

# TWO CAN PLAY THIS GAME: A STUDY OF TOUCAN DOMINANCE IN THE FRUGIVOROUS BIRD COMMUNITY AT LA SELVA, COSTA RICA

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*Abstract:* Species co-occurrence in the tropical rainforest could be understood in terms of either equilibrium or non-equilibrium models. Stable equilibrium models postulate that communities are structured, for example by niche partitioning and dominance hierarchies. We proposed that the Chestnut-mandibled Toucan (*Ramphastos swainsonii*) would be behaviorally dominant in the avian frugivore community of La Selva, Costa Rica. We observed 15 interspecific and 8 intraspecific, toucan-initiated aggressive incidents, but there was no statistical support for a dominance hierarchy. However, our study was conducted during the dry season when fruit is relatively abundant. It remains possible that Chestnut-mandibled Toucans actively displace other avian frugivores in the wet season when fruits are limiting. Niche-partitioning was implied by the uneven distribution of non-toucan frugivores. Our study introduces a base-line data set, based on over 29 hours of toucan observation, that may provide a foundation for future toucan research at La Selva.

*Keywords:* community structure, *Ramphastos swainsonii*, *R. sulfuratus*, *Pteroglossus torquatus*, species coexistence

## INTRODUCTION

How so many similar species can co-occur in the tropical rainforest is one of the oldest questions in ecology. The traditional explanation has been that species coexist in a stable equilibrium, which requires some form of community structure. This is typically thought of as niche partitioning, in which species minimize competition through spatial or temporal partitioning of resources. At the other extreme, Hubbell (2001) has proposed a neutral model in which many species co-occur via slow random walks of abundance that inevitably

lead to extinction, but at a rate roughly equal to that of speciation. A related theoretical possibility is that communities can be structured into dominance hierarchies, in which the presence of a dominant species interferes with the natural behavior of others. However, dominance hierarchies raise the question of why the dominant species does not competitively exclude other species to extinction. Thus, dominance is expected to be linked to some other factor that limits the success of the dominant species, such as increased predation or decreased efficiency in locating food sources.

We tested for structure within a guild of the avian community at La

Selva Biological Research Station on the lowland Caribbean slope of Costa Rica. Specifically, we tested for the presence of a dominance hierarchy among avian frugivores, focusing on Chestnut-mandibled Toucans (*Ramphastos swainsonii*), which are reported to displace smaller frugivorous birds in fruiting trees (Janzen 1983; Stiles and Skutch 1989). If the bird community is structured by some form of resource partitioning, we should see a non-random distribution of birds that does not change in the presence or absence of toucans. If instead, toucans are the dominant species in a hierarchy, sub-dominant species will be distributed non-randomly with respect to the presence or absence of Chestnut-mandibled toucans.

## METHODS

On 18-20 February 2008, we searched for *R. swainsonii* on the trails of La Selva Biological Station, Costa Rica. Once we found a group of toucans, we visited the site again at a later time to increase the chances of finding them for additional observations.

We conducted opportunistic scans at 3-minute intervals of all visible frugivores in a tree or group of trees (tree stands), noting species, location (top, middle, or bottom of tree canopy), and bird activity (sitting, eating, flying, resting).

Aggressive interactions between birds were noted. Because toucans did not typically aggregate in a single tree, we observed all trees in which toucans were present.

We recorded when birds left tree(s), and stopped observations after all toucans had flown away. We watched the tree(s) for a 10-minute interval immediately afterwards, noting all species' arrivals, their locations, and activities. After these 10 minutes, we returned an hour later and conducted a final 5-minute scan of the site.

Because foraging flocks containing *R. swainsonii* often contained Keel-billed Toucans (*R. sulfuratus*) and Collared Aracaris (*Pteroglossus torquatus*) as well, we grouped *R. swainsonii*, *R. sulfuratus* and *P. torquatus* (toucans) together for our analysis. We assumed that, with similar feeding habits and strategies, these three species of the toucan family (Ramphastidae) would exert a similar effect on other frugivorous birds. We limited our analysis of non-toucan bird species spatial preferences to those species with more than 6 observations.

## RESULTS

We found a total of 10 foraging groups containing Chestnut-mandibled Toucans (*R. swainsonii*), Keel-billed Toucans (*R. sulfuratus*), and/or Collared Aracaris (*P. torquatus*). Of all toucan groups

observed, 7 were mixed-species flocks while 2 were of only Chestnut-mandibled Toucans and 1 was of only Collared Aracaris (Table 1). We observed the 10 toucan groups across a total of 26 distinguishable tree stands and found them most often in the early morning (06:00 – 07:00) and late afternoon (15:00 – 17:00), up the station entrance road

to the north and along the forest edge near the Almendro lab. We observed Chestnut-mandibled Toucans for 876 observation-minutes, Collared Aracari for 625 observation-minutes and Keel-billed Toucans for 265 observation-minutes. The total observation time was 29 hrs.

Table 1. Summary of toucan observations with respect to duration, flock composition, and number of aggressive interactions at La Selva Biological Station, Costa Rica. Interspecific aggressive interactions include those with non-toucan birds.

