

PRIMATE BEHAVIOR, ECOLOGY, AND CONSERVATION FIELD COURSE IN BRAZIL

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Dr. Paul A. Garber – I am a biological anthropologist and have studied the behavior, ecology, cognition, mating systems, and conservation of nonhuman primates in Mexico, Nicaragua, Costa Rica, Panama, Peru, Brazil, Bolivia, and China. I first began working on issues of primate behavior and conservation in Brazil in 1997. I also served as the Executive Editor of the American Journal of Primatology from 2008-2017.

Dr. Nicola Schiel – I am a biologist and have studied the behavior, ecology, and cognition of free-living common marmosets in Brazil. I first began working on issues of primate behavior in 1994. I have experience in the area of Animal Behavior, acting mainly in the following subjects: behavior, ecology, and animal cognition. More recently, I have been working with Ethnobiology.

COURSE GOALS AND DESCRIPTION

Course is directed to students interested in biological anthropology, primatology, animal behavior, tropical ecology, conservation, sustainability, and field biology. Each day the professor works intensively with students, present lectures, and provide background information to help students develop a conceptual framework for understanding the diversity and complexity of tropical ecosystems. Lectures, training in field techniques, examples of animal-plant interactions, and observations of primate behavior are designed to help students develop individual research projects. Each student is required to conduct a field research project, collect field data to test a set of hypotheses on primate behavior and ecology, analyze their data, and write a final report during the course.

In addition, students will learn about the culture, food, and history of Brazil, and have the opportunity to meet and interact with local people who live in the communities adjacent to the field site. We also will visit a historical church, explore the colonial architecture, and have lunch at the World heritage city of Olinda.

Research Project

Each student is required to select one of 6 research topics that best suites their background and interests. Associated with each topic I have outlined the main theoretical issues addressed in their research proposal, a list of specific research questions they will be studying, and a set of required readings. Each student is expected to read the required articles for his/her topic, as well as 5-10 additional articles on their research topic, prior to arriving in Brazil. E copies of all of these articles should be brought to Brazil. These articles are essential for developing a powerpoint presentation and writing your final paper.

COURSE REQUIREMENTS IN BRAZIL

Assignments and Class Schedule

Attendance at all lectures, presentations, and discussions is required

July 5th - Arrive in Recife, Brazil – check into the hotel, if you arrive early on that day you can spend the day visiting the beach. Class dinner.

July 6th - Tour the historic city center and have lunch in Olinda. Travel to biological research station in Cabaceiras. Get settled in rooms, have dinner, and safety orientation

July 7th - 19th: Daily class lectures from 4:30 - 6:00pm.

July 7th - 10th: Students will be divided into groups with Brazilian TAs and Professors and will practice collecting behavioral data on marmoset monkeys. Groups will report on what they have learned each evening. Meet with faculty each evening to discuss the schedule and activities for the following day.

July 11th - Each student will meet with the professor individually to finalize his/her research project.

July 11th - Quiz on Research Methods for each student project. This will take 30 minutes (Quiz begins at 4:00pm).

July 12th - Study for Exam. 6:00-9:00pm. 3-hour essay exam. The essay exam is based on in-class lectures and field observations.

July 13th - students begin data collection for their research.

July 22th - last day of data collection. Students begin analyzing their data and writing their final report.

July 25th - Each student must hand in a final paper by 6:00pm detailing the results of their research. The paper must be written as a scientific article and include a TITLE PAGE, ABSTRACT, INTRODUCTION (brief theoretical statement indicating the research questions), METHODS (be extremely specific and detailed), RESULTS (present the data), DISCUSSION (describe how your results compare to similar research on other species or theoretical issues in the field), CONCLUSIONS (list 4 conclusions of your research), REFERENCES, TABLES, FIGURES.

July 26th - Primate Behavior and Ecology Symposium. Each student will give an oral presentation sharing the results of their research project. Presentations cannot be read. You can use note cards note figures/tables/overheads to assist in the presentation. As in scientific meetings, you will have a maximum of 15 minutes for the presentation and 5-10 minutes for discussion.

Pack on evening of July 26th and CLASS PARTY!

