Articles

Potential Competitors for Exudates Eaten by Saddleback (*Saguinus fuscicollis*) and Moustached (*Saguinus mystax*) Tamarins

Andrew C. Smith

Introduction

The aim of this study was to document competitors for the gums consumed by saddleback (*Saguinus fuscicollis*) and moustached (*S. mystax*) tamarins. Gums are potentially a high energy food source, composed mainly of water, complex polysaccharides, calcium, and trace minerals (iron, aluminium, silicon, magnesium, and sodium) (Nash, 1986). They are most commonly found as small droplets, and whilst they are rapidly depleted they are also rapidly renewed. They can also form larger "globs" or streaks. The way in which they are typically produced means that gum sites seldom permit more than one individual to exploit them at a time (Nash, 1986). Tamarins consume gum from a large number of sources. The majority of these are only used once, with relatively few sources accounting for the majority of gum feeding through repeated use. In contrast to the majority of the fruit resources exploited, even the most important exudate sites used by tamarins provide relatively little food (Smith, 1997). Hence, gums may be considered to be a limited resource of potentially high nutritional value.

Little is known about specific trophic relations within the Amazon rain forest, particularly with respect to relatively minor resources such as exudates. Few Neotropical animals have been reported to eat exudates, with the notable exception of callitrichids. For example, besides tamarins, other potential exudate consumers at the Estación Biologica Quebrada Blanco II in the Peruvian Amazon include such as the white-fronted (*Cebus albifrons*) and brown (*C. apella*) capuchins, and night monkeys (*Aotus nancymai*), based on Hladik and Hladik's (1969) report of gum feeding by related white-throated capuchins (*C. capucinus*) and night monkeys (*A. trivirgatus*). Bush-tailed opossums (*Glironia venusta*), if present, might also eat gums, based on Emmons and Feer's (1990) observation of an individual licking the surface of a branch. Other potential exudate-eaters include the green acouchy (*Myoprocta pratti*) given its taste for gum in captivity (Kelly, 1993), and the Neotropical pygmy squirrels (*Sciurillus pusillus*), observed to feed on "a substance scraped from the inner surface of tree bark" Emmons and Feer (1990, p.176). Amazon dwarf squirrels (*Microsciurus flaviventer*) may also feed on exudate as they occupy a similar ecological niche to Neotropical pygmy squirrels. Further, based on what is known for North American red squirrels (*Tamiasciurus hudsonicus*) (Kilham, 1957), larger Neotropical squirrels may also consume exudate. Species related to these, such as other cebids, opossums, and sciuromorph and caviomorph rodents may also consume gum, as might generalists such as procyonids (e.g. kinkajous, *Potos flavus*, and coatis, *Nasua nasua*) and tayras (*Eira barbara*). Some species of bat, particularly those that feed on fruit and nectar, for example long-tongued bats (Glossophaginae), little fruit bats (Carolliinae), and Neotropical fruit bats (Stenodermatinae) may also take exudates, such as gums, opportunistically. Here I report on my observations regarding the use of exudates as a food source during 1994 and 1995, while carrying out a field study of two tamarin species at the Estación Biologica Quebrada Blanco II in the Peruvian Amazon.

Methods

A mixed-species group of saddleback and moustached tamarins was observed from October 1994 until November 1995 as part of a long-term field study (Smith, 1997) at the Estación Biologica Quebrada Blanco II (4°21'S, 73°09'W) in Peru. Each month several sources of exudate that had recently been exploited by the tamarins were observed from sunrise till sunset (approx. 0550-1750 h). Eleven exudate sites of six species of trees were observed for a total of 257hrs 38min. Notes were taken of any animals that fed upon the exudate, or passed within 10 m of it. Mammals were identified using Emmons and Feer (1990), and birds using Hilty and Brown (1986). No specific identification was possible for arthropods.

Results

The observations are summarised in Table 1. Eleven exudate sites of six species of trees were observed: *Parkia igneiflora* (Mimosaecae; six trees); *Parkia nitida* (Mimosaceae; one tree); *Peltogyne altissima* (Mimosaceae; one tree); *Sloanea floribunda* (Elaeocarpacae; one tree); *Acacia* sp. (Mimosaceae; one tree); and a further tree which was not identified (Field #1494). The majority of the observations were for *Parkia igneiflora*. The exudate sites were visited for a total of 371 minutes, 2.4% of the time that they were observed.

