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President's Corner jonahrzy@gmail.com

President's Corner

Dear IPS Colleague members,

It is with great pleasure that I express my joy and deep appreciation to all IPS primatologist participants for the successful achievement of the 29th IPS Congress in Kuching, Malaysia. Once again, IPS is the society that gathers primatologists from around the world, providing a platform for them to share the results of their research.
I would like to extend my gratitude to the Organizing Committee of the 2023 IPS-MPS Congress—Aini Hasanah Abd Mutalib, Susan Lappan, and Nadine Ruppert—for their outstanding work. Special thanks go to all officers of the Malaysian Primatological Society for co-hosting the meeting, along with the officers of Place Borneo for their dedication and collaboration in our joint meeting. A heartfelt thank you to the Chairs of the Scientific Committee, Michele Mulholland and Steve Shapiro, for their heroic efforts and efficiency.

I cannot adequately describe IPS's fortune in having such an amazing Treasurer and Vice President for Membership. Once again, I want to take this opportunity to express my special thanks for the tireless and permanent help and advice of our ex-officio Past President, Karen Strier. I am pleased to deeply acknowledge Karen's support since Quito 2022.

I thank all IPS officers who dedicated their time with passion for the best of IPS and world primatology. I feel fortunate to work with a dedicated team, including the VP for Communications, Catherine Hobaiter; the Secretary General, Julio César Bicca-Marques; the VP for Ethics, Diversity, Equity, and Inclusion, Susana Carvalho; and the VP for Welfare and Captive Care, Mollie Bloomsmith.

I appreciate all IPS officers and the 12 representatives of all affiliated primate societies and few guests who participated in the Pre-Congress Meeting on August 19th, 2023.

We are delighted to work with Jo Setchell, the Editor-in-Chief of the International Journal of Primatology, which reached a better position within the field of Zoology in the last ISI evaluation.

Congratulations to our Chinese colleagues who will host an amazing and successful congress in 2027. But before China 2027, we will have the Madagascar IPS Congress 2025. Likewise, I invite everyone to attend the IPS Meeting in Antananarivo from August 10th to 16th, 2025. Congratulations to all IPS grants and award winners and specifically to our 2020 Lifetime Achievement Award Prof. Mewa Singh and our 2023 Outstanding Achievement Award Anthony Rylands.

I express gratitude to the foundations for supporting the attendance of many participants, such as the Margot Marsh Biodiversity Foundation, the Greg Carr Foundation, and re:wild.

Lastly, we were deeply saddened by the sudden passing of one of our members, Linda Burnam-Hall.

With best wishes, Jonah Ratsimbazafy, IPS President

IPS Officers

PRESIDENT
Jonah Ratsimbazafy
University of Antanarivo
Dept of Anthropology & Durable Development
Antanarivo, Madagascar
jonahrzy@gmail.com

SECRETARY GENERAL
Júlio César Bicca-Marques
Pontifícia Universidade Católica do Rio Grande do Sul
Porto Alegre, RS 90619-900, BRAZIL
jcbicca@pucrs.br

TREASURER, VP FOR MEMBERSHIP
Trudy Turner
Department of Anthropology
PO Box 413 UW-Milwaukee
Milwaukee, WI 53201 USA
trudy@uwm.edu

VP FOR COMMUNICATIONS
Cat Hobaiter
School of Psychology
University of St Andrews
St Andrews, KY16 9JP, SCOTLAND
clh42@st-andrews.ac.uk

VP FOR CONSERVATION
Tatyana Humle
School of Anthropology & Conservation
University of Kent, UK
T.Humle@kent.ac.uk

VP FOR CAPTIVE CARE
Mollie Bloomsmith
Emory National Primate Research Centre
Emory University,
Atlanta, GA 30329, USA
mabloom@emory.edu

VP FOR EDUCATION
Patricia Izar
University of São Paulo
Dept of Experimental Psychology
C. São Paulo, SP, CEP 05508-030, BRAZIL
patrizar@usp.br

VP FOR RESEARCH
Marina Cords
Columbia University
Department of Ecology, Evolution, and Environmental Biology
New York NY 10027, USA
marina.cords@columbia.edu

VP FOR ETHICS, DIVERSITY, EQUITY, & INCLUSION
Susana Carvalho
School of Anthropology & Museum Ethnography
University of Oxford
UK
susana.carvalho@anthro.ox.ac.uk

VP for Communication

clh42@st-andrews.ac.uk

Greetings Primate folk!

Time has flown since we were together in person and online in Kuching! We have collated our Officer reports, and an amazing series of updates from our grantees.

One topic that came up at our IPS meeting was language as a barrier to access. One way we're trying to address this issue is by sharing the information documents in our website in a range of languages, starting with French, Spanish, and Portuguese. If you notice any corrections or updates to these please do let us know!

Another issue that came up during discussion of our Congress was the way in which IPS structures our fees for members and meetings. We have a new Fiscal Transparency page to help members see where their money goes, and remember range country members are eligible for free membership.

Please continue to send us all your updates, queries, and primate news and fun.

Hoots and best wishes for a wonderful 2024!

Cat Hobaiter
IPS VP for Communication

VP for Captive Care

mabloom@emory.edu

I am Mollie Bloomsmith and want to introduce myself as I am stepping into the role of VP for the Welfare and Captive Care Committee. As a welfare scientist, I have focused my research on nonhuman primates who live in a variety of captive settings including research facilities, zoos, and sanctuaries, and I strive to improve their lives in meaningful ways. In the last 37 years I have worked at one zoo and two primate research institutions and have been involved with a chimpanzee sanctuary for over 20 years of that time. From 2010 to 2016, I served as the first Chair of the American Society of Primatologists' Primate Care Committee, which has many goals similar to IPS's Welfare and Captive Care Committee. I am excited about working to reinvigorate the Welfare and Captive Care Committee, which has been idle following the tragic passing of Steve Ross who was the former Chair.

My immediate aims for the Committee are to (1) identify committee members with expertise, ideas and enthusiasm who are ready to work on advancing the objectives of the Committee; (2) work with these committee members to develop goals and an action plan for the next few years; and (3) manage the Captive Care Grants program which has been so successful in supporting welfare work in range countries.
If you are interested in joining the Welfare and Captive Care Committee, please email me (mabloom@emory.edu) by December 2023, and let me know about your background in animal welfare and why you want to be a part of the group.

Looking forward to hearing from many of you.
Mollie

Secretary General

jcbicca@pucrs.br

I hope that everyone who was able to attend IPS Kuching in person or online enjoyed a scientifically stimulating, vibrant, and interactive meeting.

Since returning from Kuching, I have interacted with my fellow officers and started working on transcribing the minutes of the Pre- and Post-Congress Council Meetings and the General Assembly.

Finally, I am pleased to join everyone in welcoming Mollie Bloomsmith to our team. I wish everyone a safe, healthy and happy holiday season and an outstanding 2024!

Júlio César Bicca-Marques
Secretary General

VP for Research

marina.cords@columbia.edu

Vice-President for Research Report to IPS Council, August 2023

Since the IPS meeting in Quito, I have overseen two research grant competitions (2022 and 2023, details below). In Quito, together with VPs for Conservation and Education, we ran a workshop on writing successful IPS grant proposals, which we plan to repeat in Kuching (and ideally in perpetuity).

Changes in and activities of the Research Committee

The research committee includes 22 current members at the time of writing. Some former members rotated off (after serving a maximum of 8 years), while others wished to step down for other reasons after a shorter time. We identified new members by contacting the leaders of regional primatological societies, current committee members and IPS officers. The committee presently includes 12 women and 10 men. In terms of region, 7 come from North America, 6 from Europe, 4 from Latin America, 3 from East Asia, and 2 from Africa. In some cases, nationals of one region are currently employed in another, i.e. 2 from Europe, and 1 each from Latin America and from Africa working in the USA. The committee also represents a diversity of research interests.

The committee continued to provide feedback on draft proposals by researchers from range-state countries, as long as these were submitted a month before the final deadline. Applicants received constructive comments from two readers within a week, so still had time for revisions before submitting the final proposal. This policy was initiated by my predecessor, Jo Setchell, to try to broaden the applicant pool and reduce inequities in grant-application experience and mentorship. In 2022, we provided feedback to 14 people, and in 2023 to 6: these numbers are more than double those from the previous two grant cycles, and we are pleased that more students are taking advantage of this feedback/mentoring service. Most were from Latin America, and the large number in 2022 especially may relate to the fact that students and mentors learned about the early review option at the Quito congress, shortly before the deadline. 13 of 14 who received feedback in 2022 and 4 of the 6 who received feedback in 2023 ended up submitting a final proposal. Those who did not follow up with a final submission had projects that were not a good fit to this funding stream (they were advised to consider the Conservation Grants instead). Revised proposals were among the funded set in both 2022 and 2023 (N=1 each year), but small numbers make it hard to assess whether this pre-submission feedback increases success rates of range state applicants. Providing pre-submission feedback is still relatively new, and the opportunity is still somewhat under-used, even if there was an uptick in the last two years. We had applicants to the final competition in both years who could have requested feedback, but who did not submit an early proposal for review. Nevertheless, it is encouraging that the numbers are increasing, and I would like to encourage heads of regional societies, especially those that include range country scientists, to help get the word out. The IPS website does include information about this option, but I'm not sure how many people become aware of it from reading that information. The applicants who received feedback often indicated that they found it useful.

One question that has arisen is whether range-country nationals studying outside their own country, and often in North America or Europe, should qualify for such pre-submission feedback. To date we have included them, even though some committee members feel that they already receive much support from the institution where they study.

Research Grants competitions, 2022-2023

In 2022, we received 53 applications from 13 countries. The largest number came from the North American region (N=25), then Latin America (N=16), Europe (N=11) and Asia (N=1). The total pool was smaller than what we received pre-pandemic (typically 60-65). 21 applications (40%) were from range-country applicants. We awarded a total of US$ 14,490 to the top 9 applicants, a success rate of 17%. All awards went to students, one Master's and the rest PhD students. One of the 9 awards went to an applicant from a range-country (Mexico). Two of the successful applicants included Community Conservation Initiatives in their application. A list of awardees and their project titles is provided at the end of this report.

In 2023, we received 38 applications from 12 countries, even fewer than in 2022. It is possible that this trend reflects delays in student research planning imposed by the pandemic. Again most applicants came from North America (N=19), then Latin America (N=9) and Europe (N=9), with one application from Africa. Eleven applications (29%) were from range-country applicants. We awarded a total of $14,970 to the top 10 applicants, a success rate of 26%. All awards went to PhD students. Three of the 10 awards went to applicants who were nationals of a range-country (Colombia, India, Madagascar), matching their representation in the applicant pool. Five of the successful applicants included Community Conservation Initiatives in their application. A list of awardees and their project titles is provided at the end of this report.

Finally, along with the VPs for Conservation and Education, we developed a grant contract which all those awarded IPS funds in 2023 have signed. This contract stipulates that those receiving awards will notify the relevant VP of changes to their research aims, questions or timeline, will submit a final report in a timely way, and will return to IPS any funds that are not necessary to completing the project (e.g. if other funding is secured). For students, we also ask the advisor to sign off on notifying IPS if funds have been spent but the project has not been finalized. We felt it prudent to formalize these expectations, and plan to use the contract in the future.

Symposium featuring Research Grant recipients

We inaugurated this year a symposium at IPS-Kuching featuring recent research grant recipients. Eleven recent recipients who are ready to report on their work will be participating. We hope to make this a regular venue at IPS congresses.