July 27th - return to Recife for tourist shopping and sight-seeing, have final class dinner,

July 28th - Fly back home

COURSE LECTURE SCHEDULE

There will be lectures scheduled every day. Generally, lectures will be from 4:00-6:00pm. Lecture topics include:

1. Orientation regarding safety, procedures and behavior, course goals, and course requirements.
2. Introduction to primate behavior and ecology, primate traits, and theories of primate origins.
3. Ancestral and derived traits, parallel and convergent evolution.
4. The evolutionary history of New World Primates.
5. Problems of primate locomotion and anatomical solutions.
6. Body size, feeding ecology and the problems primates face when exploiting fruit, insects, and exudates.
7. Spatial information, cognition, and perceptual cues in primate foraging behavior.
8. Social and mating systems of New World primates.
9. Cooperation and competition: The evolution of sociality.
10. Primate social systems.
11. Brazil: its people, economics, and history.
12. Primate Conservation and Environmental sustainability in Brazil.
13. Ethical issues in field research (working with the human and nonhuman primate community).

GRADING

Essay Exam: There will be a 3 hour essay exam in Brazil based on lectures and class readings (20%)

Research Design and Data Analysis, which includes:

- (1) Quiz (5%)
- (2) Collection of your field data (10%)
- (3) Oral and power point presentation of your research results (25%)
- (4) Analysis and completion of a final written research paper based on your individual research project (40%)

FINAL GRADE =

A+=>94

A= 90-94%

B+ = 85-89

B = 80-84

C+=75-79

C=70-74

D+=65-69

D=60-64

F=<60

Attendance at all lectures, presentations, and discussions is required.

IMPORTANT TO KNOW

The forest is a very personal experience:

Difficult to describe and impossible to photograph. It is more than 3 dimensional: space, sights, colors, textures, sounds, experiences. On the last full day, please take the time to walk around the forest by yourself so that you can leave with a final and quiet memory of your time here.

Your experience here will be very intense. Try to maintain your energy, but if you are having physical or emotional problems, please let us know. We have been through this before and we can help. The entire staff is here to help.

POLICIES GOVERNING ACADEMIC INTEGRITY

Codes of Conduct and Academic Integrity. I expect all students to adhere to codes of conduct and academic integrity that is outlined in the University of Illinois student handbook. The handbook can be found on line at [and](#) clearly spells out penalties for academic dishonesty, plagiarism, and appropriate and inappropriate conduct. The field course runs 7 days per week for 24 hours a day from July 20-August 14th and I expect all students to behavior accordingly.

Dismissal Policy: This policy is set by the University of Illinois Code of Policies and Regulations Applying to all students.

1. Any behavior that endangers another person or property can result in immediate dismissal.
2. Conduct with id undesirable and in violation of the University's Code of Policies and Regulations including policies on drugs and alcohol.

3. Conduct that is in violation of the laws, rules and regulations, and customs of the host country.
4. Behavior, whether academic or social, which constitutes a clear and present danger to the health or safety of persons or property, or threatens the future viability of the program.
5. Physical or sexual assault; harassment, unlawful possession, use or distribution of illegal drugs, alcohol abuse, setting a fire or possession of explosives, possession of a weapon, threat.

Responsible use of alcohol includes the following:

1. A student does not miss any scheduled event because of the effects of alcohol consumption.
2. A student does not become ill due to the effects of alcohol consumption.
3. A student is respectful of others sharing the same housing.
4. A student does not engage in inappropriate behavior toward other individuals that is the result of alcohol consumption.
5. A student does not engage in destructive behavior toward property that is the result of alcohol Consumption.

Policy Governing the Use of Illegal Drugs:

1. Use of illegal drugs is not permitted. The penalties and penal conditions for illegal drug use in Brazil are EXTREMELY severe. If the police catch anyone using illegal drugs, that person(s) will be prosecuted to the full extent of the law. If the Program Leader catches a student purchasing or using illegal drugs, arrangements will be made to send the student back to Illinois and she/he will receive a failing grade.
2. A student abides by the laws of the country in which he or she is living.