There were few other diurnal competitors for the gum sources used by the tamarins. In addition to both species of tamarins only a squirrel monkey (*Saimiri sciureus*), two Neotropical pygmy squirrels (*Sciurillus pusillus*), two large bees and two large wasps were definitely seen to feed on gum. The behaviour of Amazon dwarf squirrels (*Microsciurus flaviventer*), and other Neotropical pygmy squirrels suggested that gum may have been eaten, but this was not directly observed. It is possible that the scale-breasted woodpecker (*Celeus grammicus*) and the plain brown woodcreeper (*Dendrocincla fuliginosa*) were taking small droplets of gum, but perhaps more plausibly they may have been after insects on the bark surface or larvae in the gum. The southern river otter (*Lutra longicaudis*) was almost certainly not interested in the gum, and was simply travelling through the forest. Of all animals observed to feed, the tamarins used the exudate sources for the greatest proportion of time (*S. fuscicollis*, 51.21%; *S. mystax*, 42.86%).

Cover photograph: The titi monkey, *Callicebus coimbrai*, from Sergipe, Brazil. Photo: S. Kobayashi and A. Langguth, 1999.

Table 1. Summary of animals seen at or near gum sites during dawn to dusk observations.

Tree #	Species	Species (No. in group)	Details	Time feeding (mins)
256	*Parkia igneiflora*	Large wasps (2)	Fed on exudate; 1 bout	2
		S. fuscicollis (5)	Passed, no interest shown	
732	*Parkia igneiflora*	*Lutra longicaudis*	Passed, no interest shown	
522	*Parkia igneiflora*	*Microsciurus flaviventer* (1)	Moved in sub-canopy, 2 bouts*	17; 24
587	*Parkia igneiflora*	*Microsciurus flaviventer* (1)	Moved in sub-canopy, 2 bouts*	3; 12
522	*Parkia igneiflora*	*Sciurillus pusillus* (2)	Moved on trunk for 25 minutes*	?
		Saimiri sciureus (*c.* 25)	Fed on exudate	2
		Large bees (2)	Fed on exudate	2
		S. mystax (7)	Fed on exudate	4
		Dendrocincla fuliginosa (1)	Tapped on trunk for 3 minutes	?
587	*Parkia igneiflora*	*Celeus grammicus* (1)	Moved on trunk for 4 minutes*	?
		Sciurillus pusillus (1)	Pecked trunk for 2 minutes	?
		Sciurillus pusillus (1)	Fed on exudate	13
111	*Parkia igneiflora*	-	-	
111	*Parkia igneiflora*	*S. fuscicollis* (3)	Fed on exudate	1.5
		S. mystax (7)	Passed, no interest shown	
587	*Parkia igneiflora*	*Sciurillus pusillus* (1)	Fed on exudate	3
732	*Parkia igneiflora*	*S. fuscicollis* (3)	Passed 5 times, no interest shown	
1515	*Parkia igneiflora*	*S. fuscicollis* (5)	Fed on exudate, 3 bouts	53; 12; 20
		S. mystax (7)	Fed on exudate	12
732	*Parkia igneiflora*	-		
454	*Parkia nitida*	*S fuscicollis* (3)	Fed on pod-exudate	90
		S. mystax (5)	Fed on pod-exudate	150
1163	*Peltogyne altissima*	*Saimiri sciureus* (*c.* 25)	Passed, no interest shown	
1085	*Sloanea floribunda*	*S. fuscicollis* (3)	Fed on exudate, 2 bouts	6; 15
		S. mystax (7)	Passed, no interest shown	
1085	*Sloanea floribunda*	*S. fuscicollis* (5)	Fed on exudate, 3 bouts	7; 32; 8
1085	*Sloanea floribunda*	-	-	
1085	*Sloanea floribunda*	*S. fuscicollis* (5)	Fed on exudate	18
1471	*Acacia* sp.	-	-	
1471	*Acacia* sp.	*S. fuscicollis* (5)	Passed, no interest shown	
1471	*Acacia* sp.	-	-	
1494	No ID	*S. fuscicollis* (5)	Fed on exudate, 3 bouts	40; 1: 32
		S. mystax (7)	Fed on exudate, 4 bouts	120; 55; 168; 16

* Behaviour suggested that gum was being eaten, but no direct observation of consumption was seen.

Discussion

The results of the study indicate that, saddleback and moustached tamarins were the principal diurnal species to exploit the gums produced by the tree and liana species observed. Squirrel monkeys, Neotropical pygmy squirrels, and possibly Amazon dwarf squirrels may also feed on the gum, but at such low rates that competition with the tamarins would appear to be negligible. Other primates, procyonids, and bats may also exploit gum resources opportunistically, although at an even lower frequency than tamarins.

