

The Secret Lives of Squirrel Monkeys

Social behavior takes surprising turns among these tiny primates

By BRUCE BOWER

Don't mess with Pacino. He brawls hard and dirty, and he stoically takes his licks. Constant no-holds-barred battles have left wicked scars on his mouth and nose. Still, he looks good compared with the guys he regularly thrashes. Their injuries include torn ears, permanent limps, scarred hands incapable of grasping, and missing tail segments.

Pacino is the alpha male—top dog, so to speak—in a troop of South American squirrel monkeys. As the undisputed champ of daily tooth-and-claw clashes, Pacino reigns over about a dozen adult males who operate as a loose-knit gang when not disfiguring each other.

Pacino and his male underlings dole out plenty of abuse to the opposite sex as well. Hostile acts range from grabbing fruit out of females' mouths to pinning females down to force them to copulate.

Simply put, these fuzzy little guys, weighing in at around 1.5 pounds, are pigs. Yet the long-suffering females show no signs of organizing efforts to protect their food or to fend off Pacino and his nasty boys. Instead, each adult female largely sticks to raising her kids and searching alone for fruit and insects.

So goes the unpleasant lives of standard-issue squirrel monkeys, an observer might conclude. Not exactly. The social arrangements of Pacino and his terrorized troop, who live in the country of Suriname, north of Brazil, are as different from those of Costa Rican squirrel monkeys as a street gang's code of conduct is from Amish etiquette. Moreover, Peruvian squirrel monkeys take another path altogether, emphasizing what some might call "girl power."

Among the Costa Rican primates, neither sex tries to push the other around or to control food supplies, and fighting almost never occurs. In Peru, however, close-knit groups of females rule. Males keep their distance as females peruse the best foraging spots; sexual activity takes place only when a female signals her readiness to a suitor of her choice.

Either of these social scenes would repel Pacino, whom researchers in the field named after actor Al Pacino, perennial movie tough guy. During the past 2 years, a team led by anthropologist Sue Boinski

of the University of Florida in Gainesville has for the first time documented the uneven battle of the sexes in the Surinamese squirrel monkey population.

Pacino the squirrel monkey, though he acts like his namesake's character in *Scarface*, plays in a larger drama that might be called *The Three Faces of Saimiri*. Scientists place all squirrel monkeys in the



Dubbed Pacino by researchers, the alpha male in a South American squirrel monkey troop bears facial scars inscribed during fierce battles over control of prime fruit patches.

genus *Saimiri* but have long debated how many species of these diminutive primates exist. Behavioral contrasts among *Saimiri* populations, combined with new DNA data, now support the existence of at least three distinct squirrel monkey species, Boinski contends.

Boinski's three-way species comparison also suggests that the time has come to revamp an influential model of primate social behavior. In particular, her work challenges the notion that intense food competition within a group always yields female alliances aimed at countering the power plays of pushy males.

Stark contrasts in squirrel monkey behavior further suggest that scientists have greatly underestimated the extent to which early *Homo* species and other human ancestors led diverse social lives, Boinski argues.

To top it off, the Florida researcher rejects the longstanding view that squirrel monkeys behave much the same in the

wild as they do in captive colonies. "Beyond descriptions of basic female-male relationships, more than 30 years of captive studies offer fragmented, often distorted, interpretations of squirrel monkey social behavior," asserts Boinski.

Peering through the thick foliage of a rain forest, a person has a tough time locating, much less keeping up with, groups of the dark-muzzled primates. So, only a few researchers have conducted detailed, extended fieldwork with squirrel monkeys. Boinski laments this situation but finds it understandable.

Squirrel monkey troops in the wild, which usually consist of 25 to 50 animals, cover home ranges measuring several miles across. Tree-swinging troop members zip through swamps and forests at a moment's notice, testing the reflexes and stamina of human observers. Tracking a specific troop becomes even harder in areas where the monkeys migrate seasonally across long distances.

As small-bodied animals vulnerable to predators such as snakes and jaguars, squirrel monkeys require at least 4 months to get used to the presence of curious scientists. Observers who pass that hurdle still find it difficult to tell individual troop members apart.

Boinski's team solves that problem by briefly trapping each animal and applying telltale dye marks.

A squirrel monkey troop often spreads out so far in the course of daily activities that most individuals cannot see any of their compatriots. To maintain contact, the monkeys yell out birdlike sounds that, after one hears them for a while, "are as blatant as a high school band," Boinski says.

Squirrel monkeys' evolutionary history is anything but blatant. Their species number from one to seven, according to various investigators. Boinski and University of Chicago anthropologist Susan J. Cropp have just completed the first genetic analysis addressing this problem.

From the hair of squirrel monkeys belonging to six separate populations and from a comparison group of South American capuchin monkeys, the scientists iso-

lated segments of mitochondrial DNA, which is inherited only from the mother. The squirrel monkey DNA samples fall into three distinct genetic groups. As a result, Boinski and Cropp argue in an upcoming *INTERNATIONAL JOURNAL OF PRIMATOLOGY* for the existence of at least three of the squirrel monkey species that were first described more than 20 years ago.

At different times over the past 2 decades, Boinski has studied representatives of these three species: *Saimiri oerstedii* in Costa Rica, *Saimiri boliviensis* in Bolivia and Peru, and *Saimiri sciureus* in Suriname and Guyana.

Squirrel monkeys throughout Central and South America look much alike physically and exhibit a fondness for berries and small, soft, easily husked fruits. At the recent annual meeting of the American Association of Physical Anthropologists in Columbus, Ohio, Boinski described the different groups' remarkable range of social behaviors. She also discussed the implications of their behavioral flexibility for understanding how primates organize their social lives.