LIST OF TOPICS FOR THE PRIMATE BEHAVIOR, ECOLOGY, AND CONSERVATION FIELD COURSE IN RECIFE, BRAZIL 2018

Why your Research and Project are Important:

The information that you collect will aid us in developing conservation policies, and determining the size and viability of the primate populations at Baracuhy Biological Research Station, northeastern Brazil (7°31'42'S and 36°17'), State of Paraíba. Detailed information on the size and composition of individual social groups, diet, and home range use allow us to determine which tree species are most important for the common marmosets (*Callithrix jacchus*) at the site, and ultimately allow us to determine the impact of human activity on the ecology, behavior, and conservation of these monkeys. Moreover, your work will contribute to our knowledge of the behavior and ecology of primates in their natural habitat.

The 400 ha field site is both a biological research station and a working farm composed of a semi-arid caatinga ecosystem. Mean annual rainfall in this region is 336 mm (about 13 inches per year). The vegetation is dominated by low arboreal shrubs (mean canopy height = 3.5m) and scattered trees of the family Anacardiaceae, Fabaceae, and Euphorbiaceae. The short stature and openness of the caatinga vegetation provide maximum visibility and will allow us to monitor the behavior of all members of the same group simultaneously.

Below is a list of research topics for your individual research projects. You should review these research topics carefully and think about which are of greatest interest to you. There are many other studies that would be interesting and important to do, but they are not possible to conduct or complete given that you will only be in Brazil for 3 amazing weeks. Choice of research topics will be assigned on a 'first come first served' basis, however 2-4 students can select the same topic but collect their data on different marmoset groups. So please contact me as soon as possible with your preferred topic.

Also, include a second preference in case we already have students who have selected your preferred topic. **STUDENTS MUST SELECT A TOPIC.**

Also, each student is required to read both the assigned articles for her/his topic, the assigned review article on callitrichines (tamarins, marmosets, and callimicos), as well as articles on marmoset behavior and ecology.

RESEARCH TOPICS

1. AGE AND/OR SEX BASED DIFFERENCE IN POSITIONAL BEHAVIOR (POSTURE AND LOCOMOTION)

Theoretical Issues: Arboreal canopy differs from the terrestrial substrate in: (1) branches are mobile and bend under an animal's weight, (2) are oriented at all angles to the ground, (3) get thinner as one approaches the periphery of the tree crown where ripe fruits, flowers, and leaves are often located, and (4) discontinuous (there are gaps that must be crossed by leaping or bridging).

Differences in body mass (weight) (sexual dimorphism) between adult males and adult females may influence balance and weight bearing in the tree crown. Larger animals may require larger supports. Many primates have evolved suspensory behaviors and musculoskeletal adaptations to exploit small supports (terminal branches)- grasping hands and feet, opposable big toe, opposable thumb, mobile shoulder joint, prehensile tail, etc. Some small-bodied primates like tamarins and marmosets have evolved claw-like nails to cling to large vertical supports (tree trunks) that are otherwise too large to be grasped by their tiny hands and feet.

Juveniles may not possess the strength and motor coordination of adults and therefore are expected to use more stable and cautious postures and avoid supports that bend and flex

under their weight. This is associated with questions of ontogeny, rate and pattern of development, and life history strategies.

Alternatively, differential use of the tree crown and differences in substrate preference (branches of small-medium-large size and branches of different angle – vertical, horizontal, oblique) by sex or age may reflect differential access to resources or social dominance.

READ:

Garber PA. 2011 Primate Positional Behavior and Ecology. In: *Primates in Perspectives Vol 2*. C. J. Campbell, A. Fuentes, K. C. MacKinnon, S. Bearder, and R. Stumpf (eds); Oxford University Press. Pp. 548-563. (I can send you an e-copy upon request)

Bezanson M. 2006. Leap, bridge or ride: Ontogenetic influences on positional behavior in *Cebus* and *Alouatta*. In: *New Perspectives in the Study of Mesoamerican Primates.: Distribution, Ecology, Behavior, and Conservation*. A. Estrada, PA Garber, M. Pavelka, and L. Luecke (eds). New York: Springer . pp. 333-348

[this book and individual chapters can be downloaded by going to the UIUC on-line library catalogue and searching for Springer E-Books.]

