

Fruit dispersal syndromes in animal disseminated plants at Tinigua National Park, Colombia

Síndromes de dispersión en plantas dispersadas por animales en el Parque Nacional Tinigua, Colombia

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ABSTRACT

Fruit dispersal syndromes (groups of plants with similar fruit morphology, presumably adapted to dispersal by a particular set of vectors) have been described in a variety of tropical localities. In some cases the presence of different syndromes in each locality suggests independent evolution of fruit traits in response to selective pressures imposed by the particular animal community in each place. However, it is still unclear how general are fruit syndromes, and this is important to understand the evolution of mutualistic relationships. We compiled morphological information from about 500 fleshy fruited species at a lowland Neotropical forest in Tinigua National Park, Colombia, in an effort to test for the existence of fruit dispersal syndromes. We found that about two thirds of the plant genera analyzed could be classified in two different fruit types (large, protected, dull colored fruits, versus small, unprotected, bright colored fruits). These two syndromes correspond to the mammal and bird dispersal syndromes originally described at Cocha Cashu Biological Station, Peru. Two years of field observations on several fruiting plants revealed close associations between these fruit syndromes and the presumed animal dispersal vector. Our results support the idea that fruit dispersal syndromes are more general in Neotropical forests than previously inferred. However, we caution that similar syndromes found at Cocha Cashu and Tinigua may be a consequence of the floristic resemblance of both regions, and may not necessarily imply an independent case for the evolution of mammal and bird dispersal syndromes. Therefore, additional studies of fruit syndromes and biogeographical analyses would be necessary to assess how general are dispersal syndromes in the Neotropics.

Key words: fruit syndromes, fruit morphology, Neotropical forests, convergent evolution, frugivory.

RESUMEN

Los síndromes de dispersión de frutos han sido descritos para diferentes bosques tropicales. En algunos casos la presencia de diferentes síndromes de dispersión sugiere la evolución independiente de características morfológicas de los frutos como respuesta a presiones de selección particulares. Sin embargo, hasta el momento hay evidencias contrastantes sobre qué tan generales son estos síndromes. Este estudio reúne la información morfológica de aproximadamente 500 especies de plantas con frutos carnosos, en el Parque Nacional Tinigua, Colombia, en un esfuerzo por encontrar síndromes de dispersión de semillas. Alrededor de dos tercios de los géneros de plantas analizados se pueden agrupar en dos categorías: (frutos grandes, con protección y colores opacos; y frutos pequeños, sin protección y de colores llamativos), que corresponden a los síndromes de dispersión por mamíferos y aves descritos por Janson (1983) en Cocha Cashu, Perú. Nuestros resultados apoyan la idea que los síndromes de dispersión endozoocórica son más generalizados de lo que se había planteado anteriormente. Consideramos que la similitud en los resultados obtenidos en este estudio y en el Perú no necesariamente implica evolución independiente de los síndromes de dispersión, porque las floras de estos lugares son bastante similares. Por lo tanto, más estudios de este tipo son necesarios para entender mejor qué tan generales son los síndromes de dispersión en bosques Neotropicales.

Palabras clave: síndromes de dispersión, morfología de frutos, bosques Neotropicales, evolución convergente, frugivoría.

INTRODUCTION

The process of seed dispersal by frugivores is a common interaction in almost every ecosystem and involves a large number of animal and plant species (Ridley 1930, Pijl 1972). For example, Neotropical rainforests animals disperse seeds of 50 % to 90 % of the plant species (Gentry 1988, Chapman 1995, Voss & Emmons 1996). The close ecological relationships that exist among some plant and animal species suggest that they have been subject to mutual selective pressures in the past (Janzen 1983). However, no specialized relationships, as required for species-to-species coevolution (Thompson 1994), have been convincingly documented in seed dispersal systems (Witmer & Cheke 1991).

Recent studies suggest that there are constraints on the evolution of fruit morphology (Howe 1984, Herrera 1985, 1986, Wheelwright 1988), and that dispersal systems have evolved mainly by diffuse coevolutionary processes (Janson 1983, Janzen 1983, Herrera 1985). First of all, different selective forces may act in every stage of a plant's life cycle (Schupp 1995) and this complex web of potential forces may limit co-evolutionary trends between plants and frugivores. Furthermore, other studies have shown that fruit shape could be associated with phylogenetic inertia and developmental constraints (Jordano 1995). Finally, some authors emphasize low heritability for the evolution of fruit traits (i.e., Obeso 1993). Consequently, diffuse coevolution is now considered as the main process affecting seed dispersal systems. This type of evolution might have produced different dispersal syndromes or associated morphological traits that could have evolved independently as adaptations for a particular seed disperser agent (Pijl 1972, Janson 1983).

Dispersal syndromes have been defined for groups of plant species with similar seed dispersal strategies, and the most general strategies involve completely different dispersal agents (Ridley 1930, Pijl 1972). For example, in a Peruvian rainforest, Janson (1983) found associations among three morphological fruit characters: size, color, and protection. Two-thirds of the fruits had one of two character complexes matching the morphological characteristics of mammals and birds. In particular, large, dull colored fruits (orange, yellow, brown or green) with a husk, were associated with primate dispersal, while small, bright colored fruits (red, black, white, blue, purple, or with mixed colors), without a

husk, seemed suitable for bird dispersal. However, the generality of these two dispersal syndromes for tropical forests remains to be demonstrated.

Gauthier-Hion et al. (1984) found one syndrome for bird and primate fruits in an African forest and a second syndrome for seed dispersal by other mammal species. Fruits dispersed by birds and primates were associated with no pre-dispersal predation; yellow, orange, red or violet colors; less than 50 g, and succulent arils with soft or no protection. In contrast, fruits dispersed by ungulates, rodents, and elephants had pre-dispersal predation; green or brown colors; more than 50 g; fibrous or dry pulp and strong protection. Although, their results differ from Janson's, they support the idea of a syndrome generated by interaction with frugivores that do not occur in the Neotropics. Fisher & Chapman (1993) compiled data on fruit dispersal syndromes from five different tropical sites and found few fruit character associations (i.e., between color and protection). They also found that the flora of New Guinea has a good representation of large, protected fruits, which elsewhere have been associated with primate dispersal, despite the lack of evidence of primate occupation of the island in the past. It is known that the largest fruits in New Guinea are consumed by cassowaries, hornbills, and flying foxes¹, but without knowledge of their dispersal efficiency, it is difficult to predict which fruit syndromes might have evolved in the island and to validate New Guinea's data as evidence of uncoupled diffuse coevolutionary paths. Interestingly, in a different region with a reduced number of seed dispersers, a particular mistletoe species in the Loranthaceae (a family characterized by colorful fruits dispersed by birds) has green fruits and is exclusively dispersed by a marsupial (Amico & Aizen 2000). This study again suggests that different fruit syndromes might evolve in response to particular dispersal agents.

Fruit syndromes have been analyzed using a variety of methods (i.e., Knight & Siegfried 1983, Dowsett-Lemaire 1986), which is an additional problem to assess how widespread are they. For example, Fisher & Chapman (1993), excluded fruits with mixed colors from their analyses and these methodological differences might explain some contrasts found

¹ MACK A & D WRIGHT (2002) The frugivore community and the fruiting plant flora in a New Guinea rainforest. *Tropical Forest: Past, Present, Future*: 69pp. Annual Meeting of the Association for Tropical Biology, Panamá City, Panamá.

when comparing fruit syndromes among tropical sites.