Acknowledgments

I am very grateful to the members of the IPS Research Committee for their help in reviewing the pre-applications and final applications, and for providing constructive feedback which we sent to all applicants. Members for 2022 and/or 2023 included: Katharine Amato, Fernando Campos, Rebecca Chancellor, Oscar Chaves, Liliana Cortes-Ortiz, Bert Covert, Anthony di Fiore, Sofya Dolotovskaya, Cedric Girard Buttoz, Maren Huck, Urs Kalbitzer, Amanda Koerstjens, Andres Link, Ikki Matsuda, Suchinda Malaivijitnond, Nga Nguyen, Patrick Onyango, Julia Ostner, Aridana Rangel, Onja Razafindratsima, Julie Teichroeb, Yamato Tsuji, Sarie van Belle, and Eva Wikberg, and Shinya Yamamoto.

List of 2023 Awardees (Research Grants)

- Silvia Carboni: Exploring the Interplay between olfaction and microbes in two sympatric species of wild Peruvian tamarins
- Sebastian Garcia-Restrepo: Unraveling the evolutionary relationships of capuchin monkeys in the northern Andean region of South America: use of integrative taxonomy in the study of *Cebus* spp. in Colombia
- Florence Landry: Can infant morbidity and mortality be influenced by infant nutritional development? The case of wild olive baboons (*Papio anubis)*
- Brynn Lowry: Integrating field and satellite data for identifying high nutrient patches and inferring primate abundance.
- Virendra Mathur: Spatial cognition in colobine monkeys: movement patterns of Himalayan langur *Semnopithecus schistaceus* in a montane habitat
- Abigail Morris: Influence of vegetation composition on male and female gorilla dispersal and population genetic structure in Lac Tele
- Jenna Owens: Characterizing directional gene flow of three primate species at The Área de Conservación Guanacaste, Costa Rica
- Faramalala Francette Vololonirina: Behavioral ecology of black and white ruffed lemur (*Varecia variegata*) population in the Vohibe Forest, Vatomandry, Atsinanana Region
- Lauren Wiseman-Jones: The physiological and behavioral responses of Virunga mountain gorillas (*Gorilla beringei*) to social and anthropogenic stressors
- Eric Wuesthoff: Exploring the influence of tropical forest regeneration on movement, diet, and seed dispersal in threatened lemurs in Maromizaha Protected Area, Madagascar

Marina Cords, VP for Research

VP for Conservation

T.Humle@kent.ac.uk

We are delighted to have run a very successful **IPS PRE-CONGRESS TRAINING PROGRAMME (PCTP)** at the IPS Congress in Kuching, Malaysia in August 2023 with 9 participants from across eight primate range countries, including three from Central/South America, two from Africa and four from Asia, including two from Malaysia. The conservation committee would like to thank the Malaysian Primatological Society, especially Nadine Ruppert, Susan Lappan, and Felicity Oram, as well as Krystal Ann Jibang and her colleagues at Place Borneo for their support and assistance in organising the PCTP programme. We are extremely grateful to the Margot Marsh Biodiversity Foundation for their continued support of the IPS-PCTP programme. I would also like to extend my deepest thanks to Trudy Turner for her help with managing the finances and Felicity Oram and Zimbo for volunteering to help with running the programme which took place in Bako National Park in Sarawak.

We keep running the **GALANTE FAMILY WINERY CONSERVATION SCHOLARSHIP** which is open to citizens of primate habitat countries with a **deadline of April 1st**. This scholarship, which awards up to $2,500, can be used for primate conservation education and training, and can help cover transportation to a training course or educational program, course, or event fees and/or expenses during the event period, including online courses or workshops **BUT NOT** conferences such as IPS congresses.

*PCTP participants and **instructors** during the IPS Congress in Kuching, Malysia, August 2023*
*(From left to right: **Ramesh 'Zimbo' Boonratana**; Nasandratra Nancia Raoelinjanakolona (Madagascar); Tainara Venturini Sobroza (Brazil); Ayoola Adeola Oluwakemi (Nigera); Anaid Cardenas Navarrete (Mexico); **Tatyana Humle**; **Felicity Oram**; Nurthaqifah Samsudin (Malaysia); Sharifah Noor Hazimah binti Mohammad Shom (Malaysia); Lief Erikson Gamalo (Philippines); Maria Fernanda Alvarez Velazquez (Mexico) and Mukhlisin Mukhlis (Indonesia)*

Please do watch out for the next call for applicants to the PCTP for the next IPS in Madagascar in 2025 on the IPS website and Facebook page!

The 2023 recipient of this scholarship was **Gaspard Nzayisenga** from Rwanda. Gaspard is full-time field veterinarian with Gorilla Doctors. He will be benefiting from training at the California National Primate Research Center, UC-Davis, USA; this scholarship will help support his travel-related expenses. Gorilla Doctors will provide all the additional expenses for this training at the CA National Primate Research Center where he will learn the latest techniques and best practices in non-human primate medicine and research; knowledge which he will then be able to apply back in his home country to help with the conservation of mountain gorillas.
We are immensely grateful to the Galante family for their continued support of this scholarship programme which is helping enhance the capacity and professional development of primatologists and practitioners.

The IPS Conservation Committee has continued to receive high calibre **IPS CONSERVATION GRANT** proposals contributing to primate conservation globally. Please note that we offer on a case-by-case basis feedback on proposals from nationals of primate range-state countries. For this purpose, draft applications must be submitted by the 1st of February for feedback prior to final submission by the **March 1st deadline**.

Of a total of 21 applications received in 2023, six grants were awarded for a total of $10,396; three awardees were from primate habitat countries. The successful awardees were:

- **Christian Howell**: *Applying a mixed-methods approach to identify the anthropogenic and ecological drivers of chimpanzee (Pan troglodytes verus) abundance and distribution at Gola Rainforest National Park*
- **Esteban Santiago Rivera Roman:** *Regional approach of the phylogeography and conservation of Ateles fusciceps in Colombia and Ecuador*
- **Manuel Fonseca**: *Illegal Wildlife Trade Hotspots of the Red Howler (Alouatta seniculus) and the Cotton-top tamarin (Saguinus oedipus)*
- **Nina Beeby:** *Nutritional implications of habitat disturbance on black-and-white ruffed lemurs (Varecia variegata).*
- **Pamela Reyes:** *Geographic distribution and conservation status of Mico melanurus G eoffroy Smo. Hilario, 1812 in Paraguay*
- **Reiko Matsuda Goodwin:** *Local ecological niche modelling (ENM) of threatened primates of Comoé National Park using high-resolution satellite imagery*

The IPS conservation committee would like to congratulate all these awardees for all their initiative, dedication and motivation to help conserve primates and we look forward to receiving their reports and another round of IPS conservation grant applications in 2024.

The IPS Conservation committee membership was refreshed in 2022 and I would like to extend my personal thanks to Arif Setiawan, Jenna Lawrence, Inza Kone, Lisa Rapaport, Mauricio Talebi, Melanie Seiler, Mike Reid and Reiko Matsuda Goodwin for their time and commitment to this committee. Anindya (Rana) Sinha, Augustin Basabose, and Ramesh (Zimbo) Boonratana will be continuing to serve one more term on the committee for the sake of continuity and I am delighted to welcome Alejandro Estrada, Andie Ang, Gladys Kalema-Zikusoka, Josia Razafindramanana, Luciana Oklander, Richard Bergl, Sery Gonedelé Bi, Stella de la Torre and Tom Gillespie as new members of the IPS Conservation Committee.

Finally, the **IPS AD HOC COMMITTEE ON MAKING THE CAPTURE OF PRIMATES SAFER**, which I co-chair alongside Elena Cunningham, Georges Omondi, Jo Setchell and Steve Unwin, seeks to promote the sharing of experience and good practice, as well as alternatives, to the capture of non-human primates. We are delighted to announce that we recently launched a private room on WildHub to facilitate the safe exchange of information, including capture protocols, and to also serve as a tool to promote best practices and assist primatologists (students, academics and practitioners) globally with planning captures or considering alternatives to capture in their research and conservation work. The room is hosted by WildHub, a global community of conservation professionals. If you would like to join the room and and contribute and learn from conservations, blogs within please click here.

Thank you,
Dr Tatyana (Tanya) Humle
VP for Conservation

VP for Education

patrizar@usp.br

IPS Prizes for best student's presentation at the IPS-MPS 2023 meeting

We were so pleased with the wonderful presentations and posters delivered by the students during the IPS-MPS joint meeting in Kuching! Judging the valuable contributions of so many young primatologists was a hard task, but certainly very satisfying. I am very grateful to members of the Education Committee and invited reviewers from the IPS membership that evaluated 78 abstracts submitted to the student's competition and pre-selected the top posters and oral presentations to be judged during the meeting: Adrian Barnett, Alejandra Duarte, Alison Behie , Amanda Tan, Andrea Presotto, Anindya Sinha, Baoguo Li, Bernardo Urbani, Dorothy Fragaszy, Filippo Aureli, Francesca de Petrillo , Gladys Zikusoka, Goro Hanya, Inza Kone, Ítalo Mourthé , Jean-Baptiste Leca, Kim Bard, Kristin Wright, Jessica Lynch, Jessica M. Rothman, Joanna Setchell, João Pedro Souza-Alves, Laurence Culot, Leonardo Oliveira , Liliana Cortes-Ortiz, Marilyn Norconk, Martha Robbins, Mewa Singh, Mike Huffman, Misato Hayashi, Ramesh Boonratana, Sam Shanee, Tiago Falótico, Valentina Truppa, and Zarin Machanda.

This year, we offered mentoring for the selected students to prepare their presentations and posters. I am very grateful to Inza Kone, Joanna Setchell, Amanda Tan; Liliana Cortes-Ortiz, Sarie Van Belle, Anindya Sinha, Goro Hanya and João Pedro Souza-Alves who kindly offer to act as mentors. This was the first time we offered mentoring and we are working to improve and expand this practice within IPS.

During the meeting, we judged 5 posters and 20 oral presentations. I am very grateful to Anindya Sinha, Andrea Presotto, Alejandra Duarte, Eleonore Setz, Elena Cunningham, Jessica Lynch, Jo Setchell, João Pedro Souza-Alves, Laurence Culot, Liliana Cortes-Ortiz, Marina Cords, Peter Kappeler, Susan Cheyne, Susana Carvalho, and Tatyana Humle, for their invaluable collaboration. They were really great and with their help, we awarded eight students in total including the two types of work, poster and oral presentation, in the tow award modalities (regular and low/middle income countries).

The awarded students were:

Best poster: *Primates and people: overcoming silos in achieving 'One Health'*
Author: Celine Ng Yuan
Honorable mention: *Morphological and genetic variation among Callithrix hybrids in Rio de Janeiro, Brazil*
Author: Adrielle Cezar

Best oral presentation: *Environmentally-Mediated Termite Behavior Shapes Seasonality of Chimpanzee Termite Fishing in Mbam & Djerem National Park, Cameroon*
Author: Tyler Andres-Bray
Best oral presentation: *Social connection as a double-edged sword: Exploring tuberculosis infection and social connectedness in free-ranging long-tailed macaques (Macaca fascicularis)*
Author: Nalina Aiempichitkijkarn

Honorable mention: *Beyond bigrams: Sequential dynamics in the vocal system of captive-housed common marmosets (Callithrix jacchus)*
Author: Alexandra Bosshard
Honorable mention: *Feeding Ecology and Dietary Preferences of the Critically Endangered Colombian woolly monkey (Lagothrix lagotricha lugens)*
Author: Manuel Fonseca Aldana
Honorable mention: *Body condition is heritable and associated with the gut microbiome in zoo-housed bonobos (Pan paniscus)*
Author: Jonas Torfs
Honorable mention: *Ranging patterns and movement strategy of the synanthropic Rhesus macaque (Macaca mulatta) in an anthropogenic mosaic landscape in northern India*
Author: Uddalak Bindhani

The best student's presentations were announced at the end of the meeting in Kuching and the students received a cash prize. Congratulations to all participants!