Garber PA. 1991. A comparative study of positional behavior in three species of tamarin monkeys. *Primates* 32: 219-230

Garber PA, Sallanave A, Blomquist G. and Anzenberger G. 2009 A comparative study of the kinematics of leaping in *Callimico goeldii*, *Callithrix jacchus*, and *Cebuella pygmaea*. P.A. Garber, A. Sallanave, G. Blomquist, and G. Anzenberger In: *The Smallest Anthropoids: The Marmoset/Callimico Radiation*. S. Ford, L. Porter, and L. Davis, Springer Science+Business Media, Inc. pp 259-278.

Research Questions:

- (1) What is the diet and activity budget of common marmosets at Baracuh Biological Research Station?
- (2) What is the postural and locomotor repertoire of adult males, adult females, and juveniles?
3. Does positional behavior vary by activity?
4. Do adults leap less, climb more, and engage in vertical clinging than do juveniles?
5. Do adults exploit larger supports or supports of different orientations (horizontal, vertical, oblique) than juveniles?
7. Is body mass or ontogeny a better predictor of positional behavior?

2. AGE AND/OR SEX BASED DIFFERENCES IN DIET AND ACTIVITY BUDGET

Theoretical Issues: Given differences in the requirements and costs (energetic, nutritional) of reproduction adult males and adult females may have different dietary requirements and consume different foods

Given differences in the nutritional and energetic requirements of growth, adults and juveniles may have different dietary requirements and consume different foods

Nutritional requirements increase in females during pregnancy by 25% and during lactation 50%. Reproductive females may be expected to feed more or exploit higher quality food items such as insects.

Juveniles may have limited foraging abilities or motor skills compared to adults, and therefore may be less efficient foragers or exploit different food items than adults.

Animals can lower energetic and nutritional costs by utilizing an energy minimizing activity pattern (increase resting, reduce travel)

Some individuals may be at greater risk of predation, infanticide, or have reduced access to resources (social dominance) and therefore may be expected to have different diets or activity budgets. Diet will be measured as time spent exploiting various food types (insects, ripe fruits, unripe fruits, young leaves, mature leaves, flowers, vertebrates, hard nuts).

READ:

2006. Food choice by juvenile capuchin monkeys (*Cebus capucinus*) in a tropical dry forest. K.C. MacKinnon. In *New Perspectives in the Study of Mesoamerican Primates: Distribution, Ecology, Behavior and Conservation* Edited by Alejandro Estrada, Paul A. Garber, Mary Pavelka, and LeAndra Luecke. Springer: New York. 349-366.

[this book and individual chapters can be downloaded by going to the UIUC on-line library catalogue and searching for Springer E-Books.]

Rose, LM. 1994. Sex differences in diet and foraging behavior in white-faced capuchins (*Cebus capucinus*) *International Journal of Primatology* 15: 95-114.

Correa HKM, Coutinho PEC and Ferrari SF. 2000. Between-year differences in the feeding ecology of highland marmosets (*Callithrix autita* and *Callithrix flaviceps*) in southeastern Brazil. *Journal of Zoology* 252:421-427.

Garber, P.A. 1993. Seasonal patterns of diet and ranging in two species of tamarin monkeys: Stability versus variability. *Int. J. Primatol.* 14:145-166.

Garber PA, Porter LM. 2010. The ecology of exudate feeding and exudate production in *Saguinus* and *Callimico*. In: *The Evolution of Exudativory in Primates*". A Burrows and L. Nash (eds). Springer Press pp. 89-108.

Amora TD, Beltrao-Mendes R, and Ferrari SF. 2013. Use of Alternative Plant Resources by Common Marmosets (*Callithrix jacchus*) in the Semi-Arid Caatinga Scrub Forests of Northeastern Brazil. *American Journal of Primatology*: 75:333–341

Research Questions:

1. What is the activity budget and diet of adult male, adult female, and juvenile common marmosets at Baracuh Biological Research Station?
2. Do adults and juveniles differ in diet, foraging efficiency or foraging techniques,?
3. During feeding and foraging do juveniles have other juveniles, adults males or adult females as their nearest neighbor?
4. Is there evidence of contest feeding competition at feeding sites?
5. Is there evidence of food sharing at feeding sites