The main purpose of this work was to assess dispersal syndromes in the flora of Tinigua National Park, Colombia. Furthermore, we wanted to verify whether fruits classified in a particular morphological syndrome were actually visited preferentially by the same group of seed dispersers predicted to be associated with the syndrome. Although our results documented two main dispersal syndromes coincident with Janson (1983), we suggest that further studies are necessary to evaluate the general occurrence of these dispersal syndromes in Neotropical forests.

MATERIAL AND METHODS

Study area

This study was conducted at the CIEM (Centro de Investigaciones Ecológicas Macarena), a tropical rain forest in the northwestern Amazon, between the eastern Andes and Sierra de la Macarena, in the Departamento del Meta, Colombia. The CIEM is located on the right margin of Río Duda (2° 40' N, 74° 10' W; 350-400 m of altitude) about 13 km before it reaches the Río Guayabero, and it is part of Parque Nacional Tinigua (Stevenson et al. 1994). Mean annual temperature is around 26 °C, and is relatively constant throughout the year. Precipitation varies between 2,600-2,800 mm annually, with a dry season between December and March and a rainy season between April and November; peak rainfall occurs in June and July (Kimura et al. 1995, Stevenson 2002). There are six basic vegetation types: mature terra firme forest, open canopy terra firme forest, two types of lowland seasonally flooded forest, secondary forest and riparian forest (Hirabuki 1990, Stevenson 2002).

A total of 445 bird species have been recorded at CIEM (Cadena et al. 2000). Many are frugivorous or eat fruits as part of their diet. Curassows, toucans, trogons, parrots, tanagers, manakins, woodpeckers, thrushes and other birds eat fruit regularly. There are seven primate species at the study site: *Ateles belzebuth*, *Lagothrix lagothricha*, *Allouata seniculus*, *Cebus apella*, *Saimiri sciureus*, *Callicebus cupreus* and *Aotus brumbacki* (see Stevenson 2002). All of them eat fruits as part of their diets. There are several other fruit-eating mammals at the CIEM including tayras (*Eira barbara*), tapirs (*Tapirus terrestris*) and some of the 34 bat species reported at the site (Rojas 1997).

Field protocols

We classified fleshy fruits into bird and mammal-dispersed classes following Janson (1983). We selected the plants collected at the CIEM (Stevenson et al. 2000, Stevenson unpublished data) that have fleshy fruits, or can potentially offer a food source to frugivores. Morphological information was taken mainly from the fruit guide of the study site (Stevenson et al. 2000). We made additional fruit measurements in the field during the study period (November 1999-July 2001), and used information from a guide to the fruits of Guyana (Roosmalen 1985). For each plant species with fleshy fruits we recorded its fruit size, color, and protection. Fruit size was either small or large. Fruit size was considered as the smaller dimension between its width and length. Large fruits are those that have a larger dimension than the average fruit size of all the plant species in this study. For capsular fruits, because the capsule is not manipulated by frugivores, we only considered the size of the seeds and fleshy pulp.

We considered the following color categories: red, white, black, blue/purple, green, yellow, brown, orange and mixed colors. A mixed color fruit has at least two different colors when ripe, including its supporting structures. The third morphological character was the presence or absence of protection. Protected fruits were those that presented a distinct hard, non-nutritious layer as a barrier to feeding. Fruits with a soft, flexible skin covering at least 10 % of the external fruit dimension were also considered protected. Otherwise fruits were considered unprotected.

Some studies of the evolution seed dispersal and fruit morphology often focused on the species level, without considering its consequences (see Fischer & Chapman 1993). This may overestimate the number of evolutionary events that led from an ancestral to a derived character (Lord et al. 1995), because phylogenetically related species are not independent unities (Harvey & Pagel 1991). In our study, we used genera as the taxonomic unit to determine the existence of associations between fruit characters (Janson 1983, 1992). We distinguished monomorphic genera (those with only one combination of fruit characters) from polymorphic ones. Each monomorphic genus was considered a basic morphological unit (BMU), and each set of species within a polymorphic genus sharing the same fruit characters was also considered a BMU.

For monomorphic genera, we calculated the percentage of protected genera in each fruit color category. We tested heterogeneity and subset homogeneity (Sokal & Rohlf 1995) to group different color fruits according to their percentage of protection. Afterwards, we tested heterogeneity within each of the subgroups or types obtained. Polymorphic genera were assigned to color groups derived from monomorphic genera analysis. A χ^2 test was used to determine association between fruit color and protection.

Color categories were the following: type A, low percentage of protection and bright colors (white, red, blue, black and mixed colors), and type B, high percentage of protected genera and dull colors (orange, green, yellow and brown). We used a Kolmogorov-Smirnov test to assess differences in fruit size between type A ($n = 300$) and type B ($n = 191$) fruits. We performed this test at the species level, because fruit size varies considerably between polymorphic and monomorphic genera.

All genera were classified dichotomously by size, color and protection which yielded eight possible combinations. We used a G-test of independence (Sokal & Rohlf 1995) to determine associations among fruit traits.

For the BMU having character complexes associated with fruit dispersal by mammals (large, type B color and protected) or birds (small, type A color and unprotected) (Pijl 1972, Janson 1983), we obtained information on visits by frugivores. This information was gathered from previous studies at the CIEM, especially for primates and birds (see Stevenson et al. 2000 and references therein). Observations on more than 75 plant species for more than 3,438 h were carried out to corroborate whether species with a particular syndrome were actually visited by the predicted seed dispersal vector. These observations were conducted mostly between 06:00 and 10:00 h and between 15:00 and 18:00, from a point of good visibility on the ground. Seed removal by nocturnal animals was checked only indirectly (using fruit traps) for a smaller set of plant species ($n = 5$).

RESULTS

We examined 491 plant species, corresponding to 80 % of the fleshy-fruited plants found at the study site. Fruit characters are described in Appendix 1. We found an association between fruit protection and color (Fig. 1). We found heterogeneity in the percentage of protected monomorphic genera ($n = 197$) in each color

category ($\chi^2_{(8)} = 51.5$, $P < 0.001$), but subgroups within each type were homogeneous [type A: ($\chi^2_{(4)} = 4.30$, $P > 0.05$); type B: ($\chi^2_{(3)} = 3.93$, $P > 0.05$)]. Type A and type B color fruits showed differences in the proportion of protected genera ($G_H = 49.4$, $P < 0.001$). Because of the small number of polymorphic genera, we grouped them in type A and type B colors. Fifteen out of the 40 polymorphic genera were grouped in one color category. Of the remaining 25 polymorphic genera, 23 varied in color and two in protection. No genus varied in both traits. From the 23 polymorphic genera, five out of eight protected BMUs are of type B color and 22 out of the 53 unprotected BMUs are of type B color, yielding no statistical association ($\chi^2_{(1)} = 0.53$, $P > 0.05$). In the two genera that vary in protection, one of two protected BMU are type B color ($\chi^2_{(1)} = 0$, $P > 0.05$) and have no significant association between color and protection.

