

Excerpt from forthcoming book manuscript: Manipulative Monkeys: The Capuchins of Lomas Barbudal By Susan Perry with Joe Manson

Table of Contents:

Prologue	1
Chapter One: All in a day's work	10
Chapter Two: The social intelligence debate and the origins of the Lomas Barbudal Monkey Project	33
Chapter Three: The challenges of foraging and self-medication	69
Chapter Four: Predators, prey and personality	95
Chapter Five: Capuchin communication	118
Chapter Six: Abby and Tattle: Two females' political careers	154
Chapter Seven: Curmudgeon: The Career of an Alpha Male	177
Chapter Eight: Moth and Tranquilo: The Strategies of Incoming Alpha Males	223
Chapter Nine: Kola and Jordan: Lethal Aggression and the Importance of Allies	272
Chapter Ten: Miffin, Nobu and Abby: Capuchin Mothers, Infants and Babysitters	308
Chapter Eleven: Guapo: Innovation and Tradition in the Creation of Bond-testing Rituals	341
Chapter Twelve: Social learning and the roots of culture	365
Chapter Thirteen: Nobu and <i>La Lucha Sin Fin</i> : Conservation of Tropical Dry Forests	397
Epilogue	421
Appendix One: Timeline of events in Abby's and Rambo's groups	439
Appendix Two: Cast of characters	443
Appendix Three: Glossary of behavioral terms in capuchin communication	452

Prologue

When I am in the Costa Rican forest and have the opportunity to watch and listen to tourists or local farmers passing by the monkeys, I am always struck by the profound difference in the way they perceive the animals, compared to my own perception. Tourists seem to see the monkeys as clones of one another – as multiple copies of a particular species template, that just happen to be near one another at the moment. Some are bigger than others, but other than that, they are all alike. A few attribute emotions and intentions to the monkeys who make eye contact with them, but typically only to attribute to them the ignoble intention of wanting to defecate on them or to “throw” a stick at them. Most of them think that after five minutes of observing these monkeys, they have learned all there is to learn about these animals: they are black and white, furry, and live in trees. As far as I can tell from their comments, it never occurs to them that these animals are part of a complex network of alliances and social intrigue that extends through vast regions of forest, and that is influenced by decades of historical circumstances. My own understanding of the social complexities of capuchin social life has been steadily built up over 15 years of hard work, tracking changes in individuals’ social circumstances and strategies as they grow up, form friendships, make enemies, and move to new social groups. Careful analysis of patterns of social behavior has led me to understand not only that the monkeys pattern their social interactions in complex ways, but they also have excellent understanding of the quality of other monkeys’ social relationships. Now, when I encounter a male monkey in the forest, I know a great deal about him: I know his parents, in most cases, as well as his brothers, sisters, cousins and aunts. Also, I have hundreds of hours of meticulous records of this monkey’s social interactions and social development. Most importantly, I know that he is not merely a resident of his current social group. His head is still filled with memories of monkeys he has known in other groups, and he knows quite a bit about the lone males who will be challenging him for reproductive opportunities in his current social group. There is no doubt about it: capuchin monkey social life is every bit as complicated as that of the Old World monkeys and apes. When I look at an individual monkey, I now see it not simply as an individual, but as an active agent connected to hundreds of other individuals in a complex and constantly shifting social structure. When I stand on a hilltop at my field site at Lomas Barbudal, looking for signs of monkey life hidden in the vast expanse of vegetation, I can palpably feel the forest seething with simian drama. I know that somewhere out there, females are feverishly grooming the same female relatives with whom they have been allied for many years, while other group members tend their infants. Meanwhile, their juvenile offspring are racing through the brush, wrestling with one another and perhaps inventing new games that will prepare them for the challenge of coalitionary politics once they are adults. And although they may seem at first glance to be less immediately involved in the frenzy of social activity as they sit on the sidelines, the adult male capuchins are nervously eyeing their allies for signs of treachery and keeping their eyes open for opportunities to better their social positions. As these males wander through the forest searching for potential allies or mating opportunities, they

know that the sort of reception they will receive with any particular individual they encounter will vary from warmest affiliation to lethal aggression, depending on who else is present when the encounter occurs, and so their cognitive machinery is constantly whirring, trying to remember who is friends with whom under what circumstances. As I stand on the hilltop, surveying the scenery below me, it is possible that two monkey groups are unknowingly drifting towards one another, to have an intergroup battle that will change capuchin history. It drives me crazy that I cannot know every fascinating detail of each monkey's life, but I am grateful that I have had the privilege of spending so many thousands of hours in their company.

But what are capuchins, anyway, and why did we decide to study them originally? When Joe and I explain our work to people outside the small worlds of academic biology and anthropology, we usually cite a number of movies and TV shows that have featured capuchin monkeys: *Friends*, *Outbreak*, *Monkey Shines*, and *Monkey Trouble*, to name a few. Because of their cleverness and trainability, capuchins are popular as movie stars, as helpers for paraplegics, and as pets. Although they shine in these roles, they are not nearly as fascinating in captivity as they are in their native forests of Central and South America, doing the things for which natural selection has shaped them to excel. Capuchin taxonomy is in a state of constant flux¹. But most taxonomists recognize that the tufted, or brown, capuchins (e.g. *Cebus apella*, *C. libidinosus*, *C. nigritus*, *C. xanthosternos*) form one broad taxonomic group, which is distinct from the non-tufted capuchins (*C. capucinus*, *C. albifrons*, *C. olivaceus*, *C. kaapori*), and some taxonomists believe that these two groups represent different sub-genera. Within each sub-genus, there is virtually no geographic overlap between the species; however, most parts of South America are home to one species of tufted and one species of non-tufted capuchin. Susan chose to study *Cebus capucinus*, the white-faced capuchin, not so much because it stood out in any way from the other species (at that time, very little was known about capuchin behavior in the wild), but because it resided in Costa Rica, a peace-loving country where we felt comfortable starting a long-term study. *Cebus capucinus* is the Central American capuchin, and it has a quite limited distribution, extending from Honduras down to the northern tip of Ecuador. There are reports of some limited range overlap with *C. albifrons* in Ecuador, but in most of its range, *C. capucinus* is the only capuchin species. Most of what we know about capuchin monkeys comes from studies of *C. capucinus* and *C. apella*.

