 0-2 and 3-5 year old secondary growth habitats (Appendix 1). We captured four frugivorous, seven nectivorous, eleven insectivorous, and eight omnivorous species. All four foraging guilds followed the same general trends in abundance and biomass (Table 3).

Fruits, flowers, and insects were all most abundant in 0-2 year old secondary growth, at intermediate abundance in 3-5 year old secondary growth, and least abundant in old secondary growth (Figure 2). We found a total of 347 seeds in two of our five 0-2 year old transects, and no seeds in any of the older secondary growth transects.

DISCUSSION (HMF)

Our results support the hypothesis that avifaunal communities vary in abundance and diversity between early successional and old second growth forests. Surprisingly, the greatest number of birds and the greatest capture rate were not found in the earliest successional habitats where the greatest abundance of resources was found. Rather, the mid-successional plots

Table 3. Abundance of foraging guilds in three forest age classes.

	Mean # of captures per net hour			Mean biomass captured per net hour		
ForagingGuild	0-2yr	3-5yr	Old	0-2yr	3-5yr	Old
Frugivore	0.28	0.28	0.07	4.1	4.1	2.0
Nectivore	0.12	0.18	0.03	0.6	1.1	0.2
Insectivore	0.10	0.23	0.07	1.9	4.7	1.6
Omnivore	0.24	0.29	0.04	11.9	13.7	2.0

supported the greatest avifaunal activity in terms of total birds caught, birds per net hour, bird biomass per net hour and species diversity. Therefore, it appears that additional factors are involved in habitat selection.

Through observations, we noticed that the 3-5yr growth had already developed some vertical stratification. Karr (1990) suggests that this structural complexity, linked with resource availability, attracts an abundant and species rich community. Further analysis of basal area, stem density and foliage height diversity would solidify our observations and quantify the structural complexity of each habitat.

Old secondary growth and early successional growth supported quite distinct avian communities. We cannot ascertain whether the five species that overlapped are utilizing the different habitats each for different reasons (i.e. food vs. nesting) or whether their ranges merely encompass both habitats.

The greatest representation of each foraging guild was in the 3-5yr habitats. However, it is unclear whether individuals were all foraging at the time of capture (for example, a manakin mating lek was heard near one net).

Further studies should examine bird communities and resources on a seasonal basis as frugivores and nectivores must migrate to take advantage of patchy and temporally variable food resources. Nets set up in larger plots would also reduce the effects of overlapping territories. Continuing these studies could improve our understanding of the effects of deforestation and habitat degradation on tropical bird communities and lend insight into possible results of conservation efforts.

Appendix. Birds captured, guild affiliation, and habitats in which they occured. (Guilds: O = omnivore, N = nectarivore, I = insectivore, F = frugivore).

Common name	Guild	0-2	3-5	old 2°	Common name	Guild	0-2	3-5	old 2°
Grey-chested dove	O	x	x		Bronzy hermit	N		x	
Band-tailed barbthroat	N	x	x		Long-tailed hermit	N	x	x	x
Little hermit	N			x	Crowned woodnymph	N	x	x	
Rufous-tailed hummingbird	N	x	x		Bronze-tailed plumeleteer	N		x	
Black-throated trogon	O			x	Wedge-billed woodcreeper	I			x
Slaty antshrike	I		x		Dusky antbird	I	x		
Black-faced antthrush	I			x	Ochre-bellied flycatcher	F			x
Northern bentbill	I		x		Yellow-bellied flycatcher	I		x	
White-collared manakin	F	x	x	x	Red-capped manakin	F	x		x
Black-throated wren	I	x	x		White-breasted woodwren	I		x	x
Swainson's thrush	F		x		Wood thrush	O	x	x	
Clay-colored robin	I		x		Ovenbird	I	x	x	
Kentucky warbler	I	x	x		Scarlet-rumped tanager	O	x	x	
Buff-throated saltator	O	x	x		Blue-backed grosbeak	O		x	x
Orange-billed sparrow	O	x	x		Variable seedeater	O	x		

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