Gums do not form a sizeable proportion of the diet of most Neotropical mammals, with the notable exception of callitrichids, in particular marmosets (*Callithrix* spp.) and pygmy marmosets (*Cebuella pygmaea*). Typically, few authors have considered gums to present a digestive challenge to the primates that consume them. However, as Power (1991) points out, they may be considered to be a type of dietary fibre (Cummings, 1981; Van Soest, 1982; Kritchevsky, 1988), and thus be difficult for mammals to digest (Monke, 1941; Booth *et al.*, 1949; Hove and Herndon, 1957; Booth and Henderson, 1963). Their complex polysaccharide structure may render them resistant to normal mammalian digestive enzymes (Cummings, 1981; Van Soest, 1982; Kritchevsky, 1988). As a consequence, microbial fermentation may be required for their digestion. They may contain phenolic or other secondary compounds requiring rapid excretion or detoxification. This may reduce the net benefit to below that potentially obtained from the majority of fruits. Coupled with their potentially limited availability, this may explain why the gum sites were visited by so few diurnal animals other than the saddleback and moustached tamarins. Even the rate at which the tamarins exploited the gum sites is well below that recorded for more gumivorous pygmy marmosets. Ramirez *et al.* (1978), for example, carried out focal observations on a *Quararibea rhombifolia* tree, and recorded gum feeding by at least one *Cebuella pygmaea* for 53% of the day.

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An Observation of Carnivory by a Captive Pygmy Marmoset (*Callithrix pygmaea*)

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Carnivory is rarely observed amongst most primate species in the wild. Most reports have concerned large bodied species such as baboons (Strum, 1981; Hamilton and Busse, 1982), and especially the cooperative hunting behavior of chimpanzees (Teleki, 1973; Goodall, 1986; Boesch and Boesch, 1989). Nevertheless, many other primate species are known to opportunistically kill and consume vertebrates including, reptiles, birds and small mammals (Wahome *et al.*, 1988; Fedigan, 1990; Cordeiro, 1994; Digby and Barreto, 1998).

Pygmy marmosets (*Callithrix pygmaea*) forage principally on exudates from gum-producing vines and trees, although they also eat significant quantities of arthropods (Soini, 1988; Townsend, in press). Most other species in the *Callithrix* genus are frugivore/insectivores (Stevenson and Rylands, 1988), and callitrichids in general display this dietary pattern with varying degrees of plant exudate consumption (Rylands, 1984; Goldizen, 1987; Rylands and Faria, 1993). In terms of vertebrate consumption, callitrichids have been observed eating frogs, lizards (*Anolis* spp.), and birds, but these take up a small proportion of overall diets (Goldizen, 1987; Snowdon and Soini, 1988; Stevenson and Rylands, 1988; Peres, 1993; Digby and Barreto, 1998; Townsend, in press).

In 1984 in Araracuara, Colombian Amazon, one of us (WRT) witnessed an attack by a wild caught pet pygmy marmoset upon a bird. The observer was sitting at a round, wide-edged table with a group of people when a small finch stunned itself against a window and was brought in and placed upon the table. A male pygmy marmoset was on the ground with a long string attached to its owner. Upon spotting the bird, the marmoset jumped up to the edge of the table and for a split second, looked at the bird. The marmoset then disappeared from view until its head appeared about one quarter of the way around the table. It looked quickly at the bird and disappeared again, only reappearing as it crept all the way around the edge of the table. The marmoset then jumped on the bird from behind, put its left hand on the bird's throat and with the right hand on its beak, twisted the head upward leaving the neck exposed and bit directly into the bird's neck. Lowering the beak as the bird was convulsing, the marmoset then began biting through the bird's brain case. The owner removed her pet from the bird before it could be determined to what extent the primate would have consumed it's prey.

In a review of the *Callithrix* genus, fledgling birds and eggs had been suggested as possible dietary constituents for free-ranging animals (Stevenson and Rylands, 1988). Recent observations of vertebrate predation by common marmosets (*C. jacchus*) in the wild (Digby and Barreto, 1998) and in captivity (Rothe, 1999) have confirmed this hypothesis. Eggs and nestlings are also occasionally consumed by buffy-headed marmosets (*C. flaviceps*) and buffy tufted-ear marmosets (*C. aurita*) (Ferrari, 1988; Muskin, 1984). To our knowledge, this represents the first recorded case of a pygmy marmoset killing a bird, and is especially interesting given that *C. pygmaea* is the smallest Neotropical primate species. The fact that the marmoset initially attempted to consume the brain of the bird is notable given that this organ is particularly energy rich. Observations of free-ranging populations have revealed similar behavior with regards to lizards and frogs which are 'highly contested among group members' (Stevenson and Rylands, 1988). Thus, the prioritization of brain consumption in vertebrate prey probably reflects an optimal foraging strategy in an intra-specific feeding competition context.

Critically, not only did the captive marmoset kill and begin