2023 grants and awards

The Education Committee of IPS awards the Lawrence Jacobsen Education grant of up to $1,500 to support the development of primate conservation education programs. In addition, we award the Charles Southwick Conservation Education Commitment Award, in the amount of $2,000: $1,500 to the recipient and $500 given in the recipient's name to a project of their choosing in their community.

Lawrence Jacobsen Education grant

I am very grateful to the Education Committee members who helped review and judge the applications in these past two years: Adrian Barnett, Alejandra Duarte, Carla Castro, Carlos Ruiz-Miranda, Francine Dolins, Inza Kone, Joana Ferreira da Silva, Luciana Oklander, Martin Kowalewsky, Mewa Singh, Misato Haiashi, Rachel Ikemeh, Renata G. Ferreira, Simplicious Gessa, Suchinda Malaivijitnond, Valentina Truppa, and Zarin Machanda.
Six reviewers reviewed and scored each grant out of 35. I standardized the scores and ranked applications based on their mean standardized score. In all editions, reviewers were asked to provide comments to help applicants in improving their future applications. Seven applicants used the opportunity of pre-application to get feedback on their proposal before the deadline in 2023.
We received 12 applications from 5 countries across Latin America (Brazil [6 applications], Colombia, Mexico [2 applications], and Peru) and one application from Madagascar. We awarded US$ 5,477.67 in three grants (two included Community Conservation Initiatives in their applications).

2023 Awardees:

Marcela Oliveira. Project: *Que mico é esse? Taking Rondon's marmoset (Mico rondoni) to public schools in Porto Velho, Rondônia*. Country: Brazil
Samara Albuquerque Teixeira. *Raising awareness for the conservation of Bearded Capuchin Monkeys through environmental education at Brasília National Park, Brazil*. Country: Brazil
Randriamanantenasoa Herilalaina. Project: *Protecting Primates through education and community art in Lavavolo, Madagascar*. Country: Madagascar

Charles Southwick Conservation Education Commitment Award

The Education Committee members also helped with evaluating the nominations for the Charles Southwick Conservation Education Commitment Award in 2023. We received twenty-one nominations! It was very exciting to see so many primatologists willing to bring recognition to people from local communities for their efforts in conservation education. We awarded US$ 8,000 in four awards to: Mrs. Comfort Davies, from Liberia, the Seasea Indigenous people from Indonesia, Mamy Razafitsalama, from Madagascar, and Mr. Henry Didier Camara, from Guinea. I am grateful to Adrian Barnett, Alejandra Duarte, Inza Kone, Martin Kowalewsky, and Zarin Machanda, that helped with evaluating the nominations in 2023.

Final remarks

In early 2024, the Education committee will be getting ready to review the applications for the Lawrence Jacobsen Education Development Grants. Details are available at the IPS website where you can find examples of past successful applications. In addition, we provide feedback on proposals from nationals of low/middle income countries. Applications must be submitted by the 1st February for feedback; revised submissions must be resubmitted by the March 1st deadline. Address questions and completed applications to me.
The Education committee also reviews recommendations for the Charles Southwick Conservation Education Commitment Award. This award is dedicated to recognizing individuals living in primate habitat countries that have made a significant contribution to formal and informal conservation education in their countries. We do encourage primatologists working in primate habitat areas to nominate members of the local community that have made a significant contribution to conservation education. The deadline for nominations is April 1st.

Patrícia Izar
VP for Education

Trea$ury Note$

Trudy@uwm.edu

Dear IPS members,

In 2023 IPS was able to meet all financial obligations and maintain our grants program at the same level as in the previous year. Our relationship with Springer, the published of IJP has been completely formalized and members of IPS now have free access to the journal. Current membership for IPS stands at 1020 members from 76 countries.

This year IPS established the Masters and Genin African Primatology Fund to support African and Malagasy students. The fund is in memory of Judith Masters and Fabien Genin who were tragically killed in their home in South Africa in October 2022. The fund can now accept donations. Another fund has been established by friends of Sebastian Ramirez Amaya to honor his memory. Money raised by friends of Amaya will be used to support primatology students.

Please feel free to get in touch with me if you have any questions about these funds.

Trudy Turner
VP for Membership and Treasurer

IPS Past President

kbstrier@wisc.edu

Report of IPS Past President's Activities, January 2022-August 2023

1. Attended post-congress Council meeting in Quito and helped provide continuity with incoming president, Jonah Ratsimbazafy.
2. Provided advice to new President about procedures for setting up the Elections and Awards committees.
3. Participated in a non-voting, advisory role on email communications and decision-making involving IPS Officers.
4. Continued to encourage donors to the IPS Heritage Fund, which was established in 2021 and currently (as of 20 July 2023) has $38,000 including mostly paid and some pledged funds.
5. At IPS President's request, served as Vice chair of the Elections committee and then as Acting chair to coordinate nominations, communications with potential nominees, and Election committee members. Election committee members (appointed by the President) were: Ramesh (Zimbo) Boonratana, Nancy Caine, Peter Kappeler, Johannes Refisch, Jonah Ratsimbazafy (Committee chair), Christoph Schwitzer, and Karen Strier (Vice chair and Acting chair).
    1. Process: All current officers who were eligible to stand for a second and final term of office opted to do so (VP for Conservation, VP for Research, VP for Membership and Treasurer, and Secretary General). There were no contenders for these positions. The call for nominations and subsequent follow-ups for the one vacant position of VP for Welfare and Captive Care yielded five candidates. Committee members independently ranked the candidates, which were then collated and submitted for approval by the Elections committee and then by the IPS Elected officers. I then contacted the candidates, beginning with the first ranked, until we had a slate of two candidates to run on the ballot for the position.
    2. Election: Once the slate was established, candidates were provided an example of statements from past years. Voting was completed in April 2023, with 216 members voting. I contacted all individuals on the ballot with the outcome and then the outcome (including voting numbers) was sent by email to all IPS members.
    3. Results: All continuing officers were re-elected for a second and final term of office, and Mollie Bloomsmith was elected as the incoming VP of Welfare and Capive Care.
6. Assisted the Awards committee chair and vice chair with procedures and communications involving selection of Lifetime Achievement and Outstanding Achievement award winners.

Karen B. Strier
IPS Past President

Obituary: Sue Taylor Parker

Sue Taylor Parker passed away from Parkinson's disease at the age of 85 on August 26, 2023. Sue was a Biological Anthropologist who taught at Sonoma State University in Northern California until she retired in 2002 as Full Professor Emeritus. She was a notable scholar of comparative cognitive development and gained international recognition for her extensive theoretical publications in the field of comparative developmental evolutionary psychology. Sue was a superb thinker, a rigorous scholar, and a prolific writer, publishing articles, chapters, books, and co-edited research volumes often based on symposia and conferences she co-organized that today provide some of the best references on the development of cognitive abilities in non-human primates. She gained international recognition from her academic colleagues for her extensive publications that focused on the comparative study of the extent and pace of cognitive development in monkeys, apes, and humans. An early adopter of employing Piagetian theory for the comparative study of non-human Primates, Piaget's infant sensory motor series formed the core of her NSF funded study of the development of an infant macaque for her Ph.D. dissertation at the University of California Berkeley (1973) where she worked under the direction of Phyllis Dolhinow and Sherwood L. Washburn. What followed was a long and distinguished career that fueled developments in the new field of comparative developmental evolutionary psychology; a field, based in a European natural history tradition rather than the learning-theory tradition of American psychology.

A series of papers Sue published with Kathleen R. Gibson on the evolutionary convergence of intelligence in Cebus monkeys and great apes (1977) and the evolution of intelligence in monkeys, apes, and early hominids as extractive foragers (1979), brought Sue to the attention of international scholars with an invitation to be a plenary speaker at the International Primate Behavior Society meeting in Florence (1980). This was followed by a Fulbright scholarship (1986) to study in Italy and Switzerland and lecture at the *Fondation Archives Jean Piaget*, Université de Genève. Sue was also one of the first scholars to employ Piagetian theory to further the understanding of cognition in early hominids. In their coauthored book, Origins of Intelligence: *The Evolution of Cognitive Development in Monkeys Apes and Humans*, she and Michael L. McKinney took a comparative view to reconstruct human intelligence, concluding that human cognitive development had occurred in part through recapitulation and acceleration of the terminal stages of development in a series of ancestors accompanied by terminal addition of new stages. A keen historian of evolution, Sue grasped the significance of grounding efforts in the new field in sound theoretical and empirical work. The range and significance of Sue's contributions was formally recognized by her election as a Fellow of the California Academy of Sciences.

During her years at Sonoma State, Sue was active in the faculty union and faculty governance, serving on many committees including transportation, general education, educational policies, as chair of the Department of Anthropology, and as Chair of the Academic Senate (1997-1998). Sue mentored both students and faculty, selecting her replacement with care when she retired to ensure a continuance of the critical subjects she thought important and loved to teach. Although there was no graduate program that included Biological Anthropology at Sonoma State, two of Sue's students who went on to receive PhD's in biological anthropology became distinguished scholars (Tim Bromage and Sharon DeWitte). In her department, Sue was known as the most scholarly faculty of her peers. Using an evolutionary approach in the classroom, her seminar presentations were known for their meticulous recounting of the history of evolutionary biology. She was loved and greatly appreciated by students; her general education course on biological pressures on the life course earned the moniker, *Sex with Sue*. Sue regularly commuted with other social scientists from their home in Berkeley, CA to Sonoma State, 50 miles north. Their carpool conversations between a developmental psychologist, sociologist, gender studies scholar, and cultural anthropologist were lively and colorful, and formed the seed for a new undergraduate program, the Interdisciplinary Studies in Human Development which Sue formally initiated and for some years coordinated. It became one of the most popular majors on campus.

Sue is loved and intensely missed by her family and friends. Among her professional friends, Sue convened an interdisciplinary group of women scholars who met monthly over wine and cheese to share and discuss key articles in their respective fields. She is survived by her husband Andrew Wilson (Wulfson), three sisters Pamela Plumb, Robin Fay-McNair, and Barbara Jensen, a son Aron Branscomb, her step-sons Ian Wulfson and Mike Wilson, and by her grandchildren Claire Branscomb and Kai Wulfson. A memorial was held in California.

IPS Research Grant Report

Allegra DePasquale

Are diet and nutrition of wild capuchins influenced by color vision type? A test of the niche divergence hypothesis

Allegra DePasquale, University of Calgary, Alberta, Canada

This work was recently published as: https://doi.org/10.1016/j.anbehav.2023.08.016

1. Background

In the monkeys of Central and South America, color vision is sex-linked and polymorphic: males and some females are dichromats, while other females are trichromats. The persistence of polymorphic color vision has puzzled researchers since its discovery in 1984 [1]; coupled with evidence that this polymorphism is maintained by balancing selection, researchers have sought to identify the mechanism(s) that underlie the persistence of polymorphic color vision [2]. Emerging evidence of the past decade suggests that dichromats and trichromats each have their own context-specific advantages. Both captive and wild studies have shown that trichromats are more efficient than dichromats in eating reddish ripe fruit, while dichromats are more efficient than trichromats in detecting and capturing surface-dwelling invertebrates due to an enhanced ability to break insect camouflage [3,4,5,6]. These discrete foraging advantages suggest that niche divergence may be occurring, in which dichromats and trichromats occupy distinct ecological niches that facilitate their coexistence. Accordingly, niche divergence has been posited as a mechanism underlying the persistence of color vision variation [7].

