

COTLOW FIELD RESEARCH FUND

Department of Anthropology
The George Washington University
Washington, DC 20052

2007 PROJECT DESCRIPTION FORM

Applicant:

Title of Project:

The Lewis N. Cotlow Field Research Fund is a GW Anthropology Department fund, established in 1990 as a bequest by the explorer Lewis N. Cotlow to further field work and exploration. All undergraduate or graduate students at The George Washington University are eligible to apply, but preference is given to those in anthropology programs. Funds are to be used for travel, research assistance, and other expenses related to field research.

The deadline for application is 5 p.m. on the first Friday in March of the year for which support is requested. Applications must be submitted in hard copy; no electronic submissions will be accepted.

DESCRIPTION OF PROPOSED COTLOW FIELD RESEARCH PROJECT

I. Personal Information

Name:

Permanent Address:

Current Address:

Home Phone: Other Phone: E-mail:

Degree Sought: Field of Study:

Expected Date of Graduation:

Faculty Advisor(s) for This Project: ,

Does your proposed project involve the use of a "field language"? Yes No

If so, state what it is, and note your degree of fluency in speaking or writing.

II. Brief Abstract of the Project

Title of Project:

Amount Requested:

In 100 words or less, clearly state the goals of the proposed research.

The goal of this project is to collect data on the mechanical properties of plant foods consumed by wild bearded capuchin monkeys (*Cebus libidinosus*) near Gilbues, Piauí, Brazil (9°S, 45°W). A portable mechanical tester will be used to quantify toughness and stiffness values. Feeding behavior will be recorded using interval focal animal sampling and continuous sampling. Results of this study will contribute to our understanding of bearded capuchin dietary ecology. This research will aid in developing hypotheses about the role of fallback resources in shaping primate dietary strategies, which can inform models of the role of diet in human evolution.

III. Significance of the Project to Anthropology. What is the relationship of the proposed research to other anthropological research in this field and region? (250-500 word maximum)

The diet of capuchin monkeys consists primarily of soft fruit pulp and insects (Fragaszy et al. 2004a). However, at various sites capuchins increase their consumption of alternative food resources such as hard seeds and palm nuts (e.g. *Attalea* sp.) to meet their energy demands when soft ripe fruit is unavailable (Terborgh 1983; Fragaszy et al. 2004a). Within the last decade, research efforts have begun to incorporate data on food mechanical properties into the study of primate dietary ecology (Yamashita 1998; Lucas et al. 2000). Building on these recent studies, the proposed research aims to collect data on the mechanical properties of all plant foods exploited by wild bearded capuchin monkeys (*Cebus libidinosus*) near Gilbués, in Piauí, Brazil (9°S, 45°W).

The ability of teeth to breakdown a particular food item depends on the toughness and stiffness of the food. Previous research has shown a relationship between the molar surface morphology and the mechanical properties of foods consumed by animals, indicating that certain molar shapes are better than others for fracturing a particular type of food (Lucas et al. 2000). For instance, blades are much better tools for fragmenting leaves than a mortar and pestle, which is an efficient configuration for breaking down nuts and fruits. Therefore, animals with diets that are composed of a high percentage of leaves or turn to a majority of leaves during certain seasons typically have molars with blade-like crests to breakdown vegetation. Alternatively, animals that rely on nuts and fruits exhibit molars with opposing cusps and basins, similar to a mortar and pestle, to crack and grind the foods into smaller, more easily digestible pieces. In addition to molar morphology, other primate cranial and dental features are thought to be adaptations to their diet. For instance, robust facial and mandibular bones as well as thick molar enamel are considered adaptations to prevent failure of the skull during biting and chewing a diet containing stiff or tough food items, while large temporalis and masseter muscles are necessary to generate adequate bite force to breakdown these foods. The masticatory system of bearded capuchins exhibit these derived features, such as thick molar enamel, a deep and broad mandibular body, and marked crests for the attachment of powerful chewing muscles, that are associated with the ability to produce and dissipate high masticatory forces (Wright 2005). At first glance, the combination of what appear to be masticatory specializations and an annual diet consisting of a high proportion of soft foods seems counterintuitive. However, these masticatory traits appear to be niche broadening characters that permit the exploitation of palm nuts or other fallback resources (foods that are annually available but exploited only intermittently). This ecomorphological picture of hard fruit exploitation and massive teeth and jaws is further complicated by the fact that the bearded capuchins in Piauí utilize stone tools to open mechanically demanding food resources.

IV. Methodology. What are the specific research questions you plan to ask? What data will you collect and how? How will you analyze the data? How do you plan to use these data to address and resolve your research questions? *Be specific.* (250-500 words maximum)

Food mechanical properties refer to a food's unique internal physical characteristics. The properties of interest in this research are stiffness and toughness since they influence the breakdown of food in the mouth. Stiffness is the ability of a material to resist deformation in response to an applied force. Therefore stiffness is a measure of the relationship between a force applied over a given area (stress) and the material's displacement as a result of this applied force (strain). In contrast, toughness describes the amount of work required to propagate a crack through a material and is calculated as the work necessary to grow a crack divided by the area of that crack.