Capuchin monkeys have captivated the public with their curiosity, agility and cleverness for hundreds of years. European travelers' reports from the 15th and 16th centuries comment on the curious behavior and appearance of these monkeys, and the similarity between coloring of the hair on their heads and the form of the cowls of capuchin monks is what gave the capuchin monkey its name. Reports of capuchins' tool use and elaborate foraging techniques date back 500 years, and the amazing ability of these animals to create and manipulate tools has been peppering obscure corners of the scientific literature ever since, though it has only come to the forefront of media attention in the past decade. Noted scientists such as Erasmus Darwin², Georges Romanes³, Thomas Belt⁴, and Heinrich Klüver^{5,6} were impressed by their manipulative ability, though an early prejudice against the intelligence of New World primates in comparison

with Old World monkeys and apes kept these results from becoming prominently featured.

In the 1980s and 1990s, primatologists such as ourselves began flocking to the neotropics in search of comparative data with which to test models of social evolution and the evolution of intelligence that had been developed out of empirical data sets on Old World monkeys and apes. Once we began collecting systematic data on this fascinating genus in the wild, there was no turning back: again and again, these monkeys challenged our pre-existing notions about what monkeys should be doing. And we began to discover that capuchins had *independently* evolved many characteristics that are identical to those that biological anthropologists most want to explain in humans: They had enormous brains, and they were experts at making and using tools to get food. They had varied and eclectic diets that included not only fruit and insects, but also meat, which was highly valued and shared. Capuchins combined a quick temper with an ability to perform quick mental calculations, such that they were formidable hunters and also teamed up with allies to kill members of their own species. But their social skills were not all spent on cruel Machiavellian plots: even the most aggressive males also cooperated in more benign contexts, such as cooperative care of infants and joint defense of the group against predators. Because their social relationships are so important to them, capuchins, like humans, are constantly testing their bonds. As in humans, non-conceptive sex is often an important means of communicating about the quality of their relationships with one another. But capuchins are intellectually creative, and much of their creativity goes towards devising unique rituals for testing and maintaining the strength of their friendships, and these rituals are transmitted within cliques of allies, such that traditions form. By the end of the 1990s, enough evidence for similarities between capuchins and humans had emerged that it was widely acknowledged that capuchins were one of the key taxa from which data were needed in order to understand critical aspects of human evolution. They had earned the title “the apes of the New World.”

The Lomas Barbudal monkey project was started in 1990, as part of Susan’s dissertation research on a single capuchin monkey troop. Since then (largely due to the generosity of the Max Planck Institute) it has expanded to include regular study of five monkey groups, and has a staff of about 10-12 researchers at any given time. Our research focus has been on social behavior, broadly defined, including topics such as dynamics of social relationships, social cognition, communication, mating systems, social development, and social learning. Because we have always been based in anthropology departments, we tend to gravitate towards those same questions that have always fascinated evolutionary anthropologists trying to explain human origins.

Our colleagues Dorothy Fragaszy, Elisabetta Visalberghi and Linda Fedigan recently published a landmark book, *The Complete Capuchin*¹, which summarizes in exquisite detail all of the work that has been done on this remarkable genus prior to 2002. It is not our intention to replicate this work by attempting to provide a complete description of the work that has been done in all capuchin species. In this book, we focus almost entirely on the research done at our own study site, Lomas Barbudal, and we attempt to describe for the layman what capuchin society is like, just as early ethnographers wrote vivid and enthralling descriptions of the human societies in which they worked. Although the work of early ethologists (researchers of animal behavior) such as Niko Tinbergen and Konrad Lorenz was rich in the description of natural history,

the recent trend in scientific writing, even in animal behavior journals, has been to ruthlessly edit out anecdotes and rich descriptions of behavior, relying strictly on quantification of behavior patterns to test particular hypotheses. In our experience, understanding any aspect of an animal's behavior is enriched by knowing as much as possible about the whole organism, as well as the society and physical environment in which it lives. In teaching primate behavior to undergraduates, we also find that they are more enthusiastic about the subject if we thoroughly immerse them in the details of just a few species, so that they can visualize what their lives are like, rather than hopping from species to species every time we switch to a new theoretical topic. This book was written in part to aid our students in understanding what it is like to be a capuchin monkey, and what it is like to do primatological research. But we hope that it will appeal to anyone who is interested in animals or in evolution. And most of all, we hope that it will be read by policy makers in tropical countries where capuchin monkeys reside, so that they will appreciate the importance of these fascinating animals and assist in the drive to conserve their habitat.

Susan wrote most of this book, aside from Chapter 6 (on female-female relationships), which was written primarily by Joe, from Joe's perspective. So the use of the word "I" means Susan throughout most of the book, except in Chapter 6, where it means Joe. Like most married couples, we cannot resist interjecting our own commentaries into one another's stories. In particular, Joe contributed to the discussions of alloparenting, mating systems, and lethal aggression.

Although we attempted to limit our examples to just a few monkey families, so as to avoid overwhelming the reader with names, it was nonetheless necessary to introduce quite a few monkey characters in order to demonstrate the complexity of capuchin social life. In order to make the reader's life easier, we have provided a "cast of characters" at the end of the book (appendix two) that provides information on each monkey's position in the social organization. We also provide a timeline of some of the key historical events in the Lomas Barbudal monkey population (appendix two) and a glossary of behavioral terms to guide the reader through the capuchin communicative repertoire (appendix three). Hopefully these additions will enable the reader to appreciate the number of individual identities and social relationships that each monkey must track over time in order to become a successful member of society. The first chapter provides the details of a typical day in the life of a monkey group, and subsequent chapters discuss particular types of social or foraging challenges that the monkeys must solve.