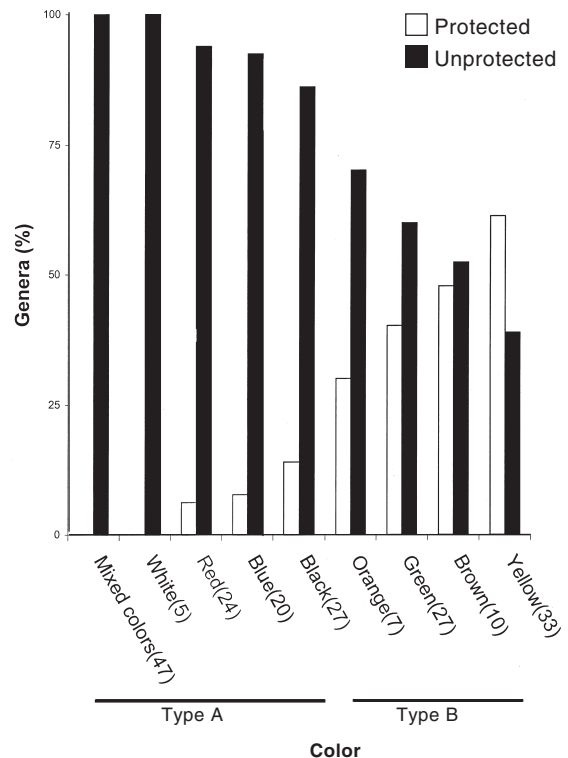


Fig. 1: Percentage of protected and unprotected fruits by different color categories in the flora of Parque Nacional Tinigua, Colombia. The number of monomorphic genera is shown in parenthesis.

Porcentaje de frutos protegidos y sin protección en las diferentes categorías de color, en la flora del Parque Nacional Tinigua, Colombia. Los números en paréntesis corresponden al número de géneros monomórficos.

We found differences in the size distribution between type A and type B fruits (Kolmogorov-Smirnov test $D = 0.507$, $n = 491$, $P < 0.001$) (Fig. 2). Average fruit size was 17.3 mm (range 1-200 mm, $n = 491$). Average size of type A fruits was 11.4 mm on average ($n = 300$), with 87 % of them smaller than the average size of all the fruits analyzed, while type B were 27.2 mm on average ($n = 191$) and 62 % were larger than the overall average. Almost 65 % of all BMUs ($n = 299$) analyzed here belonged either to large, type B and protected or small, type A and unprotected fruits (Table 1). These two character complexes corresponded closely to the fruit morphology of primates and bird dispersal syndromes (Pijl 1972, Janson 1983). The hypothesis of independence between fruit traits

was rejected for the three fruit traits considered in this study ($G_{(4)} = 165.5$, $P < 0.001$) and for each combination any two characters: color and protection ($G_{(1)} = 53.4$, $P < 0.001$); color and size ($G_{(1)} = 70.1$, $P < 0.001$); size and protection ($G_{(1)} = 80.6$, $P < 0.001$).

Out of 299 BMUs, 193 have fruit character complexes associated with either bird ($n = 150$) or primate dispersal ($n = 43$). We observed birds (excluding parrots) eating fruits of 84 BMUs; 76 of them corresponding to type A fruits. Primates were observed eating 83 BMUs; 53 of them corresponding to type B fruits. There was a significant association between the type of disperser (bird or primate) and fruit morphology (Aves: $\chi^2_{(1)} = 7.2$, $P < 0.05$; Primates: $\chi^2_{(1)} = 8.4$, $P < 0.05$).

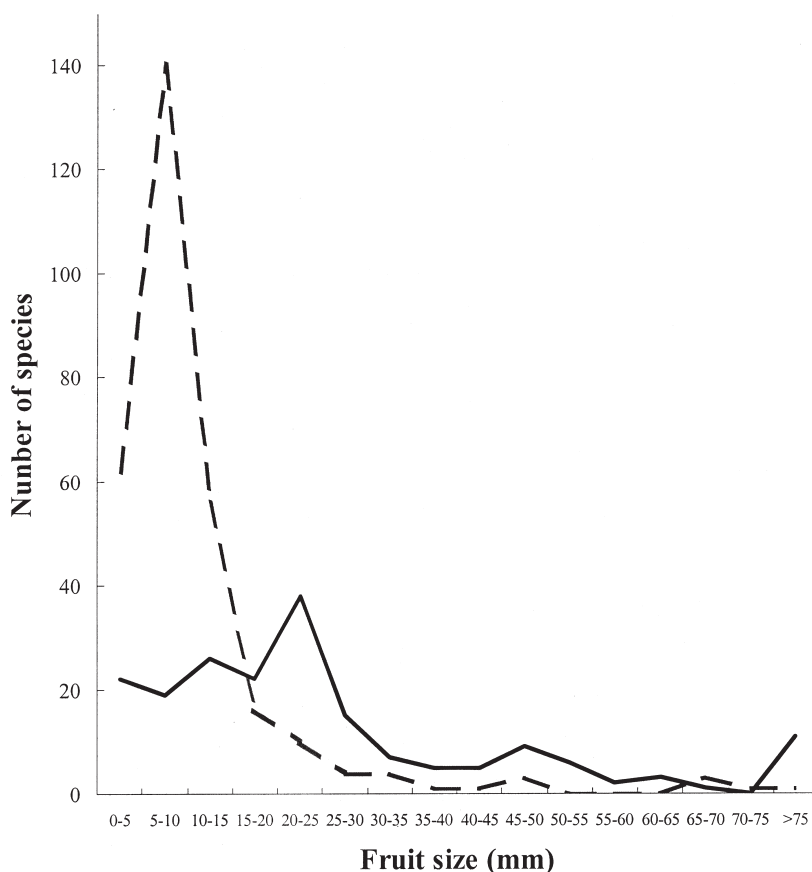


Fig. 2: Fruit size distribution for type A (non-protected and with bright colors) and type B fruits (protected and with dull colors) at Tinigua National Park. The dashed line represents type A fruits and the continuous line represents type B fruits.

Distribución del tamaño de los frutos de tipo A (sin protección y con colores vistosos) y tipo B (protegidos y con colores opacos) en el Parque Tinigua. La línea punteada corresponde a los frutos de tipo A, mientras que la línea continua corresponde a los frutos de tipo B.

TABLE 1

Distribution of BMUs (morphological basic units) into eight possible combinations of three fruit characters (fruit size, color, and protection) for animal dispersed plants at Tinigua National Park, Colombia. Type A and type B colors described in the text. Numbers in parenthesis are expected values assuming independence of characters.

Distribución de BMUs (unidades morfológicas básicas) en las ocho posibles combinaciones de tres caracteres morfológicos de los frutos (tamaño, color y grado de protección), para las plantas dispersadas por animales en el Parque Tinigua, Colombia. Los números en paréntesis corresponden a los valores esperados asumiendo independencia entre los caracteres

Size	Type A color		Type B color	
	Protected	Unprotected	Protected	Unprotected
> 17.3 mm	7 (12.5)	22 (49.7)	43 (7.8)	29 (31.0)
< 17.3 mm	5 (24.4)	150 (97.4)	5 (15.3)	38 (60.4)

DISCUSSION

The main result of this study at Tinigua is that fruit traits such as color, size, and protection are associated with the previously described bird and mammal dispersal syndromes (Ridley 1930, Pijl 1972, Janson 1983). Further, this relationship partly agrees with the use of fruits by the corresponding frugivore vectors. We found that very few bird species (some parrots, curassows, corvids and icterids) consume fruits with the primate dispersal syndrome as the size and protection of these fruits acts as a barrier to access its pulp and seeds. Nevertheless, monkeys frequently consumed fruits with the bird syndrome, and for no plant species did we find good evidence of relying on only one frugivore species for its fruit removal and dispersal. The complex web of interactions between frugivores and plants, including interactions between phylogenetically unrelated taxa do not fit the models of species-to-species coevolutionary process (Thompson 1994). Therefore, diffuse coevolution seems the most likely path for the evolution of these systems, although other non-evolutionary fortuitous events may also have a place. For example, under certain circumstances plant-frugivore interactions can be ecologically strong in spite of the lack of evolutionary history. In particular, the artificial introduction of plant species to new habitats has revealed that local frugivores are able to consume fruits never seen before, resulting in strong plant-animal interactions without evolutionary history (Herrera 1985). Thus, in the absence of a fossil record that could confirm strong interactions in the past, we are limited to describing the

products of evolution and speculating about their potential origins.