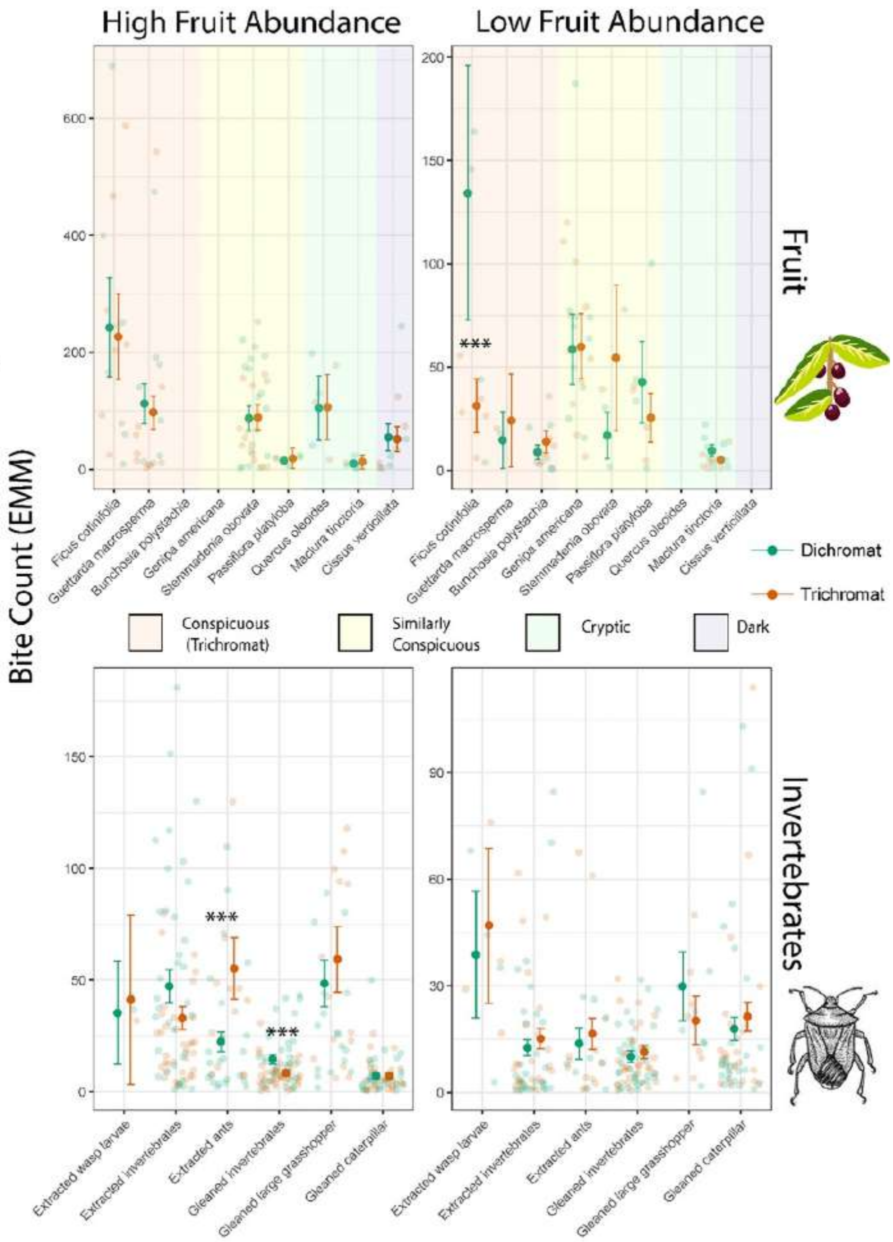
Under the niche divergence scenario, dichromats and trichromats specialize on the resources they are better suited to, thereby decreasing feeding competition between them. Trichromats are predicted to specialize on ripe fruits that are chromatically conspicuous against background foliage, while dichromats are predicted to specialize on camouflaged surface-dwelling invertebrates. Fruits and invertebrates differ markedly in nutritional profile, with the former consisting primarily of sugar and the latter consisting primarily of protein and fat. Differences in the nutritional profile of these foods suggests further downstream nutritional niche divergence, in which trichromats may consume more sugar while dichromats may consume more protein. Furthermore, these patterns are likely to be affected by habitat-wide fruit abundance, the preferred food of many primates, which has been shown to shape patterns of niche overlap and differentiation [8]. Taken together, diet, nutrition, and fruit abundance may jointly shape niche overlap in polymorphic primates, possibly underlying the longstanding persistence of color vision variation.

2. Project objectives

To test the niche divergence hypothesis, we sought to:

- Determine if dichromat and trichromat females differ in intake rates for foods which they are better suited (i.e., conspicuous ripe fruit for trichromats and surface-dwelling invertebrates for dichromats)
- Determine if dichromat and trichromat females differ in nutrient intake rates due to discrete foraging advantages
- Determine how habitat-wide fruit abundance affects niche overlap between dichromats and trichromats

3. Location & methods



We studied wild, white faced capuchin monkeys (*Cebus imitator*) in Sector Santa Rosa, Área de Conservación Guanacaste (ACG), Costa Rica. This site consists of tropical dry forest in various stages of succession. The capuchins are individually recognizable and have been genotyped to determine their color vision status. We conducted parallel 2-hour focal follows of adult female dichromat-trichromat pairs to record food intake rates via bite counts, which we further used to calculate nutrient intake. We coupled this with existing data on the conspicuity of the fruits at our site to the different color vision phenotypes in our population, as well as data on habitat-wide fruit abundance. We built a series of statistical models to test for differences in food and nutrient intake rates while controlling for confounding factors like dominance and individual ID. Based on these models, we generated estimated marginal means of food intake during high and low fruit periods and used these to calculate Pianka's niche overlap index. We further applied right-angled mixture triangles, a tool from nutritional geometry, to visualize whether dichromats and trichromats differ in the macronutrients that comprise their metabolizable energy intake. All research adhered to the laws of Costa Rica and Canada and was conducted with the necessary permits.

4. Key results

We find distinct food intake rates in high and low fruit months. In high fruit months, we found some significant differences between dichromats and trichromats in invertebrate foraging: dichromats consume more camouflaged surface-dwelling invertebrates, as expected, while trichromats consume more extracted ants. In low fruit months, dichromats consume more dark red figs than trichromats. Otherwise, we find no differences between dichromats and trichromats in fruit foraging, contrary to our expectation. Further, we find no differences between dichromats and trichromats in nutrient intake, although overall nutrient intake is distinctly lower in low fruit abundant months, reflecting the poorer nutritional landscape when fruit is scarce. This is further reflected in our right-angled mixture triangles, which illustrate a constricted nutrient intake profile in low fruit months. Lastly, Pianka's niche overlap index, which ranges from 0-1, was .99 in the high fruit period and .73 in the low fruit period, indicating reduced dietary overlap when fruit abundance is low.

5. Discussion

Our results point to modest dietary niche divergence between dichromats and trichromats, reflected in intake rate differences for some invertebrate categories in the high fruit period and in fig foraging in the low fruit period. Reflecting the large difference between dichromats and trichromats in fig foraging in the low fruit period, Pianka's index is lower (i.e., diets are more diverging) when habitat-wide fruit abundance is low. Our results mesh well with previous findings from Sector Santa Rosa. Melin et al. (2007) report that dichromat capuchins capture more surface-dwelling invertebrates per unit time, while trichromats consume more embedded prey, suggesting that trichromats compensate for a reduced ability to break insect camouflage by specializing on non-visual invertebrate foraging [5]. Given the comparable protein intake between dichromats and trichromats we report here, this suggests that trichromats may exert more energy per unit time to achieve the same protein intake as dichromats. Further, previous work has found that the dark red

Ficus cotinifolia figs studied here are highly contrasting in luminance (brightness), which is independent of fruit color and can be detected by both dichromats and trichromats; these figs have been found to carry a dichromat advantage in Santa Rosa due to such a luminance contrast [9]. Thus, dichromats appear able to use cues other than chromatic conspicuity to forage for certain fruits and achieve comparable sugar intake as trichromats. Taken together, our results suggest that niche divergence may play a role in maintaining color vision variation by allowing dichromats and trichromats to achieve comparable nutritional intake using different dietary strategies. We are pleased to report that this work is in press at *Animal Behaviour* and is scheduled to appear in the November 2023 issue.

6. Acknowledgements

We thank Roger Blanco, Maria Marta Chavarria, and the entire staff of the ACG for making this work possible. We additionally acknowledge funding provided by the International Primatological Society Research Grant, the American Society of Primatologists Small Research Grant, the Animal Behavior Society Student Research Grant, the National Geographic Early Career Research Grant, and two NSERC Discovery grants.

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IPS Conservation Grant Report

Toussaint Rahary

Leveraging *Varecia variegata* feeding behavior to restore forest and wetland ecosystems in Ihofa Forest, Madagascar

Toussaint Rabary, Madagascar Biodiversity Partnership

IPS Conservation Grant Awardee 2022

BACKGROUND

In Madagascar's eastern moist tropical evergreen forests, black-and-white ruffed lemurs (*Varecia variegata*) serve an important ecological role as seed dispersers, often consuming whole seeds and later passing them in feces at various distances from the source tree (1). While their ecological specificities have been studied at length in humid, evergreen forests, such as Ranomafana National Park (i.e. 2 ; 3 ; 4) and Manombo (5; 6), little has been explored regarding their use of and importance to wetland sites.

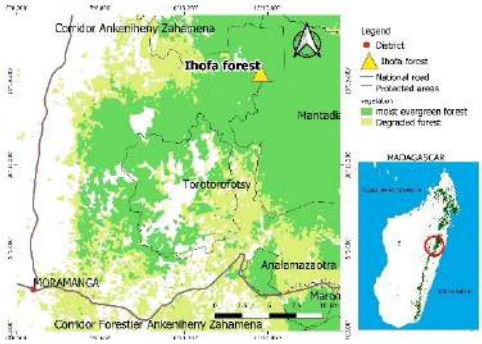
This project focused on the use of wetlands, a critical ecosystem both ecologically and anthropogenically, by *Varecia variegata editorum* (VVE). For this research, data were collected on feeding and ranging behaviors of VVE for two years in wetlands and adjacent habitats to assess how VVE uses wetlands and what plant species they consume. Additionally, this research is part of a larger reforestation project conducted by the Madagascar Biodiversity Partnership in Ihofa Forest. To that end, fecal samples were collected from habituated VVE as a source of seeds for forest restoration initiatives. This also provided data to determine if VVE can act as a natural seed disperser for wetland species and propagate these keystone ecosystems. Understanding the dynamics of VVE behaviors within wetlands, in particular the role they play as potential seed dispersers, could benefit a threatened species and ecosystem.

PROJECT OBJECTIVES

As tropical wetlands are the most threatened habitat type globally and within Madagascar (7), understanding the dynamics of VVE behaviors within wetlands, in particular the role they play as potential seed dispersers and natural forest regenerators, could benefit this threatened ecosystem and the multitude of species therein. We predict that VVE will be important seed dispersers for wetland tree species by consuming fruits and defecating viable seeds, as has been documented for trees in other habitats (8).