Los Angeles, February 2006

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Chapter One: All in a day's work

I jolt awake and look at my watch in a panic, thinking, as I do most nights, that I have overslept. It is 3:12 a.m. I could sleep another 3 minutes, but why bother? Silently, so as not to wake my husband, I pull on my green army pants, tucking them into woolen socks, and put on a long-sleeved shirt and machete belt. I rush to the kitchen, ignoring the scurrying of roaches and mice that scuttle into various holes in the termite-eaten walls, and force myself to drink half a liter of warm milk. Ugh, what a way to start the day. I grab my smelly jungle boots, still wet and slimy from the previous day, pound them against the ground to evict any scorpions or ant colonies that have lodged there over night, and put them on my feet. I buckle my leather snake leggings over those, pull on my fishing vest packed with gear, grab my backpack, and creep out the door, closing it as silently as I can.

As I pull myself over the concrete wall and push myself through the overgrown plants into the yard of the house next door, I am greeted by the usual morning mayhem. Seven men and women are stumbling about in the dark, struggling with snake leggings, and muttering to one another. "Do you have a radio?" "Who has the GPS?" "Does this cable work? Do you have the microphone?" Nick is already in the driver's seat of the Land Cruiser, trying his best to look patient. Eva is standing at the gate, ready to close it after we pull out. We pile into the back of the vehicle, and stack and restack the gear until it all fits. One person is still running in and out of the door repeatedly in a panic, looking for something. I hear an exasperated sigh from someone in the car. "Come ON! We're not going to get there in time!" hisses a voice in the dark. Finally the last body is squeezed into the car, and with great effort, we manage to close the door.

For the next 30 minutes, we sit tense and silent, crouched so as not to bash our heads on the ceiling as the car rattles over potholes in the dark. We are packed in like sardines, with backpacks weighing uncomfortably on our laps, keenly aware of one another's body odors. Someone in the front seat attempts to start a conversation and is greeted with surly silence. Nothing is funny at 4 a.m. The car passes by several pastures, drives by a few shacks and a couple of nicer cement houses, and then comes to a stone wall topped by an additional barbed wire fence. The car slows. "How are you going in?" asks Nick. "Past the tanks, or past the dogs?" "Donde los perros." "Be careful – I'd leave the road before you get to the second fence. They probably won't follow you there." "You've got a radio, right? We'll keep ours turned on, we should be able to hear you. Suerte!" Mino expertly climbs the fence, evading the barbs on the wire, and drops over the other side. In a few seconds, he has disappeared into the dark.

The Land Cruiser rattles down the road further, dropping additional people off at various points along the way. It descends into a wooded valley and lurches to a stop by a river, pulling off the road into the trees just before the gravel road crosses through the river. As Nick and I climb out of the car, a troop of howler monkeys challenges our arrival, roaring at the top of their lungs, and ending this display with a series of gurgles. Leaving the car behind, we jump a wooden fence and rush through the woods in the dark. "Where did you leave them again?" I ask after we have been walking top speed for about 20 minutes. "Near the 3-hour-tour road. We'd better hurry." We hurtle through the dark, brushing aside branches as we go and doing our best to keep an eye out for snake-like movements and patterns in the leaf litter. Nick curses and calls out "Wasp nest!"

“Thanks!” I say, and take a different route, which is less painful than his but plasters me in the face with a spider web. As we hear the sound of the waterfall up ahead, we slide down the river bank into the cool water. I wade in to my thighs, carefully negotiating the bottom of the river so as not to slip, while Nick tries the more daring approach of hopping from boulder to boulder in the dark in a vain attempt to keep his feet dry till at least 6 a.m. I hear a small splash as he loses his footing and recovers his balance. “Zip-locs?” I ask as I double check to make sure my radio is sealed in its Ziploc bag before replacing it in my pocket. “Yup” responds Nick. I slosh up the far bank, water spewing out the vents of my jungle boots. Glancing anxiously at the lightening sky, we rush through the forest for another 15 minutes. Now Nick begins to stop and listen every 50 meters or so. “Think we should split up?” I ask. “Yeah, maybe so. They should be here, but who knows – it was a full moon.” The sound of crickets and frogs is punctuated by a scream. Both Nick and I jerk our heads in that direction. Another scream breaks out about 50 meters away. “I’ll get that one,” says Nick, as he crashes through the brush towards the second scream.

I pull out my Psion palmtop computer, set the time and date, and begin typing. “Abby’s group. Location: 3-hour tour road/Cabuyo intersection. Adlib: Scream, unknown individual.” It’s too dark still for binoculars to be much use, but I peer up into the canopy at the cat-sized, curly-tailed black figure above me. The screamer and another monkey are silhouetted against the sky. They break into a “dance,” both of them grunting rhythmically and pacing back and forth, warily moving closer to one another. This continues for about a minute, and then the smaller of the two loses her cool and begins screaming again. Her dance partner lunges at her, and then two other monkeys run over to put in their two cents worth. Now three monkeys are lunging at the screaming monkey, who is kneading her prehensile tail tip between her hands. “Why does the important stuff always happen before the sun comes up?” I joke to Nick, as he runs over. Meanwhile, other pairs of monkeys start dancing, and a third fight breaks out. “Complete chaos, at 5:24:32 a.m.,” I say in an exasperated tone into my microcassette recorder – we jokingly make a habit of recording the time to the precise second when these chaotic pre-dawn events occur, since the time is the only aspect of the event that *can* be noted precisely. “I think the victim is Opie,” says Nick, squinting at the squirming, squealing monkey. “I’ll keep an eye on her till it gets light.” “Watch out!” I cry, as a monkey breaks a branch above us. We both leap out of the way, and the branch falls between us. “What’s your problem, Thornhill?” Nick asks, as we gaze up at a familiar figure who is unmistakable even in silhouette, with his left ear missing and a snaggletooth protruding at a 45-degree angle through his right lip.