3. AGE AND/OR SEX BASED DIFFERENCES IN AFFILIATIVE AND AGONISTIC SOCIAL INTERACTIONS, SOCIAL SPACING, AND INFANT CAREGIVING

Theoretical Issues: All higher primates are social and live in stable groups composed of individual of both sexes and all age groups. Group cohesion is maintained by social cooperation, partner preferences, and the formation of social bonds. Two primary measures of social affiliation are proximity or social spacing and grooming. It is a measure of tolerance and preference. The main questions are do adult females preferentially have other adult females as social/grooming partners, adult males as their preferred social/grooming partner, or juveniles? A similar set of questions exists for males and juveniles. Given the specialized cooperative infant care system present in callitrichines, does a single male or do multiple males spend more time in proximity to and/or grooming group offspring (infants and juveniles) than females. An understanding of social interactions, social spacing, and grooming provides important insight into the basis of partner preferences, sociality, friendships, and primate social organization.

READ:

2011 Cooperation, Collective Action, and Competition in Primate Social Interactions. R.W. Sussman and P.A. Garber. In: *Primates in Perspectives Vol 2*. C. J. Campbell, A. Fuentes, K. C. MacKinnon, S. Bearder, and R. Stumpf (eds); Oxford University Press. Pp. 587-599. (I can send you an e-copy upon request)

2011 Social systems and socioecology: understanding the evolution of primate behavior. A. Fuentes. In: *Primates in Perspectives Vol 2*. C. J. Campbell, A. Fuentes, K. C. MacKinnon, S. Bearder, and R. Stumpf (eds); Oxford University Press. Pp. 500-511. (I can send you an e-copy upon request)

2006. Why be alpha male? Dominance and reproductive success in wild white-faced capuchins (*Cebus capucinus*). K.M Jack and L.M. Fedigan. In *New Perspectives in the Study of Mesoamerican Primates: Distribution, Ecology, Behavior and Conservation* Edited by Alejandro Estrada, Paul A. Garber, Mary Pavelka, and LeAndra Luecke. Springer: New York. 367-386. [this book and individual chapters can be downloaded by going to the UIUC on-line library catalogue and searching for Springer E-Books.]

Ferrari, S.F. 1992. The care of infants in a wild marmoset (*Callithrix flaviceps*) group. *American Journal of Primatology*. 26:109-118.

Garber, P.A. 1997. One for all and breeding for one: cooperation and competition as a tamarin reproductive strategy. *Evolutionary Anthropology*. 5:187-199.

Garber PA, Porter L, Spross J, and Di Fiore A. 2016. Tamarins: Insights into Monogamous and Non-Monogamous Single Female Social and Breeding Systems. *American Journal of Primatology* 78 (3): 298-314.

Research Questions:

1. What is the activity budget and diet of adult male, adult female, and juvenile common marmosets at Baracuhy Biological Research Station?
2. Do adult males have other adult males, adult females or juveniles/infants as their nearest neighbors?

3. Do adult females have other adult females, adult males or juveniles/infants as their nearest neighbors?
4. Do juveniles have other juveniles, adult males or adult females as their nearest neighbors?
5. Do nearest neighbor preferences vary by distance and activity (feed, foraging, rest, travel)?
6. Are there differences in the frequency of agonistic or affiliative social interactions between sex or age classes?

4. FORAGING PATTERNS, SPATIAL MEMORY, AND THE DISTRIBUTION OF FEEDING SITES VISITED.

Theoretical issue: Given that primates, relative to most other mammals are characterized by relatively large brain size and complex cognitive skills, what types of information do primates use to locate feeding sites. Examine diet and foraging behavior (feeding sites visited, revisits to the same feeding site on the same day or on consecutive days, whether the order trees are visited is consistent with solving the traveling salesmonkey problem – selecting daily feeding and resting sites in the sequence that minimizes travel distance) and map the routes taken by primates to reach nearby and distant feeding sites. Are such routes direct, do they involve backtracking, do individuals visit several trees of the same species in the same day? Do foragers return to the same feeding sites on consecutive days and if so, do they use the same pathways? Information primates might use to select feeding sites include quantity, location, time of day, resource renewal rate, location relative to other trees exploited later in the day, and the nutritional reward of the food items.