This research will address two specific questions:

1. What are the mechanical properties of the plant foods consumed by bearded capuchins in Piauí?
2. What is the role of mechanically-demanding food resources in the diet of these capuchins?

This project will collect data on foods processed by adult and juvenile bearded capuchins using focal animal sampling at one minute intervals combined with continuous sampling of foraging and feeding bouts. Combining these methods produces greater independence of data points in the case of interval sampling and allows detailed recordings of all foraging instances. Thus, an accurate activity budget can be created, and feeding behavior can be described in detail to permit the most appropriate material tests to be conducted.

For a single feeding bout, manual and oral processing of foods will be recorded in detail noting use of the upper limb and where along the tooth row different food tissues are processed. The plant tissue type (e.g. stem, exocarp, mesocarp, or seed coat) and the appropriate mechanical test will be identified, and food specimens will be stored in re-sealable storage bags. After processing, discarded food items will be photographed for identification by me or on-site botanists. Mechanical tests will be performed in the afternoon of the same day for soft wet foods and within twenty-four hours for harder tissues.

Values for toughness, stiffness, and the force required for crack propagation will be collected using a portable mechanical tester developed by Lucas et al. (2001) to quantify food mechanical properties. Other primate field studies have used this tester with much success to collect data on the mechanical properties of primate diets (Yamashita 1998; Lucas et al. 2001; Wright 2005). The tester consists of: mechanical stage to hold the food item, data integration box, a load cell, and laptop PC computer to process the data from the integration box (Lucas et al. 2001; Wright 2005).

IV. Methodology (Continued).

Toughness will be measured using the wedge test or the scissor test, since the thickness of prepared specimens determines which test is more appropriate for calculating toughness. Stiffness will be determined by applying a force measured by the load cell and calculating the slope of the force-displacement curve. Finally, the food item's resistance to fracture will be calculated as the square root of the product of its toughness and elastic modulus (Lucas et al. 2000).

V. Ethics. Describe (in 150-200 words) how you will ensure that your research project is conducted with attention to the ethical guidelines of the discipline of anthropology (and your project's particular field within the discipline) and the guidelines of GW's Institutional Review Board (if your project involves living human beings). For the former, consult the Web site of the American Anthropological Association and its section on research ethics (<http://www.aaanet.org>). For the latter, review GW's IRB guidelines (<http://www.gwumc.edu/research/human.htm>).

The sampling methods employed in this research adhere to the ethical guidelines for non-human primate field research described by the American Anthropological Association and the American Society of Primatologists.

VI. Product. What kinds of results do you expect to come from the proposed research? (E.g., publishable article, presentation at a professional meeting, film, museum exhibit, etc.).

The product of the proposed research will be published in peer-reviewed journals and will be presented at the annual Anthropology Student Research Conference and at American Association of Physical Anthropology meetings in 2008. This research will be collected in conjunction with the ongoing EthoCebus project, whose primary goal is to compare the ecological, behavioral, and physical basis of capuchin stone tool use with that of chimpanzee populations (Boesch and Boesch 1990; Fragaszy et al. 2004b). This project will further the goal of the EthoCebus project by providing information on the feeding behavior and the mechanical properties of foods, particularly mechanically demanding foods, processed by the bearded capuchins. In addition, this research will contribute additional data to the growing database of food mechanical properties in primate diets. If primates are adapted to their diets, food mechanical property data from this project has potential applications in future studies which test hypotheses concerning the evolutionary history of primate cranial and dental adaptations to diet. Ultimately, the results of the proposed research project will advance our understanding of the role of mechanical properties in the evolution of primate cranial and dental adaptations.

VII. Schedule. State clearly your timetable of specific research activities.

June 29-July 21, 2007: Travel to Piauí, Brazil. Collect mechanical property and feeding behavior data from bearded capuchins at site and discuss methods and preliminary results with EthoCebus colleagues.

August 2007: Analyze and prepare data for publication and presentation at the Anthropology Student Research Conference and American Association of Physical Anthropologists meetings in 2008.

VIII. Budget. Provide a detailed budget for the proposed activities. Among the expenses you may need to include are transportation, room and board, and research supplies. The Cotlow Fund cannot be used to pay tuition or academic fees or to purchase equipment such as cameras or laptops. *Awards range from a few hundred dollars to around \$1500.*

Budget:

1. Roundtrip airfare from Washington DC to São Paulo, Brazil \$1035.00
The above price includes airfare and taxes estimated from <www.expedia.com>.
2. Roundtrip airfare from São Paulo, Brazil to Brasilia, Brazil \$400.00
The above price includes airfare and taxes estimated from <www.expedia.com>.

TOTAL funds requested: \$1435.00

IX. Staff. If others are to participate in the project as investigators or assistants, please give their names and qualifications.