It is March 2003, and I am following a group of white-faced capuchin monkeys that I have studied for 13 years. I came here to Lomas Barbudal, Costa Rica, as a graduate student in 1990, looking for an appropriate species in which to investigate the evolution of intelligence. Capuchins seemed like the ideal species, since they had extraordinarily large brain sizes (larger for their body size than any primate except humans) and had evolved this trait quite independently from apes. As I expected they would, capuchins turned out to be a fascinating study species, living in complex societies characterized by enough political intrigue to keep me fascinated for years on end. Nick Parker is one of over 40 field assistants who have come to us from all over the world to volunteer for the project. Many leave after just a few weeks, horrified by the many nuisances that plague monkey biologists in the tropics, but Nick has been with the project

for 9 months and is already an extremely skilled observer. It's a typical morning. We're already exhausted, even though our work day has officially begun only 2 minutes ago. And the monkeys, as usual, are cranky and belligerent. Fortunately, experience tells us that both monkeys and observers will get a second wind and an improved mood once the sun comes up and we've had some proper breakfast. I pull some cookies out of my pocket, and the monkeys start gnawing on sticks and guacimo fruits. I've only taken one bite, however, before Thornhill mounts Rain, a juvenile male, and the two of them begin grunting. Sex turns rapidly to play wrestling, and I abandon breakfast for a while to take notes on the computer.

By 6:20 a.m, the sun is high enough in the sky that we can reliably identify the monkeys. This year, the main focus of research is the social development of infants. The primary data collection protocol involves following a single monkey for 10 minutes and recording all of its social behaviors, foraging behaviors and self-directed behaviors. In addition, we record the comings and goings of all other monkeys within 10 monkey body lengths of the focal animal, and also note behaviors by nearby monkeys that could affect the focal animal's behavior. Young monkeys move quickly at all times, and so it is really a two-person job. Both observers watch the monkey, so that the identification of the monkeys and the coding of the behaviors can be cross-checked on the spot. One person narrates aloud while the second one types into the palmtop computer. If the action gets too quick to type and watch the monkey simultaneously, the data are recorded on a microcassette recorder and then transcribed into the appropriate place in the data file when the day is over. Every 2.5 minutes, and also at the beginning and end of the follow, my watch beeps to remind us to note the proximities of all animals to the focal animal.

Our first focal animal for the day is Yasuni, the 2-year-old son of Opie, the female who had been attacked first thing in the morning. I volunteer to be the spotter, while Nick types. As we start the follow, Yasuni is alone and chewing on a stick, in the hopes of finding insects inside. The stick is unoccupied, so he abandons it and pounces on a cluster of dry leaves. He slowly releases his grip on the leaves and his head darts forward to consume an insect that is concealed inside the dry leaves. Then he scampers over to a young playmate who is foraging on guacimo fruits. He handles one, and then abandons it uneaten to climb into the adjacent *Bursera* tree, where he begins munching on the hard, turpentine-flavored fruits. His gaze wanders to Toulouse and his nephew Rain, a pair of low-ranking juveniles. Yasuni glares at Toulouse, the younger of the two, and opens his mouth, baring his teeth in the stereotypical threat face. Instead of defending his uncle, Rain runs over to Yasuni, puts his arm around his shoulders, and joins Yasuni in threatening Toulouse. Such coalitionary play is common in capuchins, and they have an elaborate repertoire of gestures designed to show who is siding with whom. Yasuni bounces menacingly at Toulouse, who seems completely unperturbed by the situation. Unable to get a rise out of their chosen victim, Yasuni and Rain part company. Yasuni bounds over to another pair of juvenile males and nuzzles one of them. Then he races over to his mother, pausing to see what she is doing, and runs back to Toulouse again, who has joined company with another infant male his own age. This time Yasuni is friendlier, approaching him to contact and observing with intense but rather polite interest as Toulouse handles a leaf, looking for insects. Once the insect has been consumed, they drift apart again. He wanders about, approaching and leaving various juvenile males who are foraging, and then comes to stare me in the eye. Once again, he walks over to

Toulouse and his older brother Solo, an adolescent. Solo gives him a friendly cuff on the head, just as Nick's watch beeps to tell us that Yasuni's 10 minutes are up. "Last point sample, activity social play, one length of Solo, Toulouse and Marañon, five lengths of Cassie and Bailey, and ten of Thornhill. End of follow," I say. "That was pretty easy for a Yasuni follow," says Nick. Most follows of Yasuni seem to involve high speed chases of his best friend Cassie, and wild play bouts in which 5-10 other monkeys pile on top of him in a ball, wrestling and biting one another non-stop. After following these frenetic, play-crazed monkeys for just 10 minutes, we feel like we have been collecting data for an hour, because so much happens in just a few minutes' time.

When the focal follow is over, Nick and I split up, circulating through the group as we look for the next focal animal we need. As we wander through the group, we perform a "group scan," in which we mark the activity of each monkey we see, and the spatial relationship of that monkey to every other monkey within 10 body lengths of it. Each monkey is scanned no more than once per 30-minute period. We use these data to get a sense of which monkeys most frequently associate with one another and also to determine how the type of activity affects proximity to particular individuals. For example, infants may prefer to sleep with their mothers, even though they spend much of their foraging time peering over the shoulders of adult males, and most of their play time in the company of age-mates who are more exciting than their mothers.