Reciprocal evolution between birds and type A fruits seem to be more difficult than that between primates and type B fruits. Because of morphological constraints, many birds in Neotropical rainforests are unable to eat fruits that are either large or have a husk (Wheelwright 1985, Peres & Roosmalen 2002). Only few guilds (i.e., parrots, crows, and icterids) have the ability to manipulate fruits with their feet, breaking up the fruit's husk rather than swallowing the whole fruit. Thus, if the seeds are more efficiently dispersed by primates than by birds, it is likely that plants could evolve husks to limit bird access to the fruit pulp. On the other hand, primates do not have morphological limitations to exploit the majority of fruits in the forest and this seems to be the reason why they exploit both type A fruits and type B fruits. Therefore, even if primates are not very efficient dispersers compared to birds, it would be difficult for plants to evolve morphological adaptations to limit the access of primates. It is possible that plants have used other means to deter fruit consumption by primates, such as chemical composition of fruits. For example, it is known that some families (i.e., Solanaceae) that are predominantly dispersed by bats and birds contain high quantities of secondary compounds in the pulp (Chipollini & Levey 1997b). One of the hypotheses to explain the presence of these compounds in the pulp of fruits is the selection of particular seed dispersal agents (Chipollini & Levey 1997a), and we believe that the inclusion of nutritional analyses could reveal additional fruit dispersal syndromes.

The results about the association of fruit character complexes with particular groups of frugivores, are very similar to those reported by Janson (1983) in the Peruvian rainforest at Cocha Cashu. Both studies found associations between the size, color and presence or absence of protection. At Tinigua and Cocha Cashu, respectively, 65 % and 66 % of the fleshy fruits analyzed are either small, type A colors without a husk; or large, type B colors with a husk. Further, at both sites associations were found between the fruit character complexes and the dispersal agents. Primates and birds tend to consume preferentially those fruits assigned to their particular dispersal syndromes (Pijl 1972, Janson 1983). These results suggest that the primate and bird dispersal syndromes are more general in Neotropical communities than previously inferred (see Fisher & Chapman 1993). However, one possible explanation for this finding could be the similarity in plant and animal assemblages between sites. At least 37 % of the plant species present at Tinigua occur also at Cocha Cashu and this was the second highest percentage of similarity among 18 Neotropical localities compared with the Tinigua flora (Stevenson & Castellanos unpublished data). Animal composition is also very similar, especially birds and mammals. For example, frugivores represent a significant proportion of animal biomass, and primates, tapirs, and peccaries are the most important components at both sites (Terborgh 1983, Stevenson 1996, 2002). The avifauna is also very similar between these sites and the frugivore guild makes up a considerable fraction of avian biomass (Terborgh et al. 1990, Cadena et al. 2000), especially represented by few families such as curassows, tinamous, toucans, trogons and others. This suggests that a great proportion of the avian biomass, at both sites, have fruits as an important item of their diets. Other families of avian frugivores are diverse at these sites, like tanagers and manakins (Terborgh et al. 1990, Cadena et al. 2000). These results confirm the general similarities reported previously for the fauna and flora of western Amazonian forests (Gentry 1988, Voss & Emmons 1996). In summary, at this point it is difficult to argue that the presence of primate and bird dispersal syndromes at both sites was either the result of similar evolutionary histories or of independent evolution driven by similar dispersers. For two Neotropical sites included in Fisher & Chapman's (1993) study, only one showed a significant association of fruit characters corresponding to dispersal syndromes,

therefore more studies of this type for a variety of vegetation types could help to clarify whether bird and primate dispersal syndromes are of general occurrence in Neotropical forests.

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APPENDIX 1

Animal dispersed plant species in Tinigua National Park, that were included in the analyses of dispersal syndromes. The columns show the morphological traits for each plant species. Fruit size refers to the largest dimension of the fruit (width or length)

Listado de las especies de plantas del Parque Nacional Tinigua que fueron incluidas en el análisis de síndromes de dispersión de frutos. Las columnas muestran los caracteres morfológicos de cada especie. El tamaño de los frutos hace referencia a la dimensión mas grande (entre largo y ancho del fruto)

Species	Fruit size (mm)	Color	Protection
<i>Gnetum nodiflorum</i>	27.5	Red	No
<i>Anthurium clavigerum</i>	4	Blue/purple	No
<i>Anthurium eminens</i>	7.5	Blue/purple	No
<i>Anthurium fendleri</i>	5	Blue/purple	No
<i>Anthurium kunthii</i>	5	Blue/purple	No
<i>Anthurium cf. superbum</i>	5	Blue/purple	No
<i>Anthurium gracile</i>	3	Red	No
<i>Caladium bicolor</i>	3	Yellow	No
<i>Dieffenbachia longispatha</i>	6.5	Red	No
<i>Dieffenbachia cf. parlatoii</i>	6.5	Red	No
<i>Dracontium sp.</i>	6	Orange	No
<i>Monstera adansonii</i>	12.5	White	No
<i>Monstera dilacerata</i>	12.5	White	No
<i>Monstera lechleriana</i>	5.5	White	No
<i>Monstera gracilis</i>	6	Yellow	No
<i>Philodendron sp.</i>	3	Yellow	No
<i>Philodendron divaricatum</i>	3.5	Yellow	No
<i>Philodendron ernestii</i>	2.3	Yellow	No
<i>Philodendron fragrantissimum</i>	5.5	Red	No
<i>Philodendron cf. cuneatum</i>	2.5	White	No
<i>Spathiphyllum cannaefolium</i>	15.6	Green	No
<i>Syngonium podophyllum</i>	30	Yellow	Yes
<i>Syngonium yurimaguense</i>	34	Yellow	Yes
<i>Aiphanes aculeata</i>	22.5	Red	No
<i>Attalea insignis</i>	50	Brown	No
<i>Astrocaryum chambira</i>	47.5	Yellow	No
<i>Bactris corossilla</i>	20.5	Blue/purple	No
<i>Bactris macana</i>	24	Red	No
<i>Bactris maraja</i>	17.5	Black	No
<i>Euterpe precatoria</i>	11.5	Black	No
<i>Geonoma macrostachya</i>	8	Black	No
<i>Geonoma interrupta</i>	5	Black	No
<i>Iriarteia deltoidea</i>	34	Mixed	No
<i>Oenocarpus bataua</i>	45	Mixed	No
<i>Oenocarpus mapora</i>	11.5	Mixed	No
<i>Socratea exorrhiza</i>	22.5	Mixed	No
<i>Syagrus sancona</i>	24	Orange	No
<i>Aechmea rubiginosa</i>	24	Yellow	Yes
<i>Araeococcus flagellifolius</i>	10	Mixed	No
<i>Dichorisandra cf. aequatorialis</i>	6	Mixed	No
<i>Dichorisandra hexandra</i>	6	Mixed	No
<i>Dichorisandra villosula</i>	12	Blue/purple	No
<i>Tradescantia zanonii</i>	4	Blue/purple	No
<i>Costus guianensis</i>	20	Mixed	No
<i>Costus scaber</i>	17.5	Mixed	No
<i>Costus spiralis</i>	17.5	Mixed	No
<i>Dimerocostus strobilaceus</i>	11.5	Brown	No
<i>Asplundia moritziana</i>	15	Green	Yes
<i>Carludovica palmata</i>	9	Red	No
<i>Cyclanthus bipartitus</i>		Green	No
<i>Xiphidium caeruleum</i>	4	Red	No
<i>Heliconia episcopalis</i>	8	Mixed	No
<i>Heliconia hirsuta</i>	10	Mixed	No
<i>Heliconia latispatha</i>	10	Mixed	No
<i>Heliconia marginata</i>	10	Mixed	No
<i>Heliconia rostrata</i>	8.5	Mixed	No
<i>Heliconia spathocircinata</i>	9	Mixed	No