Dr. Barth W. Wright (Assistant Professor of Anatomy, Kansas City University of Medicine and Biosciences) is experienced with the sampling and mechanical property collection methods and will participate in the proposed research as an investigator.

The proposed research will be conducted in conjunction with the ongoing EthoCebus project. The EthoCebus project is an international collaborative research effort established in 2005 to study the cognitive and behavioral abilities of the bearded capuchins. The team is led by investigators in three countries: Dr. Dorothy Fragaszy from the University of Georgia (U.S.A.), Drs. Patricia Izar and Eduardo B. Ottoni from the University of São Paulo (Brazil), and Dr. Elisabetta M. Visalberghi from the Consiglio Nazionale delle Ricerche (Italy).

X. Outside Support. List any other sources of funding for the project, with amounts and restrictions (if any).

IGERT NSF Fellowship, includes funds for student travel.

XI. References cited and select bibliography (one page maximum).

References:

1. Terborgh J.T. (1983) *Five New World Primates: A Study in Comparative Ecology*. Princeton, NJ: Princeton University Press.
2. Boesch C. and H. Boesch. (1990) "Tool use and tool making in wild chimpanzees." *Folia Primatologica*. 54:86-99.
3. Wang C.-H. and Y.-W. Mai (1994) "Deformation and fracture of Macadamia nuts." *Int. J. Fracture* 69:67-85.
4. American Anthropological Association, Code of Ethics. (1998). Accessed on March 3, 2007 from <<http://www.aaanet.org>>.
5. Yamashita N. (1998) "Functional dental correlates of food properties in five Malagasy lemur species." *Am. J. Phys. Anthropol.* 106:169-188.
6. Lucas P.W. and C.R. Peters. (2000) Function of postcanine tooth shape in mammals. In: *Development, Function and Evolution of Teeth* (eds. M.F. Teaford, M.M. Smith and M. Ferguson) Cambridge: Cambridge University Press pp. 482-489.
7. Lucas P.L., Beta T., Darvell B.W., Dominy N.J., Essackjee H.C., Lee P.K.D., Osorio D., Ramsden L., Yamashita N., Yuen T.D.B. (2001) Field kit to characterize physical, chemical, and spatial aspects of potential primate foods. *Folia Primatologica* 72:11-25.
8. American Society of Primatologists, Principles for the Ethical Treatment of Non-Human Primates (2004). Accessed on March 3, 2007 from <<http://www.asp.org/society/resolutions/EthicalTreatmentOfNonHumanPrimates.html>>.
9. Fragaszy D.M., Visalberghi E., and Fedigan L.M. (2004a) *The Complete Capuchin. The Biology of the Genus Cebus*. Cambridge: Cambridge University Press.
10. Fragaszy D.M., Izar P., Visalberghi E., Ottoni E.B., and Oliveira M. (2004b) "Wild capuchin monkeys use anvils and stone pounding tools." *Am. J. Primatol.* 64:359-366.
11. Wright BW. (2005) "Craniodental biomechanics and dietary toughness in the genus Cebus." *J. Hum. Evol.* 48:473-492.

XII. Transcript. A copy of your academic transcript (official or unofficial) must be submitted with this form.

Transcript(s) attached

XIII. Permits. Various permits may be necessary to conduct the proposed research (e.g., research visas, research permits, antiquities permits, Historical Preservation Committee approvals, health forms, research on human subjects forms). Anyone planning to conduct research with humans -- even if through an impersonal survey form or using data about humans collected by someone else -- must fill out and submit a set of forms about the "protection of human subjects" before undertaking the research. In most cases, if you have been thoughtful about ethical aspects of your research, and you convey this clearly on the forms, the Committee will speedily approve your project.

The forms are available on the Web: <http://www.gwumc.edu/research/human/htm>. Unless you are doing biomedical research, you should use the forms labeled "non-medical." If you have questions, there is a phone number on the Web to call, but please do so only after carefully reading the instructions, trying your best to proceed according to the guidelines, and seeking advice from anthropology professors.

If you have the requisite paperwork, attach copies to this application; if you do not yet have it, summarize the steps you have taken to obtain it. If no permits or committee approvals are necessary, state that below.

Research permits for this project are not required, since it will be conducted with the EthoCebus research team, who are approved for field research by the Brazilian government. The paperwork is being processed for my tourist visa to Brazil.

XIV. Legal Conditions. All award recipients must provide a complete financial accounting within three months of the termination of research, and must submit a written report on the research within one year of its termination. This report may be a thesis or honors paper. These documents should be submitted to the department's Cotlow administrator or chairperson. Recipients are required to make a presentation at the annual Cotlow Student Research Conference. *Failure to meet these conditions may obligate the recipient to repay the award.*

By signing below, I declare that the information given on this form is accurate and complete to the best of my knowledge and that I have read and understood the Legal Conditions section above.

Signature:

Date:

The Department of Anthropology at The George Washington University does not discriminate on the basis of race, color, religion, sex, national origin, age, handicap, or veteran status. The Department is not responsible for injuries, damages, or legal liabilities engendered during the course of funded research.