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Predation attacks on wild spider monkeys (*Ateles geoffroyi*)

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53 **Abstract**

54

55 We report two cases of predation on an adult and a subadult spider monkey (*Ateles*
56 *geoffroyi*) by a puma (*Puma concolor*) and an unidentified terrestrial predator at the
57 natural protected area of *Otoch Ma'ax yetel Kooh*, in the Yucatan peninsula, Mexico.

58 Although spider monkeys are believed to experience overall low predation pressure
59 compared to other primate species, our observations show that predation occurs in the
60 study area and therefore behavioral strategies are likely to be in place to reduce
61 predation risk. Our observations are further evidence that terrestrial predators are a
62 threat for both young and full-grown spider monkeys.

63

64 **Keywords:** *Ateles*, terrestrial predators, fission-fusion dynamics, predation pressure,
65 intra-group aggression, long-term research project

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79 **Introduction**

80 Predation avoidance is known as one of the main ecological forces favoring group
81 living [van Schaik, 1983; Pulliam and Caraco, 1984; Isbell 1994]. In larger groups, the
82 probability of being preyed upon is lower due to the dilution and confusion
83 effects, increased vigilance, and the ability to mob predators [Pulliam, 1973; Elgar,
84 1988]. Predation avoidance not only favors the formation of stable groups, but also
85 affects subgrouping patterns in species with a high degree of fission-fusion dynamics
86 [e.g., Heithaus and Dill, 2002; Link and Di Fiore, 2013], in which individuals form
87 subgroups variable in size and composition [Aureli et al., 2008]. Some studies
88 demonstrate an increase in subgroup size [e.g., bottlenose dolphins, *Tursiops truncatus*,
89 Heithaus and Dill, 2002; white-bellied spider monkeys, *Ateles belzebuth*, Link and Di
90 Fiore, 2013] or in the number of males in subgroups [e.g., chimpanzees, *Pan*
91 *trogodytes*, Boesch, 1991] when the perception of predation risk is high. Primate
92 species emit specific vocalizations, or “alarm calls”, with the double function of alerting
93 conspecifics of a predator’s presence and of signaling to the predator that it has been
94 spotted [Zuberbühler et al, 1999].

95 Spider monkeys are characterized by a high degree of fission-fusion dynamics
96 [Symington, 1990, Aureli and Schaffner, 2008]. Given their large body size, their
97 predominant use of the forest upper canopy and that they form relatively small
98 sub-groups, spider monkeys are considered to be less susceptible to predation compared
99 to other primate species [Symington, 1987; Di Fiore, 2002]. However, a lower
100 susceptibility does not mean spider monkeys are free from predation. Indeed, reports of
101 spider monkey predation are published for South American sites [see Di Fiore, 2002 for
102 a list of observed and suspected cases]. To date spider monkey predators include: pumas

103 [*Puma concolor*, Matsuda and Izawa, 2008], jaguars [*Panthera onca*, Matsuda and
104 Izawa, 2008], crested eagles [*Morphus guianensis*, Julliot, 1994], and possibly harpy
105 eagles [*Harpia harpyja*, Sherman, 1991; Julliot, 1994], confirming that the main
106 primate predators in the Neotropics are raptors and felids (Hart, 2012). Spider monkeys
107 use the short and repetitive “bark vocalization” as an alarm call [Einseberg and Kuehn,
108 1966], which is further evidence that they are vulnerable to predation.

109 Here, we report the first two observations of predation on Geoffroy’s spider
110 monkeys (*Ateles geoffroyi*). Both predation attacks resulted in the death of the monkey.
111

112 **Method**

113 **Study site and subjects**

114 Observations reported here occurred in the *Otoch Ma’ax yetel Kooh* protected area,
115 Yucatan Peninsula, Mexico (20°38’ N, 87°38’ W), adjacent to the village of Punta
116 Laguna. The protected area covers 5367 ha, and includes a mosaic of old-growth, semi-
117 evergreen medium forest, with trees up to 25 m in height, and 30–50-year-old
118 successional forest [Ramos-Fernandez and Ayala-Orozco, 2003]. In the protected area
119 terrestrial predators, such as pumas and jaguars, could prey upon spider monkeys, but
120 there are no reports of potential aerial predators [CONANP, 2006].

121 Study subjects were members of two groups (“E” and “W”) of wild spider
122 monkeys (*Ateles geoffroyi*), which have been continuously studied since 1997 [Ramos-
123 Fernandez et al., 2018]. Over the years, group size in each group varied from 14-51 (E),
124 and 18 to 43 (W) [Ramos-Fernandez et al., 2018].

125

126

127 **Results**

128 **Case 1: Unidentified predator attack**

129 On February 2, 1997, at 07:50, upon disembarking from a canoe near the western shore
130 of the Punta Laguna lake (2km across, 20°39'10.3"N 87°39'01.1"W), GRF and a field
131 assistant saw a subgroup of spider monkeys moving north. Immediately after this, the
132 observers heard bark vocalizations coming from the southern direction, from a different
133 subgroup of spider monkeys. When approaching, 3 monkeys, including an adult female,
134 were alarm-calling. The monkeys had likely spent the night there, as there were fresh
135 feces accumulated under a large tree. On the ground, the observers found traces of fresh
136 blood, some of which appeared smeared as if left by a bleeding animal being dragged
137 away. The observers followed these traces for about 100m in a southern direction, until
138 they found an adult female spider monkey lying dead on the ground. The corpse had an
139 incomplete skull and brain, and a chest injury near the right arm. While sitting 20m
140 away from the dead body, the observers heard movement sounds coming from the area
141 around the dead monkey. The observers waited for approximately 30 min, but no animal
142 was seen approaching it. They then photographed and weighed the corpse (6kg; Figure
143 1a).