STUDY LOCATION

This research was conducted in Ihofa Forest, Madagascar (18.86666°S, 48.36666°E). Ihofa includes both rainforest and natural wetlands and is near the Andasibe-Mantadia-Zahamena National Park which has some of the most intact wetlands in the eastern rainforest corridor as well as highly biodiverse forests on terra firma. Within Ihofa Forest, are two focal VVE groups with non-overlapping territories, Tsimanasovy localized (18.74923°S; 48.42416°E) and Sahanody (18.77566°S; 48.42757°E).



Map 1: *Study site location*

Map 2: Representation of two territories

METHODS

For this project, three data collection components were conducted: behavioral observation of two VVE groups (composed of two individuals in each group) in non-overlapping territories (Tsimanasovy and Sahanody), botanical plot sampling, and seed germination testing. Data were collected on feeding and ranging behaviors of VVE from October 2021 – October 2023 to assess how VVE uses wetlands and what plant species they consume. Behavioral data were collected over the entire duration of the study using instantaneous group scans (9) where behaviors of all individuals in the focal group were recorded every five minutes over an eight-hour period every Tuesday, Wednesday, and Thursday, starting around 7 am and ending at 3 pm. For each scan, when applicable, the plant part consumed, species of tree used during the behavior, approximate height in the tree, DBH of the tree occupied, and GPS location were recorded.

The Modified-Whittaker nested vegetation sampling method was used for the collection of microhabitat data (10). Nine 20 m x 50 m (1,000 m^2) plots using stratified random sampling were established within the VVE-occupied undisturbed forest and six in wetlands. In these plots, all tree species with a diameter at breast height (DBH) ≥10 cm were recorded. Contained within the middles of these plots, a 10 m x 10 m (100 m^2) subplot was established wherein all species of trees with a DBH between 5 - 10 cm were recorded. Then, shrubs, defined as woody plants with a DBH between 1 - 5 cm, were recorded in four 2 m x 5 m (10 m^2) subplots placed in the corners of the larger plot. Lastly, ten 1 m x 1 m plots were randomly distributed within the largest plot in which seedlings were recorded. The objective was to assess floristic composition of each vegetation strata and identify microhabitat differences that may influence VVE habitat use.

Defecated seeds were measured and classified by size (length and width) and tooth marks or other marks of seed destruction were noted (11). Following the study design of Samuels and Levy (12), three seed treatments were compared to assess the impact of gut passage on germination: the germination success of seeds in intact fruits, seeds extracted from fruit (determine if pulp inhibited germination), and seeds extracted from feces (determine if processes such as mechanical and chemical scarification are necessary to break seed dormancy). Seed germination tests were conducted from March 2022 to May 2023, in the reforestation nursery.

RESULTS AND DISCUSSION

Both VVE groups ate from 79 plant species, combined. Among these species, there were three palms, two Pandanaceae, eight lianas and vines, two orchids, one Cactaceae, and 63 trees. Additionally, both VVE groups consumed fruits more than other parts such as leaves or flowers. This was expected as this species is a well-known frugivore (13). Among those plants, two species are specific to wetland ecosystems, *Symphonia urophylla* (Clusiacea, Fig.1) and *Pandanus longissimepedunculatus* (Pandanaceae, Fig. 2), from which VVE consumed respectively flowers and fruits. However, *S. urophylla* was only present in the territory of Sahanody which included more wetlands than Tsimanasovy. The flowers of *S. urophylla* were observed being consumed by VVE from November 2022 to January 2023. Overall, flowers of this tree accounted for 8.9% of all feeding observations, peaking to 17.4% in January 2023. For *P. longissimepedunculatus*, the large fruit containing many large seeds were only observed being consumed in January and February, but data from 2022 was severely limited due to cyclones. Based on data from 2023, *P. longissimepedunculatus* fruit accounted for 1.5% and 0.3% of consumption frequency respectively in Sahanody and in Tsimanasovy, peaking to 5.0% in January 2023 for the Tsimanasovy group. Studies on preference are recommended for future research as well as the possible impacts of flower predation by VVE.

Fig 1: *Symphonia urophylla*

Fig 2: *Pandanus longissimepedunculatus*

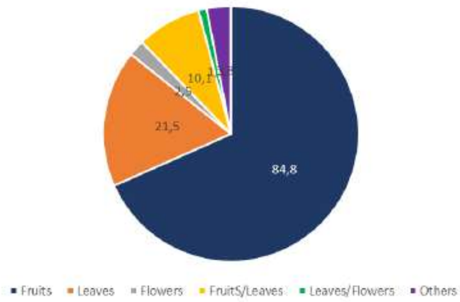


Fig 3*: Proportion of plant parts consumed by VVE*

According to our germination test, fecal seeds (FS) had the highest germination rate (61.9%) compared to seeds extracted from fruits (SEEF, 45.1%) and intact fruits (IF, 24.4%; Fig. 4).

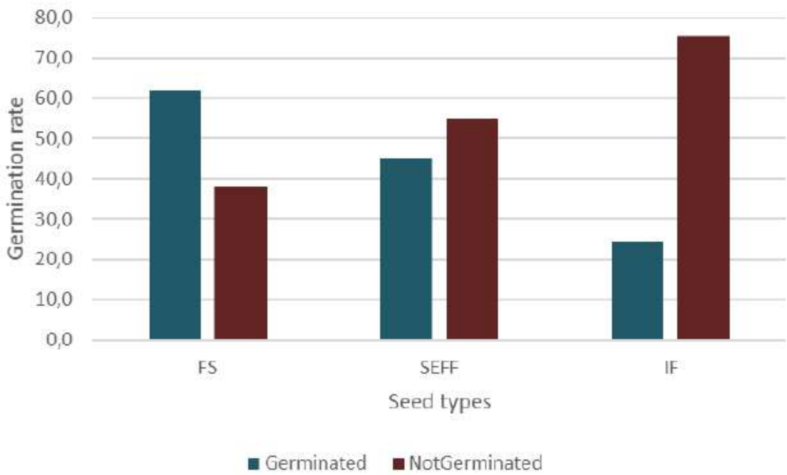


Figure 4: Representation of germination success per seed treatment (FS: Fecal Seeds; SEFF: Seed Extracted from Fruits; IF: Intact fruits)

ACKNOWLEDGEMENT

I would like thank University of Antananarivo, Department of Plant biology and Ecology, Madagascar Biodiversity Partnership, IUCN Save our Species, International Primatological Society, Primate Conservation Inc., Re:wild and IdeaWild.

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IPS Conservation Grant Report

Daniela Solano Rojas

Primate Watching as a tool for primate habitat conservation

M.Sc. Daniela Solano Rojas, Fundación Saimiri

Conservation Grant

8. BACKGROUND/INTRODUCTION

The Osa Peninsula is a hotspot for biodiversity and is home to four species of monkeys (*Saimiri oerstedii* (VU), *Ateles geoffroy*i (EN), *Alouatta palliata* (VU), *Cebus imitator* (LC)) found in Costa Rica. We used the Monkey Watching tool, a system to train local talents on primate conservation, and to support the revival of tourism in the Osa Peninsula, an industry that was devastated in 2020, due to the COVID-19 pandemic.

2. PROJECT OBJECTIVES/AIMS

A. Set out the guidelines to perform Monkey Watching in a sustainable way.

B. Develop educational materials and a course for tour guides to become certified in Monkey

Watching.

B. Issue a certificate to those guides and tourist businesses completing the training.

C. Promote ethical practices for primate watching.

D. Engage guides in data collection in accordance with our prescribed methods.

E. Assist tourists with the precise whereabouts of the four species along the Osa Peninsula in touristic places.

F. Promote our project through social media to inform our followers about our certification process and primate locations, and at the same time, promote citizen science and the monitoring of primate populations.

G. Establish a WhatsApp group for the certified guides to exchange relevant information.

9. BRIEF OVERVIEW OF STUDY LOCATION AND METHODS IF/AS RELEVANT

This project was developed in the Osa Peninsula, southern Costa Rica but we had students from five main locations shown on map. Most of the guides came from Puerto Jiménez and Drake Bay.

We held 15 zoom meetings for our 15 enrolled guides and a representative of tour operators and lodges. This training was led by 5 primatologists, including one from Mexico. All trainer professors had 7-25 years of experience. All 15 guides participated in all 15 meetings with a few exceptions: when guides missed live presentations, they watched recordings instead. At the end of the program, we arranged a field trip for the guides: nine were able to attend, and this is why we only issued nine certificates, with six pending the completion of the field trip.

We also gave a comprehensive presentation about monkey watching during a festival where people from more than eight different communities were present. All of these communities had monkeys living in their regions (Rancho Quemado, Alto San Juan, San Juan, Agujas, Puerto Jiménez, Cañaza, La Palma, Quepos, Paso Canoas, Chacarita, Bahía Chal, Río Claro, Piedras Blancas), and we offered T-shirts for the participants with the Monkey Watching logo. This means that we were able to carry out outreach beyond the five target communities.

10. KEY RESULTS/MAIN FINDINGS OR OUTCOMES [no more than 4 paragraphs]

We trained 15 local guides (5 more than expected), 2 hotels (3 less than expected) and 2 tour operators (same as expected) as an initial stage and pilot program.

The main outcome was the interest developed by guides all over Costa Rica. This project elicited a motivation to learn more about monkeys. The group of guides we worked with also felt the need to give something back to the monkeys, i.e., contribute to their conservation considering the touristic value and attraction they offer.

We expect that most guides and hotels in the area will adopt the idea of "Monkey Watching" with the supervision of the Saimiri Foundation to ensure that best practises are being applied. In the long term, we hope that this programme will enhance greater awareness of the importance of protecting, conserving, and studying the four species of monkeys and their habitat (*Saimiri oerstedii* (VU), *Ateles geoffroy*i (EN), *Alouatta palliata* (VU), *Cebus imitator* (LC)) amongst visitors, the tourism industry and the local inhabitants of the Osa peninsula.

11. IMPLICATIONS OF PROJECT/DISCUSSION OF RESULTS

Our project was a success, as we managed to train 15 guides (5 more than expected), and work with 2 tour operators and 2 hotels. We expected to recruit 5 hotels into the programme, but it was sadly hard to solicit interest of some hotels; this indicates a clear need to promote greater awareness and understanding of the importance of primates as a benefit and attraction for tourism. The culture of 'giving back to nature what we are profiting from it' is unfortunately low in an area that harbours 50% of the country's biodiversity.

Nevertheless, this was a great start. The guides who participated in the trainings are knowledgeable about primates and can now provide valuable information to their clients about these animals. This knowledge sharing will, we hope, promote a greater understanding and appreciation of primates and their role in the ecosystem.