As we cycle through the group performing these group scans, we also document anything interesting we see: for example, sex, aggression, grooming bouts, and interactions with other species of animals. At the moment, however, there is little action. Most of the group has moved into a big *Sloanea terniflora* tree to eat the fruits. *Sloanea* is one of the most popular foods in the capuchin diet. It is, however, far less popular among the researchers and is, in fact, currently the number one most hated "field site nuisance," defeating the snakes, wasps and killer bees hands down. The big, buttressed trees are huge, with thick canopies that make visibility difficult. But worse yet, the fruits are coated with tiny purple hairs (which account for the Spanish common name of the tree: *terciopelo*, or velvet). In order to access the tiny kiwi-flavored fruit inside, the monkeys must remove the hairs from their protective capsule and then bite off the end of the capsule. These hairs are virtually invisible to the human eye, and they are extremely sharp, like shards of fiberglass. As the monkeys forage above us, these dislodged hairs float down in shimmering purple clouds to land on us, going straight through our clothes and lodging in our skin or, worse yet, in our eyeballs. Once they are in your skin, you start itching like mad. The most frequently used attachment of a capuchinologist's Swiss army knife is the tweezers, which we use about 40 times a day, to remove these annoying hairs. Nick and I had both been to the hospital in the past couple of months to have *Sloanea* hairs removed from our eyes, and so we reluctantly pulled safety goggles from our packs and put them on, sweaty and annoying though it is to wear them while working in a tropical forest. One of the studies we are currently conducting is the role of social learning in the acquisition of food processing skills. Since *Sloanea* is one of the most difficult-to-process foods in the capuchin diet, it is one of the food species for which we have developed a special data collection protocol.

Nick sensibly edges over to the upwind side of the tree and calls out "I'm starting with Al Gore." (Al Gore is a juvenile monkey, named by an enthusiastic Democrat. According to project tradition, whoever sees the newborn infant monkey first gets to

name it according to project tradition.) “OK,” I respond. How about I’ll cover Vishnu, Jackson, and Diablita and anyone else who comes up to the trunk of the tree, and you do everyone else?” “Sounds good.” We pull out our microcassette recorders and get to work. I start with Jackson and begin to narrate into the recorder. “Jackson has plucked an entire twig from the tree and holds it in his right hand, scrubbing the fruits against the branch. As he does this, his left hand swings back and forth in the opposite direction of the right hand, and it slaps the fruits every time the two hands pass one another. He is in 10 body lengths of Vishnu, who is also processing, but neither of them is looking at the other.” Jackson bites off the tip of the capsule and uses his fingers and tongue to pluck out the fruit and eat it. I pause and wait for Vishnu to select a new fruit and then record her movements: “Vishnu grasps a single fruit in the left hand and draws it down the branch in a long, slow stroke. Then she holds the fruit in both the left and right hands simultaneously, and pushes it up and down the branch repeatedly, using the force of her entire body to push it against the branch. Ten lengths of Jackson, neither looking at the other.” Then I move on to Diablita, the alpha female. Like most adults, she has a set routine, efficient and inflexible. She selects an entire twig, holding onto the twig so as not to touch the annoying hairs on the fruit, and scrubs quickly and rhythmically against the branch with her left hand. She does not look at anyone else in the tree, but is focused on the foraging task. Five lengths away, 4-year-old Al Gore is still refining his technique. Like Diablita, he holds the twig in the left hand and scrubs. But midway through the task, he seems to get impatient with his progress and scrubs the hairy fruit between his two palms. He does manage to get some fruit via this technique, but he spends quite a bit of time wiping his palms on the branch to rid them of hairs that have lodged there. Undaunted, he picks another fruit and tries again. This time he starts by ineffectually pounding the fruit against the branch before resuming a scrubbing strategy. Now he is scrubbing as fast as he can with the right hand, and his left hand is spastically flailing about. It takes the juveniles several years to master this technique, and some of their earlier attempts are hilarious. Sometimes, after watching mom forage, infants will rub the hairy fruits all over their entire bodies, apparently understanding only that these fruits are interesting and should be scrubbed somewhere, but completely misunderstanding the purpose of the scrubbing.

After an hour or so, the last of the monkeys leaves the *Sloanea* tree, and we very gladly take off our goggles, brush off our clothes, and start picking hairs out of our skin. As I remove the teensy purple hairs, I also notice several virtually microscopic dots moving slowly up my shirt. “Uh oh Nick, better check for ticks, I seem to have walked through a nest.” “Can I have some masking tape?” he asks. I pull out a roll of wide masking tape, hand Nick a piece, and we both proceed to run tape all over our clothes. I go through several pieces of tape before I am satisfied that I have removed the dozens of little seed ticks from my pants and shirt. Nick fares better, with just 6 ticks.

The monkeys begin to socialize once more. Nut, a 7-year-old natal male, grooms Thornhill. When Thornhill fails to reciprocate, Nut walks over to Tattle, a low-ranking adult female, and supplants her at her foraging spot so that she screams and moves away from him. Thornhill stands up, arches his back, and fluffs out his hair. He places his hand between his legs and begins to urinate, splashing urine around in a boisterous way before strutting down the branch. Then he crouches and makes eye contact with Vandal, another adult female. She responds by pursing her lips so that they resemble a duck’s bill and

uttering a series of breathy squeaks that rise in pitch. Then she begins to grunt rhythmically. Thornhill also purses his lips in the “duck face” and pirouettes, never taking his eyes off Vandal. All of these vocalizations and gestures are part of the typical courtship display. It is hard to imagine a young, attractive female like Vandal being sexually attracted to someone as asymmetrical and decrepit looking as Thornhill, but of course the monkeys often surprise us. In this case, Vandal loses interest before a mating occurs. We move on to collect more focal follows of infants.