Flock number	Date & Time	Duration in tree stand (min.)	Toucan flock composition (max. number/scan)			# Aggressive interactions	
			Chestnut-mandibled Toucan	Keel-billed Toucan	Collared Aracari	Inter-specific	Conspecific
1	2/18 8:33-8:37	4	5	1	1	3	-
2	2/18 9:05-9:17	12	-	-	10	-	1
3	2/18 15:00-15:27	27	2	-	4	6	-
4	2/18 16:26-17:04	28	1	-	11	3	2
5	2/19 6:29-6:34	5	-	-	3	-	-
6	2/19 6:04-6:15	9	3	-	5	-	-
7	2/19 6:45-6:50	5	-	1	5	-	-
8	2/20 6:01-7:05	64	11	4	-	1	5
9	2/20 6:11-6:16	5	2	-	-	2	-
10	2/20 6:42-6:53	11	3	-	-	-	-
<b>Total</b>		<b>170</b>	<b>27</b>	<b>6</b>	<b>39</b>	<b>15</b>	<b>8</b>

We also observed a total of 16 other frugivorous bird species (non-toucan species), of which we were able to positively identify 6 (Table 2). Montezuma Oropendolas (*Psarocolius montezuma*) were the most common (present in 122 bird scans), implying that they have high local abundance relative to the other 16 species and/or are more likely to use the same resources as toucans.

Table 2. Number of bird scans (154 total) that included each identified bird species La Selva Biological Station, Costa Rica.

Species	Number of bird scans
Montezuma Oropendola ( <i>Psarocolius Montezuma</i> )	122
Bananaquit ( <i>Coereba flaveola</i> )	15
Red-lored Parrot ( <i>Amazona autumnalis</i> )	10
Crested Guan ( <i>Penelope purpurascens</i> )	4
Mealy parrot ( <i>Amazona farinose</i> )	4
Scarlet-rumped Tanager ( <i>Ramphocelus passerinii</i> )	3

Of 6 non-toucan species tested, 5 were unevenly distributed among the top, middle, and bottom of tree canopies. Most birds preferred the middle (406 observations) and top (380) of tree canopy over the bottom (102). This distribution was unaffected by the presence or absence of toucans ( $\chi^2 = 0.89$ ,  $df = 2$ ,  $P = 0.005$ ). Additionally, non-toucan birds were equally likely to be in a tree with or without toucans present ( $\chi^2 = 0.02$ ,  $df = 1$ ,  $P = 0.89$ ). Roughly half (13 of 27) of our observations of non-toucans feeding were in the presence of toucans. However, toucans spent 30% of their time in trees feeding, which was more than twice as often as other birds (Pearson  $\chi^2 = 14.16$ ,  $df = 2$ ,  $P = 0.0002$ ). The three toucan species did not differ in time allocation between behaviors (sitting, flying, resting, eating; Pearson  $\chi^2 = 2.50$ ,  $df = 6$ ,  $P = 0.87$ ).

Although our analyses found no statistical evidence of toucans affecting the presence, distribution or activity of other birds, our

observations did include 15 instances of toucans engaged in interspecific aggressive behavior. Chestnut-mandibled Toucans were the main aggressors, instigating 11 interspecific confrontations in 876 observation-minutes. There were also 8 occurrences of intraspecific aggression: 5 among Chestnut-mandibled Toucans and 3 among Collared Aracaris. Chestnut-mandibled Toucans were also seen in displays of dominance over other toucan species: there were 6 instances of Aracaris displaced by a Chestnut-mandibled Toucan, and 3 instances of Keel-billed Toucan displacement. The most frequent victim of aggression from toucans was the Montezuma Oropendola (4 out of 8 interspecific incidents). On one occasion, we observed a Keel-billed Toucan chase an Oropendola from its branch, only to be chased away moments later by a Chestnut-mandibled Toucan.

## DISCUSSION

The spatial distribution of non-toucan birds remained constant regardless of toucan presence and absence, which is inconsistent with the hypothesis that toucans are dominant over other birds. Feeding frequency of frugivores was also unaffected by toucan presence or absence, indicating that toucans do not prevent other birds from foraging. The overall uneven spatial distribution of bird species suggests that all birds prefer similar areas within a tree (potentially because that is where the fruits are), and indicated that toucans do not dominate this community. In other words, two (or more) species can play the "game" of coexistence.

In this tropical rainforest, fruits are more abundant during the dry season than during the wet season. Our study was done during the dry season. It is possible that toucans do not need to exert dominance over other bird species when food is not limiting. Because of their larger size, toucans may require more nutrients for survival and therefore need tighter control over limited food resources in the wet season. Studies examining toucan dominance, foraging behavior, and food availability in the wet season could evaluate the effect of seasons on community structure.

The high incidence of displacement of Aracaris and Keel-

billed Toucans by Chestnut-mandibled Toucans suggests that a dominance hierarchy may exist among these three species. These species have similar diets (Stiles and Skutch 1989), and it may be more efficient for Chestnut-mandibled Toucans to exclude close competitors than to expend energy excluding all frugivores in the avian community.

To our knowledge, there have been no previous Dartmouth studies of the potential role of toucans in structuring the frugivorous bird community at La Selva. Our study provides a set of base-line data on toucans, including flock size and behavior, which may be used for future studies involving toucan species.

## LITERATURE CITED

- Stiles, F. G. and Skutch, A. F. 1989. A guide to the birds of Costa Rica. Comstock Publishing Associates, Ithaca, New York, USA.
- Janzen, D. H. 1983. *Ramphastos swainsonii*. Pages 603 - 604 in D.H. Janzen, editor. Costa Rican Natural History. University of Chicago Press, Chicago, Illinois, USA.