Species	Fruit size (mm)	Color	Protection
<i>Heliconia stricta</i>	15	Mixed	No
<i>Eucharis ulei</i>	10	Mixed	No
<i>Calathea inocephala</i>	9	Mixed	No
<i>Pleiostachya pruinosa</i>	8.5	Mixed	No
<i>Smilax aequatorialis</i>	16	Orange	No
<i>Phenakospermum guyanense</i>	70	Red	No
<i>Renealmia breviscapa</i>	6	Mixed	No
<i>Renealmia cernua</i>	7	Mixed	No
<i>Antrocaryon amazonica</i>	26	Yellow	No
<i>Spondias mombin</i>	25	Yellow	No
<i>Spondias venulosa</i>	25	Yellow	No
<i>Tapirira guianensis</i>	7.5	Yellow	No
<i>Annona sp.</i>	55	Yellow	No
<i>Duguetia quitarensis</i>	115	Red	Yes
<i>Guatteria punctata</i>	5.5	Blue/purple	No
<i>Malmea sp.</i>	14	Blue/purple	Yes
<i>Oxandra mediocris</i>	7.5	Blue/purple	No
<i>Rollinia edulis</i>	50	Green	Yes
<i>Ruizodendron ovale</i>	17.5	Black	No
<i>Unonopsis cf. guatterioides</i>	14	Green	No
<i>Xylopia amazonica</i>	8	Red	No
<i>Pacouria guianensis</i>	140	Yellow	Yes
<i>Stemmadenia grandiflora</i>	14	Mixed	No
<i>Tabernaemontana heterophylla</i>	12	Mixed	No
<i>Tabernaemontana sananho</i>	15	Mixed	No
<i>Dendropanax caucanus</i>	10	Black	No
<i>Schefflera morototoni</i>	7.5	Black	No
<i>Sciadodendron excelsum</i>	8.5	Black	No
<i>Bixa urucurana</i>	18	Mixed	No
<i>Pachira orinocensis</i>	25	Green	No
<i>Quararibea cf. wittii</i>	22.5	Orange	No
<i>Cordia bicolor</i>	8.5	Green	No
<i>Cordia bifurcata</i>	4	Red	No
<i>Cordia nodosa</i>	11	White	No
<i>Cordia cf. ripicola</i>	14	Black	No
<i>Tournefortia foetidissima</i>	6	White	No
<i>Bursera inversa</i>	8.5	Blue/purple	No
<i>Crepidospermum goudotianum</i>	5	Red	No
<i>Crepidospermum rhoifolium</i>	11	Orange	No
<i>Dacryodes sp.</i>	19	Black	No
<i>Protium aracouchini</i>	8.5	Mixed	No
<i>Protium crenatum</i>	11	Mixed	No
<i>Protium glabrescens</i>	10	Mixed	No
<i>Protium robustum</i>	17	Mixed	No
<i>Protium sagotianum</i>	22	Mixed	No
<i>Trattinnickia rhoifolia</i>	8.5	Black	No
<i>Epiphyllum phyllanthus</i>	35	Red	No
<i>Hylocereus polyrhizus</i>	75	Red	No
<i>Pereskia aculeata</i>	26.5	Yellow	No
<i>Pereskia bleo</i>	45	Yellow	No
<i>Disocactus sp.</i>	6	White	No
<i>Rhipsalis baccifera</i>	5	White	No
<i>Dialium guianense</i>	6.5	Brown	Yes
<i>Hymenaea courbaril</i>	60	Brown	Yes
<i>Hymenaea oblongifolia</i>	25.5	Brown	Yes
<i>Capparis detonsa</i>	20	Green	No
<i>Capparis frondosa</i>	11	Blue/purple	No
<i>Crateva tapia</i>	62.5	Yellow	Yes
<i>Carica cf. goudotianum</i>	40	Orange	Yes
<i>Jacaratia digitata</i>	45	Orange	No
<i>Cecropia engleriana</i>	10	Green	No
<i>Cecropia ficifolia</i>	10	Green	No
<i>Cecropia membranacea</i>	9.5	Green	No
<i>Cecropia sciadophylla</i>	15	Yellow	No
<i>Coussapoa asperifolia</i>	14	Red	No
<i>Coussapoa orthoneura</i>	7	Red	No
<i>Coussapoa villosa</i>	23	Mixed	No
<i>Pourouma bicolor</i>	11.5	Blue/purple	Yes