144

145 **Case 2: Puma predation attack**

146 On June 18, 2013, LB and two field assistants followed a subgroup of at least 7 adult
147 females and their respective juvenile and infant offspring, who started to travel from
148 their sleeping trees at 06:28. At 06:38 two adult females and two juveniles began to
149 attack an unfamiliar subadult female just encountered by the subgroup. At least 3 times
150 the subadult female approached the ground as a consequence of being attacked. At
151 06:43, observers heard a sound like a heavy piece of wood hitting the ground, coming
152 from the tree where the subadult female was seen. All members of the subgroup started
153 to produce alarm calls. A field assistant arrived at the location where the sound

154 originated and saw a puma running away [the species identification was confirmed by
155 the footprints using the key in Bowers et al., 2007]. Soon after, the observers
156 discovered the subadult female on the ground with severe head injuries including an
157 exposed piece of brain close to the left ear (Figure 1b). The subadult female was slowly
158 moving her head and legs, producing soft vocalizations. The other monkeys stopped
159 alarm calling around 07:20 and remained in the same location, resting quietly and
160 producing only three whinnies (i.e. contact calls: Ramos-Fernandez, 2005) at 07:37,
161 07:58 and 08:04. The observers sat 20 m away from the monkey to wait for the puma to
162 take its prey, but no animal appeared and no noise was heard. Between 09:00 and 09:20
163 all the other monkeys moved away so silently that observers did not realize when they
164 left. The injured monkey was still alive, but eventually died.

165

166 **Discussion**

167 Our observations constitute further evidence that terrestrial predators are a threat for
168 adult and subadult spider monkeys. The low frequency of observations of predation can
169 be attributed to three main factors. First, spider monkeys face a low predation risk
170 [Symington, 1987; Di Fiore, 2002]. The low predation pressure results in a low
171 perception of predation risk by individuals [cf. Hill and Lee, 1998], which allows them
172 to form small subgroups [mean subgroup size: 3-5 individuals, Chapman et al., 1995;
173 Ramos-Fernandez and Ayala-Orozco, 2003]. Second, predator behavior can be elusive
174 [Isbell, 1994]. If the predators' elusive behavior is partially related to their not being
175 habituated to human presence, predation events can be less frequent in areas with higher
176 human presence and on studied rather than unstudied primate groups [Isbell and Young,
177 1993]. Third, predation can occur even if rarely observed by researchers given that
178 Neotropical primate

179 skeletal remains are regularly found in puma and jaguar feces [e.g., Emmons, 1987;
180 Chinchilla, 1997].

181 In Case 2, an aggressive interaction occurred in the minutes prior to the
182 predation attack on the unfamiliar subadult female. Aggressive interactions from
183 resident females to recently immigrated females are not uncommon events in spider
184 monkeys [Asensio et al., 2008; Slater et al., 2009; Riveros et al., 2017]. Descending
185 toward the ground, as the subadult female did, is a common response by spider
186 monkeys to avoid aggressive interactions [Campbell et al., 2005]. The predation attack
187 presumably occurred when the subadult female was at a relatively low height. For a
188 species living mainly in the forest upper canopy, the ground is likely perceived as an
189 area of high predation risk [Link and Di Fiore, 2013]. If terrestrial predators are in the
190 same area when aggressive interactions occur, they may take advantage of spider
191 monkeys' tendency to escape aggressors by moving toward the ground, as we observed.

192 There are many benefits of long-term field investigations on habituated primate
193 groups [Kappeler and Watts, 2012]. One of these is the possibility of observing
194 relatively rare events. During our 20-year project we have documented rare events such
195 as raids [Aureli et al., 2006], within-group coalitionary killing [Valero et al. 2006], and
196 homosexual behavior [Busia et al., 2018]. Our observations of two predation events in
197 over 20 years represent further evidence that predation rate in spider monkey can be
198 extremely low, but also that terrestrial predators represent a threat to spider monkeys of
199 all age classes. These are important contributions to the appreciation of the role of
200 predation in spider monkey behavior. In addition to research on predator's diet [Hart,
201 2007], the use of camera traps and/or radio-collars on predators would make primate
202 researchers aware of predator ranging behavior and would help them better understand

203 the role of predation in driving behavior (e.g., degree of fission-fusion dynamics,
204 ranging) of primates experiencing low predation pressure, such as spider monkeys. .
205

206 **Additional note**

207 On May 14 2018, a local villager found a dead adult female spider monkey within the
208 home range of the studied monkey community. The monkey had been dead for a few
209 days and part of its head was missing. Although the head injury could have been
210 inflicted by a large cat, as in the events we report, we had no other evidence to infer a
211 third predation event.

212

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359 Zuberbühler K, Jenny D, Bshary R (1999). The predator deterrence function of primate

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362

363 Figure 1: Preyed spider monkeys: a) the adult female attacked by an unidentified