The rest of the morning passes quickly, as we efficiently move through our list of subjects, losing only one focal animal before her 10 minutes are complete. We hear an occasional gunshot, probably from someone hunting deer or peccaries, but it sounds like the poachers are too far away to worry about today. The monkeys meander slowly down the river, sometimes foraging in the canopy above the water, and sometimes moving out into the drier areas to forage on insects and guacimo fruits. We pass right through a group of howler monkeys, who are napping, as usual. It is hard to believe that howlers and capuchins are from the same family – they could hardly be more different! Howlers spend about 80% of daylight hours sleeping, and all of the night as well. When they are awake, they spend most of their time just eating, and it is extraordinarily rarely that they engage in any social interactions. They just can’t be bothered. Capuchins, in contrast, are rambunctious and feisty all day long and go out of their way to make trouble for anyone who crosses their paths. “Go get ‘em, Cassie!” chuckles Nick, as his favorite juvenile, a 2-year-old male, charges toward a pair of snoozing howler monkeys and shakes the branch they are on, waking them up. They hoot a little bit and pull themselves up, backing down the branch away from Cassie. Thrilled with his success, Cassie once again lunges at the howlers, both of whom are twice his size. A subadult male, Till Eulenspiegel (named after the legendary German mischief-maker), rushes to Cassie’s assistance and chases the hapless howlers out of the tree. Till forces an adult female to the end of the branch and glowers at her, as she clings helplessly to a few tiny twigs and looks anxiously up toward him. Then he gives her a final push, and she falls a few meters to a branch below. Both Cassie and Till bounce and squeak at the howlers, wagging their tongues at them menacingly, as the howlers slink away.

Shortly after noon, we come across a forest fire. A few days earlier, a forest fire had begun on a nearby ranch and had burned quite a large section of forest before we discovered it. We had run for assistance from Daniel Rojas, a *campesino* (Costa Rican farmer) who has been our staunchest ally in defending the monkeys’ forest in the past few years. He brought rakes, shovels, buckets, and a “*bomba*” – a plastic “backpack” with a pump for spraying water or insecticide on plants. We spent the better part of the day cutting firebreaks with machetes and rakes, and hauling water from the river to put out flames. Daniel, a short, wiry man in his 60s, always puts us to shame in these situations by cutting *rondas* (firebreaks) three times faster than we can, and hauling far more water than we can manage. While we are sweating, dehydrating and choking on the smoke, he cheerfully tells stories, makes good-natured jokes at our expense, and proceeds with the work without breaking a sweat. Apparently we had not been entirely successful in putting out the fire before, because now there was a burning fallen tree that was threatening to spread the flames across the *ronda* to unburned portions of the forest. Sometimes the roots of burning trees are so hot that fires rekindle hours after they have apparently been doused. Setting aside data collection for a while, Nick and I chop a new

firebreak around the crown of the tree with a machete and haul water rather ineffectually in Ziploc bags from the river, which fortunately is nearby, to extinguish the flames. The monkeys never react at all to flames and seem unfazed by the smoke.

An hour later, having accomplished all we can with just a machete and a leaky Ziploc bag, we leave the still steaming tree and resume data collection. The infants and juveniles are having a wild play bout, scampering along the ground. As they rush past us, one of them reaches out a hand and playfully slaps Nick. Jackson, one of the males who had immigrated to Abby's group from nearby Chingo's group relatively recently, forages on guacimo fruit just a meter away from us. "His wound is healing pretty well. Did you see it?" asks Nick. "No, not today," I answer. "Hey Jackson!" calls Nick, trying to get him to turn around so we can see his forehead. Nick tries all his funniest noises, trying in vain to get him to turn around and look at us. But he is too busy eating to care about anything we do. In a few minutes, however, adult female Vandal comes into view, and then suddenly Jackson fluffs up his hair, jerks his head toward Vandal, and bounces up and down on the ground in front of us, threatening Nick. Vandal starts threatening Nick as well and moves towards Jackson. We pull out the sound recording equipment and try to get some of the threat vocalizations on tape. Little Dali, the infant daughter of the alpha female, runs up to Jackson, squirming with excitement, and shakes her head back and forth rapidly, lips smacking and teeth chattering as she looks at him. Her immense clitoris is erect, and her hair stands on end as she produces a harsh, guttural series of gargling sounds. Inching closer to Jackson, she scrunches up her face like an accordion and "gargles" some more while staring at him. Dali's mother Diablita rushes over and threatens me. She is soon joined by her 4-year-old niece Fishy, who also threatens me, pressing her cheek against her mother's as she does so. Fishy then climbs on top of her aunt, stacking her head on top of mom's like figures in a totem pole. Both threaten me again, and Diablita twitches and bounces at us. In her excitement, she grabs Fishy's toes and chews on them while glowering at us. Fishy's cousin Cookie rushes over to join the excitement and takes Diablita's place on her back, threatening us. Diablita makes strange, soft, growly sounds in her throat as she stares at us. Nick and I pretend not to notice their aggressive display, humorous though it is. Finally they get tired of threatening us and return to foraging.

The infants and juveniles keep us busy with exuberant play bouts for the next couple of hours of focal follows. This is normally a lot of fun, but today, instead of choosing a nice flat place to play, they are sliding up and down a cliff, which makes data collection difficult. Every now and then they all dash to the top of the cliff, and then they chase each other, progressively sliding lower and lower until they make another mad dash to the top. There is really no good vantage point, especially since there is a virtually impenetrable (to humans) vine tangle midway up. We abort three focal follows in a row, as the monkeys zip up and down the cliff with us clambering behind them, cursing and trying futilely to find some plant to hold onto that does not have thorns on it. The ground is dry and often gives way beneath us, causing minor avalanches. Finally Nick stays at the top of the hill, and I stand in the middle of the cliff, clinging to a sapling. I narrate the data into a microcassette recorder, with Nick radioing the action to me on walkie talkie when the monkeys get out of my view for a few seconds.

While the youngsters play, adult female Mani stealthily courts Jackson. She follows him at a distance, rarely taking her eyes off him, and makes "duck faces" at him.

Whenever he moves towards her, however, she loses her nerve and backs away a bit. A juvenile natal male, meanwhile, pursues Mani, making duck faces at her. The three of them make an odd procession.