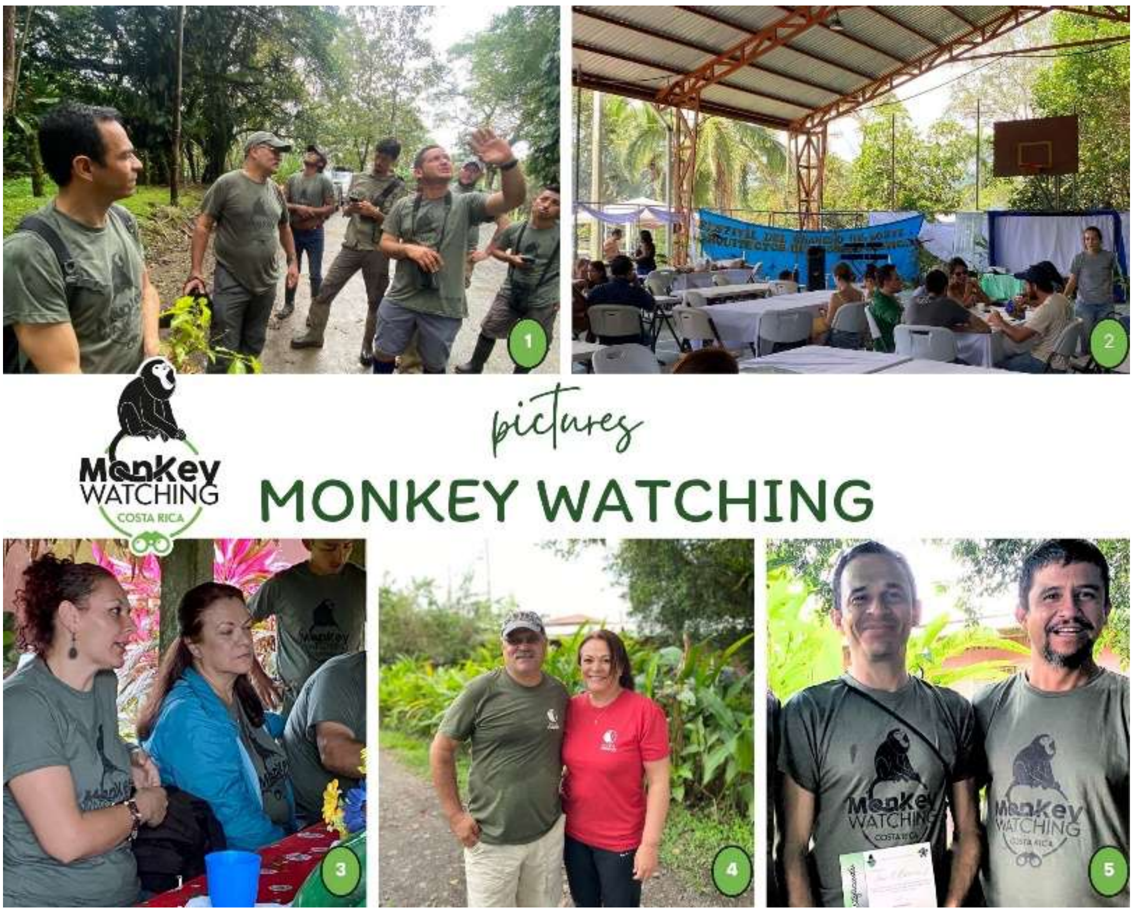
In summary, we now have a group of trained guides about primates which can help to promote primate tourism in a safe and educational way for a positive impact on both human and non-human primate populations.

12. ACKNOWLEDGEMENTS

We want to acknowledge the International Primatological Society for its support of this pilot project, and all the professional primatologists who supported the training of the local guides: Ph.D. Filippo Aureli, Ph.D. Pablo Riba-Hernández, Juan Carlos Ordoñez J., M. Sc. Inés Azofeifa-Rojas. M.Sc. Ronald Sánchez, Ph.D Liz Brenes, M.Sc. Daniela Solano-Rojas.

PICTURES

Group of Senior Primatologists and guides on the field trip 2.Festival where we shared with more than 8 communities our initiative 3. Wrap up after field trip 4. Senior primatoloigist on the field trip 4. White face monkey expert Juan Carlos Ordoñez and field work partner Alexander Fuentes.



IPS Research Grant Report

Meredith Lutz

Behavioral mechanisms underlying seasonal social plasticity in two sympatric lemur species

Meredith Lutz
University of California, Davis
Research Grant Report

INTRODUCTION

Complex social networks characterize primate groups. Several lines of evidence point to the fitness benefits of strong, enduring relationships [1, 2], but social relationships can be influenced by many environmental factors [3]. For example, primate socioecological theory has historically focused on the relationships between factors such as food availability and distribution, predation risk, and infanticide to competitive regimes within and between groups and to resulting social phenotypes for a particular species [4-6]

Yet, the ecological context that primates live in can vary across the course of a year (or even between years). For example, lemurs (Superfamily: Lemuroidea) living in Madagascar face extreme seasonal changes and interannual changes due to topographic diversity, climate change, and frequent cyclones [7, 8]. These fluctuations in climate cause unpredictable fruiting – both across years and within seasons [8]. Given the magnitude of climatic variation, changes in social structure related to the ecological context are likely. Preliminary data on diademed sifaka (*Propithecus diadema*) supports hypothesis as spatial proximity networks in the rainy season and the dry season differ in several key structural attributes reflecting the strength and distribution of social relationships. Yet, the exact mechanisms underlying this seasonal plasticity is unknown and could include the influences of dietary changes, climatic changes, and reproductive cycles. Thus, this project aimed to examine ecological mechanisms driving temporal changes in primate social networks using two lemur species from Madagascar's rainforests as a model system.

PROJECT AIMS

Our project aimed to address the question: How do seasonally changing phenomena promote social flexibility? To that end, we sought to:

(1) Quantify the extent of seasonal plasticity in social relationships in each species

(2) Evaluate three possible behavioral mechanisms (dietary shifts, climate, and reproductive cycles) underlying the plasticity.

STUDY LOCATION AND METHODS

Study site. We conducted our study in the Maromizaha Protected Area, a 2150 ha protected area within the Ankeniheny Zahamena corridor in Madagascar's eastern rainforests (Figure 1).

Study species. We studied frugivorous common brown lemurs (*Eulemur fulvus*) and seasonally frugivorous diademed sifaka (*Propithecus diadema*; Figure 1). These lemur species are ideal because they have (a) diverse diets and levels of dietary flexibility and (b) live in groups of 5 - 10 individuals, permitting sufficient, high intensity data collection. To decrease variation due to differences in forest quality, our study groups were paired such that one group of each species ranged sympatrically. We followed *P. diadema* group 1 (10-11 individuals), *P. diadema* group 2 (6 individuals), and *E. fulvus* groups 2 and 3 (6-8 individuals each).

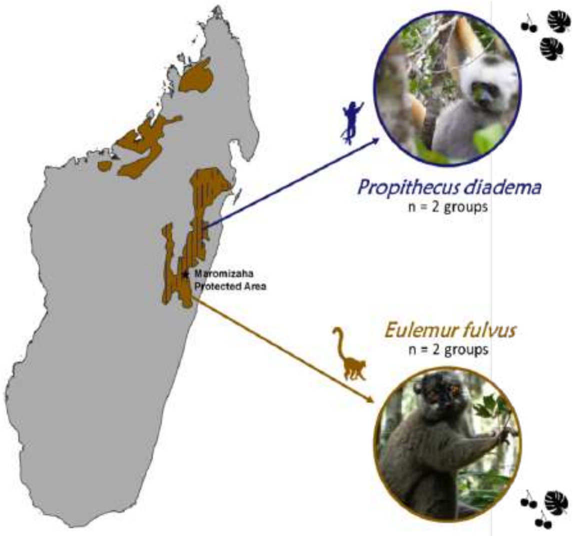


Figure 1. Geographical distribution of the two study species (*Propithecus diadema* in blue stripes and *Eulemur fulvus* in brown solid shading).

Behavioral data collection. Our research adhered to the legal requirements of Madagascar, was approved by Madagascar's CAFF/CORE committee, and was conducted with appropriate research permits. We collected 1-hour continuous recording focal samples of all individuals in each study group between September 2019 and March 2020. We recorded the occurrence duration of all feeding and social behavior. We had three field teams which rotated among the four groups to collect concurrent data. We collected over 1,500 hours of behavioral data, including over 900 hours on *P. diadema* and 600 hours on *E. fulvus*.

RESULTS

Diets. We found that *P. diadema*'s diet concentrated on fruit and young leaves, however there was a wide range of plant parts consumed. They exhibited seasonal consumption patterns of ripe fruit, unripe fruit, and young leaves (Figure 2 upper). Ripe fruit and unripe fruit showed generally inverse patterns (when one was high, the other was low), and young leaf consumption peaked in October and then decreased. *E. fulvus*, on the other hand, ate primarily fruit and exhibited less seasonal changes in their diet (Figure 2 lower).

Social behavior. Social networks for each group for each social behavior (spatial proximity, grooming, and play) showed small incremental temporal changes in the rate of the behavior, the number of relationships, and the distribution of relationships among individuals. How the social networks changed temporally was dependent both on species and on behavior (Figure 3).

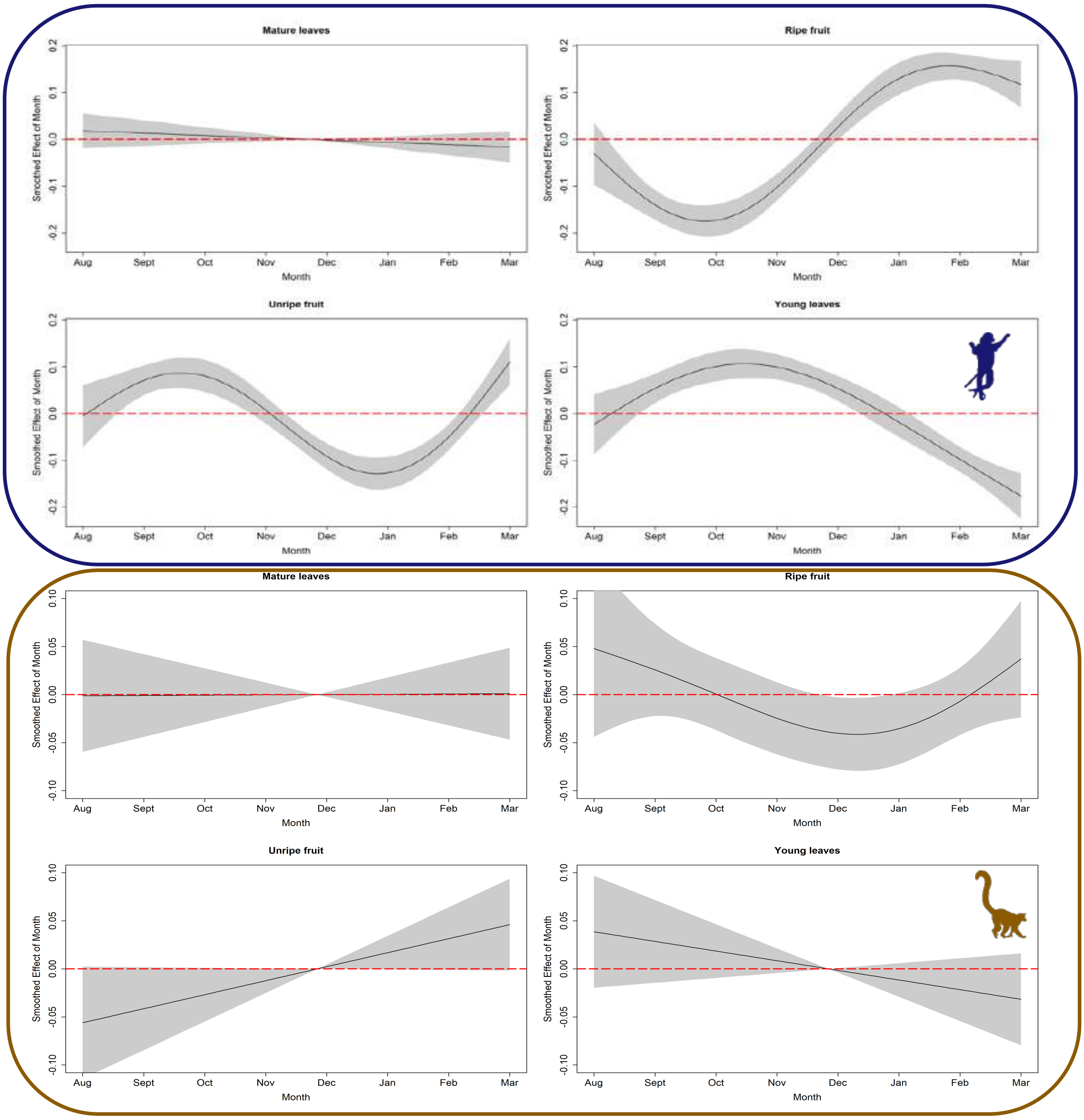


Figure 2. Dietary composition over the study period for *P. diadema* (upper boxed in blue) and *E. fulvus* (lower boxed in brown). For each panel, the y axis represents relative consumption. The black line represents the temporal trend in consumption for the particular plant part with a 95% confidence band shown in gray. If the grey bands do not overlap with the red dashed line (which represents no effect), then there was not a seasonal consumption pattern for that plant part. Plant parts plotted include mature leaves (upper left of each colored box), ripe fruit (upper right), unripe fruit (lower left), and young leaves (lower right).