Species	Fruit size (mm)	Color	Protection
<i>Pourouma minor</i>	14	Blue/purple	No
<i>Pourouma mollis triloba</i>	11.5	Blue/purple	Yes
<i>Pourouma petiolulata</i>	11.5	Blue/purple	Yes
<i>Maytenus macrocarpa</i>	10	Mixed	No
<i>Hirtella americana</i>	11.5	Black	No
<i>Licania cf. arborea</i>	20	Green	No
<i>Licania kunthiana</i>	9.5	White	No
<i>Licania subarachnophylla</i>	27.5	Brown	No
<i>Chrysochlamys aff membranacea</i>	4	Mixed	No
<i>Clusia grandiflora</i>	9	Mixed	No
<i>Clusia nigrolineata</i>	6	Mixed	No
<i>Clusia palmicida</i>	6	Mixed	No
<i>Clusia renggeroides</i>	5	Mixed	No
<i>Clusiella sp.</i>	5	Mixed	No
<i>Garcinia macrophylla</i>	50	Yellow	Yes
<i>Garcinia madruno</i>	32.5	Yellow	Yes
<i>Buchenavia capitata</i>	10.5	Yellow	No
<i>Cnestidium rufescens</i>	6	Mixed	No
<i>Conarus punctatus</i>	10	Mixed	No
<i>Rourea glabra</i>	4	Mixed	No
<i>Maripa cf. axilliflora</i>	18	Yellow	Yes
<i>Maripa peruviana</i>	14	Yellow	Yes
<i>Calycophysum cf. pedunculatum</i>	65	Orange	Yes
<i>Cayaponia capitata</i>	50	Red	Yes
<i>Cayaponia ophthalmica</i>	25	Red	No
<i>Cayaponia cf. ruizii</i>	24	Blue/purple	No
<i>Cayaponia granatensis</i>	19	Blue/purple	No
<i>Gurania eriantha</i>	20.8	Green	Yes
<i>Gurania cf. macrantha</i>	20.8	Green	Yes
<i>Gurania pedata</i>	20.8	Green	Yes
<i>Gurania rizantha</i>	20.8	Green	Yes
<i>Melothria dulcis</i>	30	Yellow	Yes
<i>Psiguria triphylla</i>	25	Green	Yes
<i>Sicydium diffusum</i>	7	Black	No
<i>Dichapetalum spruceanum</i>	15	Black	No
<i>Tapura acreana</i>	10	Green	No
<i>Davilla nitida</i>	5	Red	No
<i>Davilla rugosa</i>	5	Blue/purple	No
<i>Doliocarpus multiflorus</i>	9	Blue/purple	No
<i>Tetracera willdenowiana</i>	3	Mixed	No
<i>Diospyros artanthifolia</i>	30	Yellow	Yes
<i>Muntingia calabura</i>	12.5	Red	No
<i>Sloanea guianensis</i>	8	Red	No
<i>Alchornea glandulosa</i>	8.5	Red	No
<i>Caryodendron orinocense</i>	45	Green	No
<i>Drypetes amazonica</i>	10.5	Green	No
<i>Hyeronima alchorneoides</i>	4.5	Blue/purple	No
<i>Hyeronima oblonga</i>	3.5	Blue/purple	No
<i>Margaritaria nobilis</i>	4	Blue/purple	No
<i>Omphalea diandra</i>	90	Green	Yes
<i>Pera arborea</i>	5	Mixed	No
<i>Pera benensis</i>	5	Mixed	No
<i>Plukenetia polyadenia</i>	19	Green	Yes
<i>Sapium glandulosum</i>	6	Mixed	No
<i>Apium laurifolium</i>	5	Mixed	No
<i>Sapium marmieri</i>	6	Mixed	No
<i>Andira inermis</i>	50	Green	No
<i>Dipteryx micrantha</i>	29.5	Yellow	No
<i>Swartzia arborescens</i>	20	Green	Yes
<i>Swartzia cardiosperma</i>	13	Green	Yes
<i>Swartzia leptopetala</i>	16	Green	Yes
<i>Swartzia trianae</i>	22	Green	Yes
<i>Casearia aculeata</i>	3	Red	No
<i>Laetia corymbulosa</i>	7	Mixed	No
<i>Laetia procera</i>	4	Mixed	No
<i>Lindackeria paludosa</i>	8	Mixed	No
<i>Mayna odorata</i>	20	Yellow	Yes
<i>Drymonia serrulata</i>	12	Mixed	No

Species	Fruit size (mm)	Color	Protection
<i>Salacia macrantha</i>	37.5	Yellow	Yes
<i>Tontelea attenuata</i>	20	Yellow	Yes
<i>Tontelea</i> sp.	20	Yellow	Yes
<i>Aniba hostmanniana</i>	12.5	Mixed	No
<i>Endlicheria krukovii</i>	19	Mixed	No
<i>Endlicheria sericea</i>	17.5	Mixed	No
<i>Nectandra membranacea</i>	12	Green	No
<i>Ocotea</i> sp.	7	Mixed	No
<i>Ocotea cernua</i>	7.5	Mixed	No
<i>Ocotea longifolia</i>	7	Mixed	No
<i>Ocotea oblonga</i>	14.5	Mixed	No
<i>Ocotea tomentosa</i>	8	Green	No
<i>Ocotea</i> cf. <i>amazonica</i>	10	Green	No
<i>Ocotea floribunda</i>	12.5	Black	No
<i>Rhodostemonodaphne kunthiana</i>	15	Mixed	No
<i>Rhodostemonodaphne synandra</i>	15	Mixed	No
<i>Couroupita guianensis</i>	200	Brown	Yes
<i>Eschweilera andina</i>	80	Brown	No
<i>Grias peruviana</i>	55	Brown	No
<i>Gustavia hexapetala</i>	47.5	Orange	Yes
<i>Gustavia poeppigiana</i>	50	Green	Yes
<i>Strychnos schultesiana</i>	90	Yellow	Yes
<i>Phthirusa retrofelxa</i>	5	Red	No
<i>Psittacanthus cucullaris</i>	11.5	Red	No
<i>Struthanthus orbicularis</i>	3.5	Blue/purple	No
<i>Adenaria floribunda</i>	3	Blue/purple	No
<i>Byrsonima crispa</i>	9.5	Yellow	No
<i>Byrsonima</i> cf. <i>japurensis</i>	9.5	Yellow	No
<i>Marcgravia macrophylla</i>	10	Mixed	No
<i>Norantea guianensis</i>	9	Mixed	No
<i>Souroubea sympetala</i>	10	Mixed	No
<i>Bellucia grossularioides</i>	15	Green	No
<i>Bellucia pentamera</i>	35	Green	No
<i>Blakea rosea</i>	10	Black	No
<i>Clidemia hirta</i>	8.5	Blue/purple	No
<i>Clidemia inobsepta</i>	4	Blue/purple	No
<i>Clidemia octona</i>	9.5	Blue/purple	No
<i>Clidemia septuplinervia</i>	10	Blue/purple	No
<i>Clidemia</i> sp.	13.5	Blue/purple	No
<i>Henriettella fissanthera</i>	4	Green	No
<i>Henriettella sylvestris</i>	5	Green	No
<i>Leandra longicoma</i>	5	Blue/purple	No
<i>Loreya strigosa</i>	11.5	Green	No
<i>Miconia</i> cf. <i>affinis</i>	5.5	Blue/purple	No
<i>Miconia elata</i>	4	Blue/purple	No
<i>Miconia napoana</i>	8.5	Blue/purple	No
<i>Miconia ampla</i>	7.5	Yellow	No
<i>Miconia argyrophylla</i>	4.5	Black	No
<i>Miconia</i> cf. <i>prasina</i>	4	Black	No
<i>Miconia ternatifolia</i>	3	Black	No
<i>Miconia dolichorhyncha</i>	3.5	Black	No
<i>Miconia erioclada</i>	7	Black	No
<i>Miconia nervosa</i>	7	Mixed	No
<i>Miconia trinervia</i>	4	Mixed	No
<i>Guarea guidonia</i>	11	Mixed	No
<i>Guarea kunthiana</i>	8	Mixed	No
<i>Trichilia martiana</i>	8	Mixed	No
<i>Trichilia maynasiana</i>	8	Mixed	No
<i>Trichilia micrantha</i>	10	Mixed	No
<i>Trichilia pallida</i>	7	Mixed	No
<i>Trichilia</i> cf. <i>verrucosa</i>	15	Mixed	No
<i>Trichilia pleeana</i>	7	Mixed	No
<i>Trichilia tuberculata</i>	9	Mixed	No
<i>Mendoncia lindavii</i>	13.5	Blue/purple	No
<i>Mendoncia odorata</i>	13.5	Blue/purple	No
<i>Abuta grandifolia</i>	12	Yellow	Yes
<i>Abuta</i> aff. <i>grandifolia</i>	12	Yellow	Yes
<i>Cissampelos</i> cf. <i>tropaenifolia</i>	5	Red	No