Around 3 p.m., the monkeys once again troop into a grove of *Sloanea* trees for a second feast. This keeps them busy for the next several hours. Occasionally they make little forays into shorter, leafless trees to look for insects. Cookie spends quite a bit of time searching for ants: she gently strokes sticks, while looking for evidence of ants leaving their holes. When they run out, she bites open the sticks and quickly licks up the ants before they can bite her.

As the light dims, making it impossible to accurately record the details of *Sloanea* processing, our conversation turns as always to the two burning issues for the evening: what will be served for dinner, and where will the monkeys sleep tonight? No doubt the other field assistants are discussing these important matters (especially dinner) in various parts of the forest at this very moment. Our breakfast and lunch in the forest are rather dismal, since cooked food quickly rots in the tropical heat, putting us at risk of food poisoning if we eat lunch later than 9 a.m.. Also, we cannot eat fresh fruit in the field without inciting feeding competition from the monkeys and putting them at risk of disease transmission from tourists who would want to feed them. So we mainly stick to peanut butter sandwiches, prepackaged cookies or crackers, and peanuts – foods that the monkeys will not recognize as food, so that they will not view humans as potential food sources. This arrangement is good for the monkeys, but it is a terribly boring diet when you eat it every day for a year or more running. Hence the inordinate fascination with dinner, the one meal of the day that does not come out of a cellophane wrapper. “So who’s home today?” I ask.

“Hmm, I think it’s Matt and Tom. But who cooked last time?”

“Matt, remember? When I went to the *pulperia* yesterday to pay Norma for this month’s groceries, she asked me why on earth Matt was buying 30 sweet peppers. I guess he bought every one she had in stock. Since locals only use them as condiments, not as a main dish, she was thoroughly mystified.”

“That’s funny. Is there anything Norma doesn’t notice? I hope Tom makes lentil stew. Then again, it would be nice to have homemade tortillas, and those don’t go with stew so well.”

“I’m hoping for fried zucchini. It’s group dinner tonight, so Joe will be bringing something too – I bet it’ll be banana cake in the slow cooker.”

“What are we talking about tonight?”

“Those papers on medicinal plant use in animals.”

“Oh yeah, I read those last week. Have you ever read *The Shaman’s Apprentice*? I’m reading that right now; it’s really interesting.”

“So do you think Cassie will be a great shaman someday?” I ask.

Nick laughs, “No doubt.” Earlier in the year, the field assistants had been amusing themselves by arguing over the “nationalities” and “professions” of all the monkeys.

Cassie runs by on the ground, skids to a stop 5 feet from us, and pounces on Toulouse. Toulouse wrestles with him, somersaults away, and grabs a scorpion out of the leaf litter. He bites it, winces, bites it again, gets stung once more, and then chews it as fast as he can, contorting his face in a hilarious manner as the scorpion stings him over and over.

“No way would I take my cues from a capuchin shaman,” I say, as I watch Toulouse suffering through his scorpion snack. “Look how painful their normal diet is! I hate to think how much worse their medicine would be. Have you ever tried biting the *Capsicum* peppers that they rub in their fur in the rainy season?”

“No, but Nando did one day when we were out together. The monkeys were so funny chewing them – their eyes were watering, and their noses were running.”

“I only tried it once. I used up a whole water bottle trying to get my tongue to stop burning. I just don’t see what is so enjoyable about the experience, but they go wild over those peppers.”

“So where do you think they will sleep?”

“Ridgeway *Sloanea*.”

“I bet they’ll sleep on Daniel’s Superhighway. They’ve been doing that a lot lately. Then they run up Pizote ridge first thing in the morning. If they do that, we should have someone approach the top of the ridge from the fenceline in the morning, and send someone else in on the trail below.”

As the sun makes its rapid descent, the acacia trees close up their leaves and the birds’ calls are replaced by the sounds of the night: frogs, crickets, and nightjars. The mosquitoes come out and begin to whine in our ears, settling all over our bodies. I take off my hat and swat the backs of my legs, killing several with each swat. At least it is not the rainy season now; in the dry season, the mosquitoes tend to plague us only at dawn and dusk or near water, but for the other half of the year, they are a constant nuisance, stinging our hands so hard that we can hardly hold the binoculars steady and whining loudly into the microphone while we record.

The monkeys do a bit of frantic last-minute foraging before they file into the sleeping tree for the night. They choose a *Sloanea* on the Ridgeway stream origin, but near the Daniel Superhighway – we both made good guesses, but it will be a pain to find them in the morning. Satisfied that the monkeys are really bedding down for the night, we swiftly move towards the nearest trail and head for the car. As we depart, we hear some monkeys bickering over the best sleeping branches.

“Rambo Rambo Rambo?” Nick calls into his radio, as we approach the car. “Hola Skanky!” replies Mino. “Donde está, Mino?” “Voy a salir por el camino, donde me dejé por la mañana. Los otros están por el gravel pit!” A female voice joins the conversation: “Hello! Rambo’s here!” “Hey Laura, where are you?” “We’re coming out of Water Source. Wait for us – we can meet you at the car.” “Oh man, I bet we’ll have an intergroup encounter tomorrow. OK, see you soon.”

We arrive at the car first and unlock it. Nick removes his snake leggings and tosses them into the back of the Land Cruiser. We peer into the dark. Laura and Eva come down the road. “What’s new in Rambo’s today?” I ask.

“Ohhhh, Aramis is in the dog house again.”

“That’s hardly news,” I laugh.

“No, but it was so sad. He was chewing his tail all day. Every time he went in a fruit tree, they chased him out.” We pile into the back of the Land Cruiser, and Nick starts the car. We rumble up the rocky hill.

“So how’s Cassie doing?” asks Eva. “I haven’t seen him in sooo long.”

“Great!” says Nick. “He creamed some howlers today.”

“He was having a bit of trouble with the *Sloanea* though,” I said. “You would have thought he was practicing juggling instead of trying to eat it.”