READ:

Garber, P.A. 1988b. Foraging decisions during nectar feeding by tamarin monkeys *Saguinas mystax* and *Saguinas fuscicollis* in Amazonian Peru. *Biotropica* 20:100-106.

2000 The Ecology of Group Movement: Evidence for the use of Spatial, Temporal, and Social Information in Some Primate Foragers. P.A. Garber. In: ON THE MOVE: HOW AND WHY ANIMALS TRAVEL IN GROUPS. S. Boinski and P. A. Garber. Chicago, IL, University of Chicago Press. pp. 261-298. (I can send you an e-copy upon request)

Di Fiore A, Suarez S. 2007. Route-based travel and shared routes in sympatric spider and woolly monkeys: cognitive and evolutionary implications. *Animal Cognition* 10: 317-329.

Garber, PA. 1989. The role of spatial memory in primate foraging patterns: *Saguinus mystax* and *Saguinus fuscicollis*. *American Journal of Primatology* 19: 203-216.

Primate Spatial Strategies and Cognition: Introduction to this Special Issue. PA Garber and FL Dolins. *American Journal of Primatology* 76: 393-398.

Garber PA and Porter LM. 2014. Navigating in Small-Scale Space: The role of landmarks and resource monitoring in understanding saddleback tamarin travel. PA Garber and LM Porter. *American Journal of Primatology* 76: 447-459.

Bicca-Marques JC and Garber, PA (2004). The use of visual, olfactory, and spatial information during foraging in wild nocturnal and diurnal anthropoids: A comparison among *Aotus*, *Callicebus*, and *Saguinus*. JC Bicca-Marques and PA Garber · *American Journal of Primatology* 62: 171-187.

Research Questions:

1. What is the activity budget and diet of adult male, adult female, and juvenile common marmosets at Baracuh Biological Research Station?
2. How many feeding sites do group members visit per hour and what is the distance between sequential feeding sites?

3. Do group members revisit the same sites on sequential days or during the same day, and do they use the same travel routes in reaching these sites?
4. Does the order of feeding sites visited across several hours coincide with a least distance travel pattern?
5. In large scale space is travel most consistent with a route-based on coordinate-based mental map?

5. INTRASPECIFIC (WITHIN SPECIES) VARIABILITY IN BEHAVIOR: COMPARE YOUR RESULTS ON ACTIVITY BUDGET, DIET, AND RANGING PATTERNS WITH OTHER STUDIES THAT HAVE BEEN DONE ON THIS SPECIES IN DIFFERENT FORESTS.

Theoretical Issues: Compared to other groups of mammals, primates have relatively large brain size and complex cognitive skills. Primates also have a long developmental (juvenile) period in which individuals learn both social and ecological information. Therefore, we may expect that different groups of the same species exhibit considerable variability in their behavior, activity budget, diet, and ranging patterns in response to local differences in social and ecological conditions. However, some aspects of an individual's behavior is species specific, and will not vary (for example, all humans walk on two legs and have language, this does not vary). In this study you would collect data on diet, foraging, activity budget, and ranging patterns in common marmosets and compare your results to published studies of this same species in different forest types. For example, Baracuhy Biological Research Station is an extremely dry and hot habitat characterized by caatinga vegetation. *C. jacchus* also has been studied in the wetter Atlantic forest forests of northeastern Brazil and other marmoset species also have been studied across a range of forest types. To complete this research you will need to bring many pdf research articles with you to Brazil on the behavior, ecology, diet, and group size and composition of marmosets to compare with your results.

READ:

2006. Demographic features of *Alouatta pigra* populations in extensive and fragmented forests. S. Van Belle and A. Estrada. In *New Perspectives in the Study of Mesoamerican Primates: Distribution, Ecology, Behavior and Conservation* Edited by Alejandro Estrada, Paul A. Garber, Mary Pavelka, and LeAndra Luecke. Springer: New York. 121-142. [this book and individual chapters can be downloaded by going to the UIUC on-line library catalogue and searching for Springer E-Books.]