DISCUSSION AND FUTURE STEPS

While analyses are still ongoing, we found that both species showed seasonal plasticity in their social relationships, although the exact patterning was behaviorally dependent. We found that *P. diadema* had a more diverse diet in terms of plant parts consumed and switched among different plant parts throughout the study period. *E. fulvus* had a more specialized diet on fruit with minimal seasonal changes in the plant parts consumed.

In order to address aim 2, we will begin developing statistical models to compare the timing of seasonal changes in behavior across species and behaviors. These models will account for the temporal changes in diet as well as the shared climate. In addition, we will track individual female's reproductive cycles to include data about seasonal breeding. Lastly, we aim to incorporate demographic data on the groups, as animals are known to preferentially affiliate with certain age-sex classes, which also may be seasonally dependent.

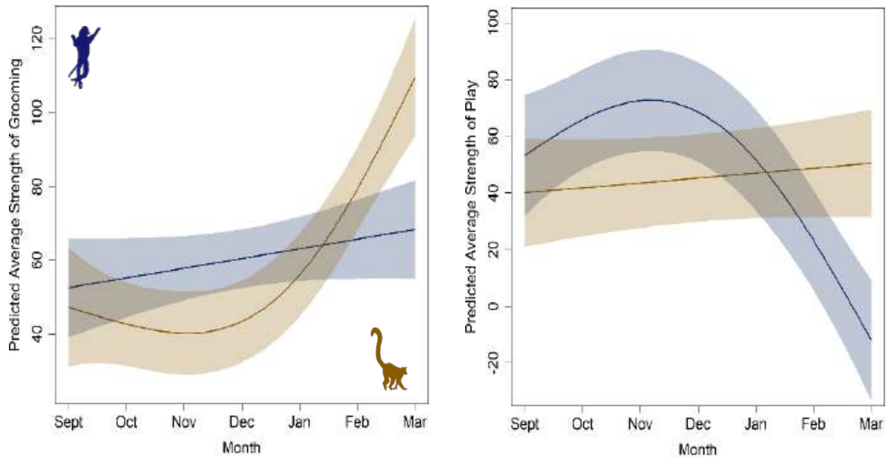


Figure 3. Social network measures for grooming (left) and play behavior (right) shown across the study period. For each curve, the solid line shows the fitted effect and the transparent band

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Wild Chimpanzee Genetic Diversity, Health, and Behavior in Isolated Forest Fragments in Rwanda: Population Viability in Isolated Habitats

Sylvain Nyandwi, The George Washington University

BACKGROUND

Human landscape use has led to fragmentation and deforestation in over 50% of tropical and subtropical forests[4]. Habitat fragmentation can alter ecological processes[9] and have dire consequences for species living in fragments. Species in fragmented landscapes may face restricted dispersal that can lead to inbreeding depression, increased risk of disease, and edge effects, all of which threaten population viability[5]. Non-human primates are particularly vulnerable to fragmentation since most species are forest specialists[1]. Researchers estimate that 60% of primate species are now threatened by extinction[8]. This conservation crisis has larger implications for global biodiversity since primates are crucial to ecosystem functions[2].

In this study, I investigated female chimpanzee (*Pan troglodytes*) behavior and dispersal in two forest fragments in Rwanda: Gishwati Forest Fragment (GFF) and Cyamudongo Forest Fragment (CFF). A female perspective on how primates cope with fragmentation is critical given their central role in population growth and viability. Chimpanzees are an interesting system in which to investigate this topic for several reasons. First, they have a longer developmental period and lower fertility than most other primates[10] which may limit the extent to which this species can rebound from deleterious effects of fragmentation. Second, chimpanzees are one of the few mammal species characterized by female-biased dispersal, meaning that females born into forest fragments may face limited dispersal opportunities. Third, chimpanzees occupy large home ranges, but their terrestrial locomotion may allow them to exploit human-modified landscapes as evidenced by crop-raiding[6] and recent reports indicate that females can disperse over large geographic areas occupied by humans[7]; Gombe National Park: unpublished data). Finally, chimpanzees are characterized by a fission-fusion social organization, in which communities temporally split into smaller groups for several hours to days in order to reduce feeding competition[3]. This social heterogeneity may allow females more flexibility to offset costs associated with fragmentation and reduced food availability.

PROJECT AIMS

In this study, I investigated how fragmentation relates to female behavior in terms of grouping pattern and dispersal. Specifically, I:

- Characterized chimpanzee habitat quality in the two fragments under investigation by integrating vegetation surveys and remote sensing data.
- Investigated the relationship between habitat quality, subgrouping, and ranging patterns.
- Evaluated how habitat fragmentation and isolation distance relate to female chimpanzee dispersal and genetic diversity.

OVERVIEW OF STUDY LOCATION, METHODS, AND RESULTS

This study took advantage of two fragments in Rwanda that are similar in chimpanzee population density, but which differ in terms of proximity to a larger chimpanzee reservoir in Nyungwe National Park (NNP) and food availability. The Cyamudongo Forest Fragment (CFF) contains approximately 24 individuals and is about 10 km from NNP and about 90 km from GFF, while Gishwati Forest Fragment (GFF) contains approximately 35 individuals and is approximately 50 km from NNP. Additionally, GFF has lower food resources as a result of long-term human disturbances (Figure 1).

To characterize chimpanzee habitat quality in the two fragments, I combined vegetation plots, monthly phenology and remote sensing data and, generated monthly food availability indices for fruit trees that are consumed by chimpanzees at the two study sites. I then performed MaxEnt modeling to generate habitat quality surfaces based on species presence and key environmental predictors that predict food species distribution and abundance. My results demonstrated that CFF has a higher habitat quality in general but there are key differences in how foods are distributed across the landscape with better habitat quality in the core of the forest compared to edge area. GFF has lower habitat quality in general and edge areas are better than the core. These habitat differences likely have consequences on chimpanzee ranging and subgrouping patterns, in a manner that presents differing risks to females living in the two fragments.

To relate habitat quality and subgrouping patterns in two fragments, I integrated the behavioral and ecological data. The behavioral data was obtained through full day chimpanzee group follow during which we recorded data on group location, group size and composition, group behavioral activities, and the number of females with full sexual swellings at 15-minute time point samples. I used these datasets to test the following predictions: (1) Subgroups are larger in general at CFF than at GFF; (2) Subgroups are larger in the edge than in the core at GFF; (3) Subgroups are larger in the core than in the edge for CFF; (4) GFF females spend more time feeding in the edge than in CFF; and (5) GFF females spend more time in the edge and in human-modified landscapes (HML) than CFF females. All of these predictions were supported except #5; I did not detect any difference in the amount of time females spend in HML between the two fragments. These patterns suggest that GFF female chimpanzees may face increased risks of zoonotic diseases as they spend a relatively larger proportion of time in the edge than CFF. On the other hand, I conclude that CFF females may face increased within-community disease transmission and contest competition, resulting from being forced to range in larger groups in the core forest.

We used matrilineally-inherited mitochondrial genetic data generated from non-invasively collected fecal samples to evaluate how habitat fragmentation and isolation distance relate to female dispersal and genetic diversity of the two populations under investigation. The results indicated a striking difference in mtDNA composition between the two Rwandan forest fragments where CFF had the fewest haplotypes (n = 2) identified among the study populations (mean: 14.3; range: 2-25), while six haplotypes were obtained from the GFF population, and 10 haplotypes were detected in the samples from NNP. Compared with other populations in the region, the results indicated that all population pairs-wise are significantly differentiated (Figure 2). These results suggest that female dispersal is limited in the forest fragment that is further from a larger population (GFF), yet genetic diversity is maintained at relatively high levels.

In sum, the results of this study highlight that finer-scale consideration of local ecology, and behavior, can reveal specific risk factors associated for individuals in fragments. It is our hope that these results provide data that can shape and inform future conservation efforts in Rwanda.

FIGURES

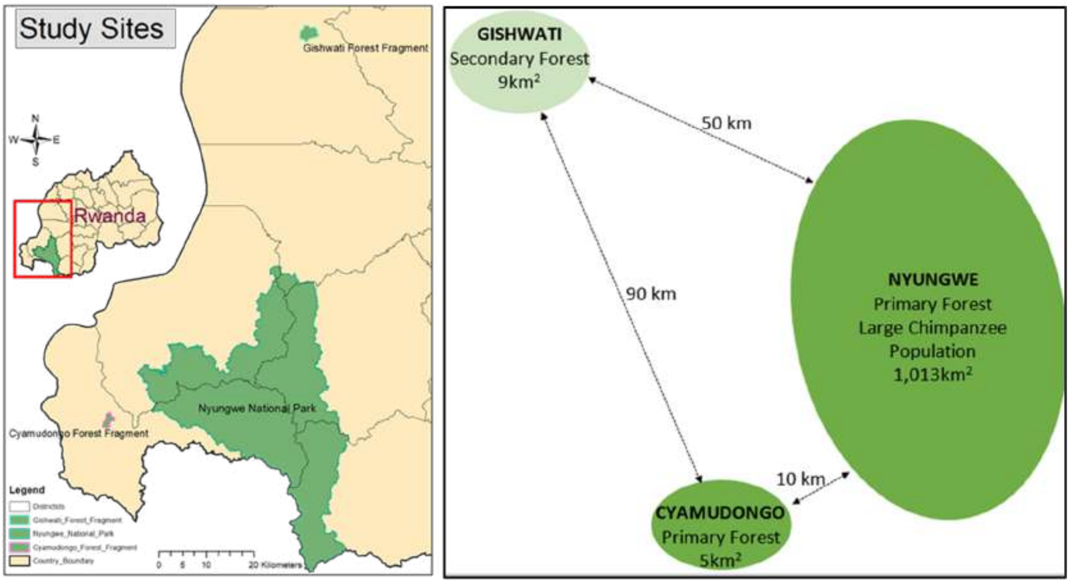

Figure 1. Map of the location of the study sites and straight-line distance to the larger chimpanzee population residing in Nyungwe National Forest