“Aww, come on! He’s a genius!” laughs Nick. “Remember how he wrapped that spiny caterpillar in leaves before he rubbed it to get the spines off?” Cassie is Nick’s favorite monkey, so he feels obliged to defend his honor.

“But what about the time he stuck his head in that plastic bag he found in the river and then started doing lost calls?” Eva chimes in.

“He wasn’t being stupid, he was being creative!” Nick insists, grinning.

“Was it a lost call, or a scream he did? I keep hearing different versions of that story,” I say. “Who saw it? Was it Hannah? Good thing we write this stuff down.”

As we round the bend in the road, we are flagged down by Nando and Juanca.

“How was your day?” I ask.

“Not too bad.”

“Where are they sleeping?”

“By the killer bee boxes.”

“Oh, that’s not so bad. I was afraid you’d say the quebrador.”

“How’s Fonz?”

I can tell even in the dark that Nando is glowing with pride, just thinking about his monkey hero. “Fonz rules. We had an intergroup with El Salto group. You know, the group with the really huge males. I hardly even saw them though, Fonz chased them away so fast. I got some great video of Fonz tooth grinding. It was *so loud!*” Nando has hardly sat down before he is rummaging in his backpack to find the camcorder and show us Fonz’s latest moment of glory.

The car slows again to pick up Mino. He makes a show of holding his nose as he climbs in the back with all of us sweaty, grimy people. “*Abre las ventanas!*” he says.

“Sorry, the windows are already open.”

“Aaargh!!! *No way!* This can’t be happening!” says Laura as she doubles over.

“What?”

“I think some *Sloanea* just flew in the window and went in my eye. It’s not fair! I’m not even in the forest right now! I just can’t go back to the clinic. I’ve been in there for *Sloanea* removal 3 times this month.”

“You have the worst luck. Maybe you should start sleeping in those goggles,” I suggest. “Don’t rub your eye. Maybe it’ll come out on its own this time.”

“Hey Mino, did you have any luck?”

“Por supuesto!” Mino grins, and he proudly pulls out a plastic vial and hands it to me. “Caca de Took!” We had sent Mino out on a very difficult mission this morning: his job was to track down a male who had migrated out of Abby’s group, so that we could get a fecal sample from him and extract DNA from it, to see if he had fathered any offspring while residing in Abby’s group.

“Where did you find him?” I ask.

“Cerca los tanques. El andaba con dos novias.” [“Near the tanks. He was with two girlfriends.”]

“Way to go Took! I always liked him. Did you recognize either of the females he was with?” I asked. Mino wasn’t positive, but he thought he had seen the two females with Chingo’s group the previous year.

The ride home is always a quite different experience from the ride in. Although we are still tired, and even dirtier and smellier than we were in the morning, we are bursting with monkey gossip that we want to share, in both Spanish and English, to make sure that no interesting detail has been missed. Also, the ride is made more exciting by the fact that we must negotiate the Pan-American highway for the last leg of the trip, and it is now full of lunatic drivers, all of them careening from one lane to the next to avoid potholes, such that it is impossible to tell who is drunk and who is not. Distracted by conversation, we often crash into an unexpected pothole, which sends the passengers' heads crashing into the roof.

As we reach the turnoff into town, the people in back peer anxiously out the back window to try to determine whether the drivers behind us will interpret our left turn signal as an invitation to pass us on the left. Indeed, they do – someone screams out a “traffic alarm call” and Nick slams on the brakes to let a stream of cars pass us before turning in. I jump out of the car and open the gate so that Nick can pull in. As we pile out of the car, we are greeted by the house menagerie, which consists of several dogs and crooked-tailed cats that have been rescued from the street. Rulo the one-eyed watch dog wags his tail, and the puppies Tucker and Strider bound up to us, generously bearing putrid gifts of a rotting iguana carcass and a dirty diaper that they have found in their explorations around town. Everyone pauses in the hammocks to take off their snake leggings and boots, and to greet the animals. I go inside to fill out the data summary worksheet, saying what kinds and amounts of data were collected for each group that day. Tom is waiting with the computer, ready to start dumping the palmtops into the laptop. Some of the field assistants come in and start doing exercises, as if 13 hours of scrambling up and down cliffs isn't enough exercise for one day.

I climb the wall again, heading to my own house for a shower. My 4-year-old daughter Kate, decked out in a pink ballerina tutu and a party hat, is bouncing and squealing at the door, holding her bedraggled Piglet doll. “Mommy, mommy! Hurry and take a shower because I want to hug you, but I don't want to get monkey poop and bugs on me. Do you have lots of ticks on you today? I can bring you the tick tape. Piglet had a birthday party today. She is 4. She got a new Quidditch broom for her birthday. See, she can fly! She's really good at it. And I helped daddy make a banana cake! Yuck, your clothes are disgusting. Don't let them touch me.” She stops bouncing for a second, looks remorseful, points at my muddy clothes, and adds “Sorry, mommy, I love you but that is really gross.”

I shower and remove the ticks that evaded me in the field, while Kate stands in the bathroom, chattering happily about her day. My family once again climbs the wall, this time with Piglet and a banana cake, to join the rest of the gang for our weekly group dinner. Evenings are every bit as chaotic as mornings, as everyone dumps their data into the laptop, passes their equipment to the people who will be working in the field the next day, and discusses the logistics of who will be working with which monkey group. There is a lengthy discussion regarding the time at which we will have to wake up, and a strategy session about how to send everyone in to their respective groups the next morning. Once this business is out of the way, we can proceed to discussion of the journal club topic of the week, and fill in the cooks and data-cleaners on the monkey gossip for today. There is no time to dawdle over dinner. Everyone still needs to make lunches, fill water bottles, and pack gear for the following morning. I head home to read

Kate some bedtime stories and to contend with the most critical of my email messages, which Joe has kindly screened already to save me time. Technology is really a mixed blessing. I think nostalgically about the early days of the project, when there was no phone and no electricity, and I was therefore exempt from all responsibilities other than following monkeys.