Species	Fruit size (mm)	Color	Protection
<i>Disciphania ernstii</i>	2.1	Blue/purple	No
<i>Odontocarya tripetala</i>	9	Yellow	No
<i>Odontocarya mallosperma</i>	9	Yellow	No
<i>Sciadotenia ramiflora</i>	7.5	Green	No
<i>Sciadotenia toxifera</i>	17.5	Green	No
<i>Abarema jupunba</i>	6	Mixed	No
<i>Enterolobium cyclocarpum</i>	35	Black	Yes
<i>Enterolobium schomburgkii</i>	17.5	Black	No
<i>Inga cf acreana</i>	24	Green	Yes
<i>Inga acuminata</i>	27.5	Green	Yes
<i>Inga alba</i>	12.5	Green	Yes
<i>Inga cylindrica</i>	25	Green	Yes
<i>Inga brachyrhachys</i>	12.5	Green	Yes
<i>Inga heterophylla</i>	17.5	Green	Yes
<i>Inga densiflora</i>	12.5	Green	Yes
<i>Inga edulis</i>	11.2	Green	Yes
<i>Inga gracilior</i>	19	Green	Yes
<i>Inga leiocalycina</i>	22.5	Green	Yes
<i>Inga macrophylla</i>	30	Green	Yes
<i>Inga sapindoides</i>	22.5	Green	Yes
<i>Inga umbellifera</i>	20.5	Green	Yes
<i>Inga marginata</i>	12.5	Green	Yes
<i>Inga stenoptera</i>	25	Green	Yes
<i>Inga tenuistipula</i>	28.5	Green	Yes
<i>Inga acrocephala</i>	40	Green	Yes
<i>Inga thibaudiana</i>	23	Green	Yes
<i>Inga vera</i>	12.5	Green	Yes
<i>Inga vismiifolia</i>	70	Green	Yes
<i>Parkia multijuga</i>	70	Black	Yes
<i>Samanea saman</i>	16.5	Black	Yes
<i>Stryphnodendron guianense</i>	9.5	Black	Yes
<i>Siparuna cf asperula</i>	3	Red	No
<i>Siparuna gilgiana</i>	3	Red	No
<i>Siparuna cervicornis</i>	3	Blue/purple	No
<i>Siparuna cuspidata</i>	3	Blue/purple	No
<i>Batocarpus amazonicus</i>	40	Yellow	No
<i>Batocarpus orinocensis</i>	50	Green	Yes
<i>Brosimum alicastrum</i>	20.5	Yellow	No
<i>Brosimum guianense</i>	16.5	Red	No
<i>Brosimum aff. lactescens</i>	15	Blue/purple	No
<i>Brosimum lactescens</i>	15	Orange	No
<i>Brosimum utile</i>	16	Green	No
<i>Castilla ulei</i>	30	Yellow	Yes
<i>Clarisia biflora</i>	23	Green	No
<i>Clarisia racemosa</i>	14.5	Red	No
<i>Dorstenia contrajerva</i>	25	Green	No
<i>Ficus americana</i>	9	Red	No
<i>Ficus andicola</i>	6	Red	No
<i>Ficus donnell-smithii</i>	8	Red	No
<i>Ficus guianensis</i>	6.5	Red	No
<i>Ficus pertusa</i>	6	Red	No
<i>Ficus sphenophylla</i>	6.5	Red	No
<i>Ficus trigona</i>	9.5	Red	No
<i>Ficus gomelleira</i>	17	Green	No
<i>Ficus insipida</i>	31.5	Green	Yes
<i>Ficus maxima</i>	32.5	Green	No
<i>Ficus membranacea</i>	22.5	Green	No
<i>Ficus nymphaeifolia</i>	23	Green	No
<i>Ficus obtusifolia</i>	24	Green	No
<i>Ficus paraensis</i>	16	Green	No
<i>Ficus schultesii</i>	25	Green	No
<i>Ficus trigonata comp maximiliana</i>	25	Green	No
<i>Ficus trigonata comp trigonata</i>	27.5	Green	No
<i>Ficus usiacurina</i>	20	Green	No
<i>Ficus yoponensis</i>	15	Green	No
<i>Ficus sp. 2126</i>	19	Green	No
<i>Helicostylis tomentosa</i>	25	Yellow	No
<i>Maquira calophylla</i>	22.5	Yellow	Yes

Species	Fruit size (mm)	Color	Protection
<i>Perebea mollis</i>	24	Yellow	No
<i>Perebea xanthochyma</i>	4.5	Red	No
<i>Pseudolmedia laevigata</i>	7.5	Red	No
<i>Pseudolmedia laevis</i>	8	Red	No
<i>Pseudolmedia obliqua</i>	14	Yellow	No
<i>Sorocea briquetii</i>	6.5	Blue/purple	No
<i>Sorocea steinbachii</i>	10	Blue/purple	No
<i>Trophis racemosa</i>	7	Red	No
<i>Iryanthera juruensis</i>	13	Mixed	No
<i>Iryanthera leavis</i>	19	Mixed	No
<i>Virola calophylla</i>	11	Mixed	No
<i>Virola cf. cariniata</i>	12	Mixed	No
<i>Virola cf. elongata</i>	10	Mixed	No
<i>Virola flexuosa</i>	12	Mixed	No
<i>Virola multinervia</i>	12	Mixed	No
<i>Virola peruviana</i>	13	Mixed	No
<i>Virola sebifera</i>	10	Mixed	No
<i>Ardisia panurensis</i>	4	Blue/purple	No
<i>Ardisia pellucida</i>	6.5	Blue/purple	No
<i>Stylogyne turbacensis</i>	8	Mixed	No
<i>Campomanesia speciosa</i>	30	Brown	Yes
<i>Eugenia biflora</i>	6	Blue/purple	No
<i>Eugenia florida</i>	12.5	Red	No
<i>Eugenia nesiotica</i>	24.5	Red	No
<i>Eugenia stipitata</i>	45	Yellow	No
<i>Eugenia lambertiana</i>	8.5	Yellow	No
<i>Guapira cf. cuspidata</i>	10	Red	No
<i>Guapira olfersiana</i>	8.5	Black	No
<i>Neea laxa</i>	8	Mixed	No
<i>Neea cf. divaricata</i>	6.5	Blue/purple	No
<i>Neea verticillata</i>	10.5	Black	No
<i>Ouratea cf. polyantha</i>	6	Mixed	No
<i>Ouratea weberbaueri</i>	7.5	Mixed	No
<i>Heisteria acuminata</i>	7	Mixed	No
<i>Heisteria nitida</i>	11	Mixed	No
<i>Passiflora ambigua</i>	55	Yellow	Yes
<i>Passiflora cf. micropetala</i>	21	Black	Yes
<i>Passiflora vitifolia</i>	55	Green	Yes
<i>Phytolacca rivinoides</i>	4	Mixed	No
<i>Trichostigma octandrum</i>	6.5	Mixed	No
<i>Peperomia laxiflora</i>	1	Green	No
<i>Peperomia magnoliifolia</i>	5	Green	No
<i>Peperomia rotundifolia</i>	1	Green	No
<i>Peperomia serpens</i>	1	Green	No
<i>Piper aduncum</i>	5	Green	No
<i>Piper aequale</i>	5	Green	No
<i>Piper arboreum</i>	5	Green	No
<i>Piper cf. avellanum</i>	4	Green	No
<i>Piper cumanense</i>	3	White	No
<i>Piper demeraranum</i>	7	Breen	No
<i>Piper fresnoense</i>	4	Breen	No
<i>Piper hispidum</i>	5	Breen	No
<i>Piper laevigatum</i>	3	Breen	No
<i>Piper peltata</i>	5	Breen	No
<i>Piper phytolaccaefolium</i>	4	Green	No
<i>Coccoloba densifrons</i>	13.5	Black	No
<i>Coccoloba coronata</i>	7.5	Blue/purple	No
<i>Coccoloba mollis</i>	11.5	Blue/purple	No
<i>Coccoloba cf. parimensis</i>	7.5	Blue/purple	No
<i>Quiina macrophylla</i>	7.5	Red	No
<i>Prunus myrtifolia</i>	10.2	Blue/purple	No
<i>Alibertia cf. hadrantha</i>	30	Black	No
<i>Bertiera guianensis</i>	4.5	Black	No
<i>Duroia hirsuta</i>	25	Yellow	Yes
<i>Genipa americana</i>	80	Brown	Yes
<i>Genipa cf. williamsii</i>	60	Brown	Yes
<i>Geophila cordifolia</i>	4	Red	No
<i>Geophila repens</i>	5	Red	No