Prior observations of squirrel monkeys in Costa Rica and Peru, conducted by Boinski and others, fit well with a popular model of primate social behavior. Its proponents theorize that as competition for food within a group intensifies, females prove more likely to remain in their birth troop and to form alliances with their female relatives.

As this competitive scenario plays out, according to the so-called ecological model, males compete fiercely for food. Males in their prime enjoy an advantage over younger males, who look to join new troops as they reach breeding age. Resident, related females in the new troops retain an edge over the incoming males in controlling who eats what and who copulates with whom.

By contrast, when food is plentiful and competition declines, the model predicts that males will usually stay in their birth troops while females will take up with new troops in order to diminish inbreeding. In such situations, related males frequently develop moderate-to-strong alliances.

Costa Rica's squirrel monkeys nicely illustrate this low-competition scenario. They gulp down fruit from small, isolated patches that require no protection and inspire few fights or aggressive displays. Males and females operate relatively equally. Females form weak social bonds with one another and disperse to new troops upon reaching maturity, while related males maintain modest alliances.

Peruvian squirrel monkeys uphold the ecological model from the opposite direction. They compete intensely for hard-to-defend fruit patches spread throughout large trees. Females live out their lives in their birth troop, where they join

forces with same-sex relatives to reign with an iron paw over males.

Squirrel monkeys in Suriname, however, show no respect for the ecological model. There, trees hold small, dense fruit clumps that one individual easily can, to put it bluntly, hog for as long as the bounty lasts. So, the alpha male takes the best fruit patch and his minions take the others, after some vicious squabbling. Boinski suspects that this "winner-take-all" strategy best protects against freeloaders who would pilfer the riches of fruit sources that are tough to find.

Yet despite constant, pitched battles over food, females of this apparent species settle for what fruit they can gather without forming alliances. They simply gather enough grub for themselves and their infants, while enduring unrelenting male violence and bullying.

Reasons for the females' unwillingness to band together remain unclear. Boinski's field observations suggest that Surinamese females leave their birth troops at maturity and enter new troops, where the lack of female kin probably discourages coalition building. Males may entice females to stay in a troop by offering them some, as yet unobserved, foraging assistance, she adds.

Only further fieldwork can tease out the subtleties of social interplay among these monkeys. For now, a general theme stands out. "Primates have coevolved with the plants and other foods that they eat," Boinski holds. "You need to know how large and predictable a species' food resources are and have been, to understand its social behavior."

Two capuchin monkey species living in a forested area of Peru also display distinctive social structures largely consistent with the ecological model, says Charles H. Janson of State University of New York at Stony Brook. Neither they nor any other monkey species, however, has shown the extreme social diversity noted in squirrel monkeys.

Little information of this kind exists for ancient species in the human evolutionary family. Dispersed populations of human ancestors could easily have matched or exceeded the range of social behaviors observed in squirrel monkeys, Boinski contends. Yet, this possibility gets short shrift in leading theories of prehistoric social life.

Boinski's efforts impress primate researchers who know firsthand about the skittishness of wild squirrel monkeys.

"Sue's one of the few people who's been able to get anything out of wild squirrel monkeys," remarks John G. Fleagle, also at Stony Brook. "They have the attention span of a gnat and are always flicking all over the place. It's like being in the middle of hurricane."

Fleagle accepts Boinski's argument for there being at least three squirrel monkey

species. Specific features of each species' habitat appear to have promoted unique social structures, Fleagle agrees.

Boinski's surprising observations of *S. sciureus* illustrate the need either to renovate or to raze the ecological model of primate social behavior, comments Carel P. van Schaik of Duke University in Durham, N.C., a prime architect of that theory. Certain types of conflict that have not been observed so far between the sexes, such as males killing newborns that they did not father, may deter alliances among females, van Schaik suggests.

Sally P. Mendoza of the University of California, Davis, who studies captive colonies of squirrel monkeys, considers it too early to draw firm conclusions from Boinski's findings. It's not clear why or to what extent the animals travel different social paths in the wild, Mendoza asserts. She views all squirrel monkeys as part of one genetically diverse species.

Scientists have long noted behavioral contrasts between captive colonies imported from the regions where Boinski studied *S. boliviensis* and *S. sciureus*, Mendoza notes. "Genetic variation or hormonal factors could account for the monkeys' behavioral differences just as easily as patterns of food distribution," she holds.

Also, she doubts that the forced copulation reported by Boinski in Suriname occurs regularly. "I've never seen nor can I imagine forced copulation among squirrel monkeys," Mendoza contends.

The new evidence for genetic distinctiveness of wild squirrel monkey species may challenge the widespread use of their captive relatives in biomedical research. Most captive animals are hybrids of a number of different species, Boinski argues. In her view, it's difficult to interpret the relevance for either wild squirrel monkeys or humans of medical and physiological data gleaned from small groups of these animals.

Boinski's concerns about genetic confusion in captive-monkey research are overstated, Mendoza argues. Mixing of monkeys from different regions, resulting in hybrid offspring, has rarely occurred in captive colonies over the past 20 years, the Davis researcher holds. Boinski vigorously disagrees.

Her most pressing concern, however, is not the animals' use in medical research but further investigations of squirrel monkeys' behavior in the wild. She suspects that such work will uncover an even wider range of social behaviors. Finding scientific recruits willing to spend weeks chasing speedy monkeys through miles of forest and swamp presents a major challenge, though.

"Each year I have several graduate students who try this fieldwork and give up on it," Boinski says, sounding both amused and dismayed. □