1990. C.A. Chapman and L.M. Fedigan. Dietary differences between neighboring *Cebus* monkey groups: local tradition or responses to food availability? *Folia Primatologica* 54: 177-186

Asensio N, Cristobal-Azkarate J, Dias PA, Vea JJ, Rodríguez-Luna E 2007. Foraging habits of *Alouatta palliata mexicana* in three forest fragments. *Folia Primatologica* 78: 141-153.

Garber PA, Porter L, Spross J, and Di Fiore A. 2016. Tamarins: Insights into Monogamous and Non-Monogamous Single Female Social and Breeding Systems *American Journal of Primatology* 78 (3): 298-314.

Correa HKM, Coutinho PEC and Ferrari SF. 2000. Between-year differences in the feeding ecology of highland marmosets (*Callithrix aurita* and *Callithrix flaviceps*) in southeastern Brazil. *Journal of Zoology* 252:421-427.

Hilario RR, Ferrari, SF. 2010. Four breeding females in a free-ranging group of buffy-headed marmosets (*Callithrix flaviceps*). *Folia Primatologica* 81: 31-40.

Lacher, T.E., Jr., Bouchardet da Fonseca, G.A., Alves, C., Jr., Magalhaes-Castro, B. 1981. Exudate-eating, scent marking and territoriality in wild population of marmosets. *Anim. Behav.* 29:306-307.

Martins MM, Setz, EZF. 2000. Diet of buffy tufted-ear marmosets (*Callithrix aurita*) in a forest fragment in southeastern Brazil. *International Journal of Primatology* 21: 467-476.

Passamani, M. 1998. Activity budget of Geoffroy's marmoset (*Callithrix geoffroyi*) in an Atlantic forest in Southeastern Brazil. *Am. J. Primatol.* 46:333-340.

Raboy, BE, Canale GR, Dietz JM 2008. Ecology of *Callithrix kuhlii* and a review of Eastern Brazilian marmosets. *Int. J. Primatol.* 29: 449-467.

Research Questions:

1. What is the activity budget and diet of adult male, adult female, and juvenile common marmosets at Baracuh Biological Research Station?
2. What is the daily path length of common marmosets at Baracuh Biological Research Station?
3. How does the diet, activity budget, and daily path length of common marmosets at Baracuh Biological Research Station compare to the diet, activity budget, and daily path length of common marmosets and other marmoset species inhabiting different forest types.
4. What aspects of behavior and ecology of common marmosets vary considerably across sites and what aspects of behavior and ecology remain relatively consistent?

You should review these research topics carefully and think about which are of greatest interest to you. There are many other studies that would be interesting and important to do, but they are not possible to conduct or complete given that you will only be in Brazil for 3 amazing weeks.

REQUIRED READING FOR ALL STUDENTS

2011. Digby LJ, Ferrari SF, Saltzman W. 2011. Callitrichines: the role of competition in cooperatively breeding species. In *Primates in Perspective* 2nd Edition. Campbell CJ, Fuentes, A, MacKinnon CK, Bearder SK, and Stumpf, RM. New York: Oxford University Press, pp. 91-107.
2016. Garber PA, Porter LM, Spross J, and Di Fiore A. Tamarins: Insights into Monogamous and Non-Monogamous Single Female Social and Breeding Systems. *American Journal of Primatology* 78 (3): 298-314.
2017. Schiel N., Souto A. The common marmoset: an overview of its natural history, ecology and behavior. *DEVELOPMENTAL NEUROBIOLOGY*, vol. 77, issue 3, pp. 244 - 262.
2017. Estrada et al. Impending extinction crisis of the world's primates: why primates matter. *Science Advances* DOI 10.1126/sciadv.1600946 and the eLocator is e1600946 (published January 18, 2017).

JOURNALS THAT COMMONLY INCLUDE INFORMATION ON NONHUMAN PRIMATES

1. American Journal of Primatology
2. International Journal of Primatology
3. Folia Primatologica
4. Primates
5. Journal of Human Evolution
6. American Journal of Physical Anthropology
7. Behavioral Ecology and Sociobiology.
8. Evolutionary Anthropology

Please bring E-copies of the articles you use in project to the Baracuhy Biological Research Station so that you can review these papers in writing your research paper. Given there is no internet signal at the field site, it is not possible to download pdf files.