Species	Fruit size (mm)	Color	Protection
<i>Geophila macropoda</i>	10	Black	No
<i>Gonzalagunia cornifolia</i>	6	White	No
<i>Guettarda aromatica</i>	11	Black	No
<i>Hamelia axillaris</i>	7.5	Black	No
<i>Isertia leavis</i>	8.5	Green	No
<i>Posoqueria longiflora</i>	35	Yellow	Yes
<i>Psychotria bahiensis</i>	7.5	Blue/purple	No
<i>Psychotria bracteocardia</i>	5	Blue/purple	No
<i>Psychotria caerulea</i>	8.5	Blue/purple	No
<i>Psychotria casiquiaria</i>	4.5	Blue/purple	No
<i>Psychotria deflexa</i>	9	Blue/purple	No
<i>Psychotria herzogii</i>	10	Blue/purple	No
<i>Psychotria racemosa</i>	4.5	Black	No
<i>Psychotria psychotriifolia</i>	7.5	Red	No
<i>Psychotria muscosa</i>	5	Red	No
<i>Psychotria tenuifolia</i>	6	Red	No
<i>Psychotria viridis</i>	6	Red	No
<i>Psychotria poeppigiana</i>	7	Mixed	No
<i>Randia hondensis</i>	20.5	Yellow	Yes
<i>Rudgea cornifolia</i>	7.5	White	No
<i>Sabicea villosa</i>	8	Blue/purple	No
<i>Cupania cinerea</i>	8	Mixed	No
<i>Cupania cf. latifolia</i>	8	Mixed	No
<i>Cupania pallida</i>	9	Mixed	No
<i>Cupania scrobiculata</i>	6	Mixed	No
<i>Paullinia alata</i>	8	Mixed	No
<i>Paullinia bracteosa</i>	8	Mixed	No
<i>Paullinia faginea</i>	7	Mixed	No
<i>Paullinia grandifolia</i>	10	Mixed	No
<i>Paullinia hispida</i>	7	Mixed	No
<i>Paullinia obovata</i>	9	Mixed	No
<i>Paullinia rugosa</i>	8	Mixed	No
<i>Paullinia serjanifolia</i>	6	Mixed	No
<i>Paullinia sp.</i>	9	Mixed	No
<i>Talisia intermedia</i>	22	Yellow	Yes
<i>Talisia cf. nervosa</i>	20	Red	Yes
<i>Vouarana guianensis</i>	10	Mixed	No
<i>Chrysophyllum argenteum</i>	22	Green	No
<i>Chrysophyllum cf. lucentifolium</i>	45	Yellow	No
<i>Chrysophyllum sp.</i>	27.5	Yellow	No
<i>Chrysophyllum parvulum</i>	10	Blue/purple	No
<i>Pouteria caimito</i>	25	Yellow	Yes
<i>Pouteria cuspidata</i>	22.5	Yellow	Yes
<i>Pouteria lucuma</i>	85	Yellow	No
<i>Pouteria pariry</i>	100	Yellow	No
<i>Pouteria procera</i>	37.5	Yellow	Yes
<i>Pouteria reticulata</i>	13.5	Blue/purple	Yes
<i>Pouteria sp.</i>	35	Brown	Yes
<i>Sarcaulus brasiliensis</i>	22.5	Yellow	Yes
<i>Picramnia latifolia</i>	5.5	Red	No
<i>Simarouba amara</i>	10	Black	No
<i>Brunfelsia grandiflora</i>	13.5	Green	No
<i>Cestrum racemosum</i>	4	Black	No
<i>Cestrum sylvaticum</i>	5	Black	No
<i>Lycianthes cyathocalyx</i>	6.5	Red	No
<i>Lycianthes pauciflora</i>	12.5	Red	No
<i>Solanum cyathophorum</i>	6.5	Black	No
<i>Solanum grandiflorum</i>	47.5	Black	No
<i>Solanum lepidotum</i>	8.5	Black	No
<i>Solanum pectinatum</i>	48.2	Black	No
<i>Solanum jamaicense</i>	7.5	Red	No
<i>Solanum cf. americanum</i>		Red	No
<i>Solanum cf. sessile</i>	12	Red	No
<i>Solanum sessiliflorum</i>	31.6	Red	No
<i>Solanum sp. 2125</i>	11	Green	No
<i>Witheringia solanaceae</i>	7	Red	No
<i>Guazuma ulmifolia</i>	13	Black	No
<i>Herrania nitida</i>	50	Green	Yes

Species	Fruit size (mm)	Color	Protection
<i>Sterculia apetala</i>	15	Brown	No
<i>Sterculia guapayensis</i>	20	Brown	No
<i>Sterculia colombiana</i>	15	Mixed	No
<i>Theobroma cacao</i>	80	Yellow	Yes
<i>Theobroma glaucum</i>	80	Green	Yes
<i>Theobroma subincanum</i>	85	Brown	Yes
<i>Clavija ornata</i>	21.5	Yellow	Yes
<i>Apeiba aspera</i>	30	Black	Yes
<i>Apeiba tibourbou</i>	37.5	Black	Yes
<i>Ampelocera edentula</i>	18	Yellow	No
<i>Celtis schippii</i>	9	Black	No
<i>Celtis iguanaeus</i>	10	Yellow	No
<i>Trema integerrima</i>	3	Red	No
<i>Trema micrantha</i>	3	Red	Yes
<i>Urera baccifera</i>	3	Yellow	No
<i>Urera caracasana</i>	8.5	White	No
<i>Aegiphila guianensis</i>	4.5	Blue/purple	No
<i>Aegiphila integrifolia</i>	4.5	Blue/purple	No
<i>Citharexylum spinosum</i>	6.5	Black	No
<i>Vitex compressa</i>	20	Green	No
<i>Vitex orinocensis</i>	12.5	Blue/purple	No
<i>Leonia crassa</i>	52.5	Brown	Yes
<i>Leonia glycyarpa</i>	52.5	Brown	Yes
<i>Phoradendron piperoides</i>	4	Red	No
<i>Cissus erosa</i>	7	Blue/purple	No
<i>Cissus microcarpa</i>	11.5	Black	No
<i>Cissus sicyoides</i>	7.5	Black	No
	Average = 17.3		

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