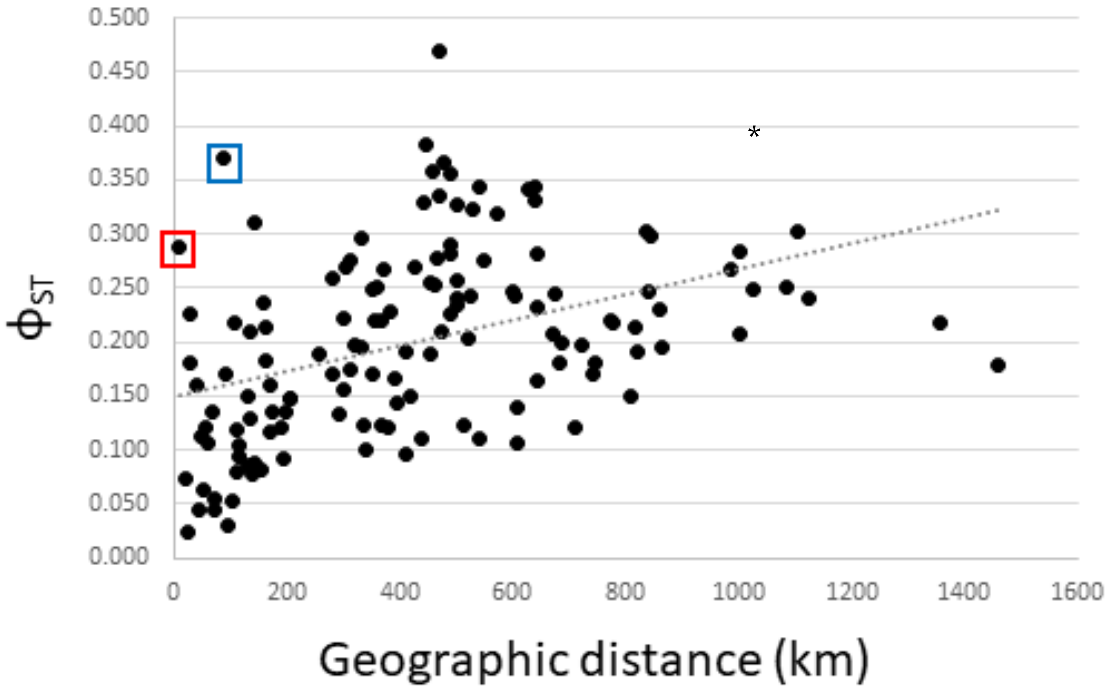

Figure 2. Mantel test of correlation between Φ_{ST} genetic distances and geographic distances in kilometers. The two colored boxes highlight the data points for CFF with the other Rwandan populations: red is CFF-Nyungwe, blue is CFF-GFF.

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Endocrine Effects of Anthropogenic Pollutants in Wild Primates

Tessa Steiniche, Indiana University
IPS Research Grant awarded 2020

Background. Although anthropogenic pollutants are an increasing threat to primates, biomonitoring studies in wild populations remain limited[1]. Predicting the effects of pollutants in primates is challenging, as much of our knowledge regarding toxic effects in wildlife has been acquired retrospectively in response to ecological disasters or observations of abnormal morphology or physiology [2,3]. As such, risk assessment models are generally based on chemical environmental fate, persistence, and laboratory toxicity testing [4,5]. This is problematic as toxicity tests historically focus on acute toxicity of single chemicals, whereas environmental exposure involves chronic exposure to mixtures of chemicals that can interact with one another. Chemical mixtures can contribute to additive, synergistic, or other emergent physiological effects that cannot be predicted based on a series of single-chemical tests, even if exposure to single chemical concentrations occurs below effective thresholds [6]. Logistically, biomonitoring that is non-destructive and does not involve experimental exposure in animals is also rare [7-9].

Project Objective. Noninvasive fecal biomonitoring was used to examine associations between cumulative concentrations of 97 chemical pollutants, including organochlorine pesticides (OCPs), brominated flame retardants (BFRs), and organophosphate esters (OPEs), and fecal hormone metabolites of the HPA (*i.e.,* cortisol) and HPG (*i.e.*, estradiol) axes across four species of primates inhabiting Kibale National Park in western Uganda: chimpanzees (*Pan troglodytes*), olive baboons (*Papio anubis*), red colobus (*Piliocolobus tephrosceles*), and red-tailed monkeys (*Cercopithecus ascanius*).

Methods. The study was conducted at Kibale National Park in western Uganda. Fecal samples were collected from adult and juvenile chimpanzees (N= 19), olive baboons (N=28), red colobus (N=12), and red-tailed monkeys (N=12) for a total of 71 samples. At Indiana University, we measured 22 organochlorine pesticides (OCPs), 50 brominated flame retardants (BFRs), and 25 organophosphate esters (OPEs) following Wang et al. (2020). Hormones were analyzed using enzyme immunoassays.

Data Analysis. Pollutant concentrations for all congeners within a category were summed to calculate a total chemical load (*i.e.,* □OCPs, □BFRs, and □OPEs). To examine associations between pollutants and hormone metabolites, linear mixed effect models using restricted maximum likelihood (REML) (package 'lmer' in R) were performed using log-transformed hormone concentration (i.e., estradiol and cortisol) as the dependent variable, log-transformed pollutant concentration (i.e., □OCPs, □BFRs, and □OPEs) as a predictor, and species category as a random effect (see SM for description of model selection).

Results. Our results demonstrated positive associations of organochlorine pesticides (β = 0.143, p = 0.020) and organophosphate esters (β = 0.112, p = 0.003) with cortisol in adult females. Additionally, positive associations of organochlorine pesticides (β = 0.192, p = 0.013) and brominated flame retardants (β = 0.176, p = 0.004) with cortisol were found in juveniles. No significant associations were found in adult males (Figure 1).

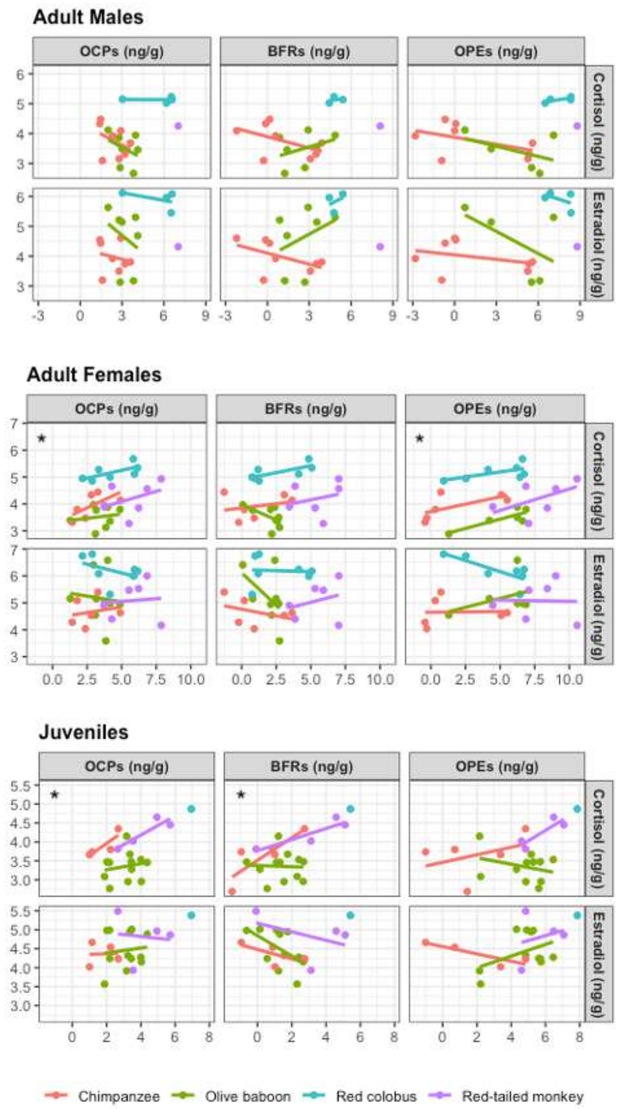

Figure 1. Associations between concentrations of 1) ΣOCPS, 2) ΣBFRs, and 3) ΣOPEs and concentrations of cortisol and estradiol hormone metabolites. Asterisks indicate significant relationships at the .05(*) level.

Implications. Results from this study were notable in in several regards. First, they suggest that females and juveniles are the most vulnerable to endocrine disruption within a population. Second, as most studies on endocrine disruption focus on EATS pathways (i.e., estrogen, androgen, thyroid, steroidogenesis), disruptions involving the HPA axis and changes to circulating cortisol may represent a broadly understudied mechanism of endocrine effects. Further, that these associations were demonstrated based on cumulative pollutant loads, rather than individual chemicals, may suggest some emergent effect not otherwise detected in laboratory or *in vitro* studies. Finally, significant correlations between fecal pollutants and cortisol across four species indicates a potentially conserved pathway shared in primates. Overall, while studies using feces to determine toxicants loads are rare, our results indicate an important opportunity to assess risks and outcomes of exposure to anthropogenic pollutants in vulnerable primate populations.

Permissions. All primates in this study were observed without any invasive methods or contacts with researchers. Permissions to conduct this research were granted by the Uganda Wildlife Authority (UWA) (no. COD/96/06), Uganda National Council for Science and Technology (UNCST) (permit no. NS506) and Indiana University Institutional Biosafety Committee (no. 1229).

Data accessibility. Data from this study are publicly available from the Dryad Digital Repository: https://doi.org/10.5061/dryad.76hdr7t1s

Final publication
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Pictured (left to right): Isaiah, Bonny, Naomi, Swaibu, Tessa, Jimmy, Richard

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IPS Research Grant Report

Helen Slater

BIOPHYSICAL MODELLING OF EDGE EFFECTS ON SUMATRAN ORANGUTAN, *PONGO ABELII*

DR HELEN D SLATER, BOURNEMOUTH UNIVERSITY

IPS RESEARCH GRANT

1. BACKGROUND/INTRODUCTION

Primates will have a high exposure to climate change relative to other taxa [1], however, we still have a very limited understanding of their potential responses [2]. Correlative models of species-environment relationships are most commonly used; however, they have more uncertainty for species that are rare, have limited ranges or do not have widespread population data (i.e., many primate species). They also provide limited insight into the underlying mechanisms behind population declines and local scale threats and are therefore not useful for local-scale conservation planning [3]. Coarse-scale correlative models also do not incorporate information on microclimate variations, which can be significant, particularly in degraded or fragmented tropical forests. Abiotic conditions at forest edges are influenced by adjacent open human-dominated agricultural areas, often leading to warmer and drier average conditions, and more extreme fluctuations in temperature; these effects can be evident as much as 2 km into forest fragments. Approximately 70% of forested areas are within 1 km of a forest edge [4] and therefore a large proportion of forest habitat is likely to be subject to edge effects, with animals in these areas facing more frequent and longer periods of exposure to sub-optimal temperature extremes. These temperature extremes are likely a more important constraint on survival than average conditions [5]. Accounting for forest microclimates and the physiological constraints for primates to cope with extreme temperatures will vastly improve our ability to predict their responses to climate change. Biophysical models use a theoretical approach to determine species' ecophysiology and can therefore be applied at smaller scales and when distribution data are limited [6]. These models can be adapted to incorporate behavioural and physiological responses to climatic variation to predict the potential metabolic costs of climate change and thermoregulation at the individual level. These predictions can then be scaled up to determine climate change impacts on fitness and survival at population and species levels without the need for detailed and extensive distribution data [7]. These models have been used to predict climate change impacts on sportive lemurs and vervet monkeys [8,9], however they have not yet been applied to apes. This study aimed to pilot test a biophysical modelling approach to assess edge effects and physiological responses for a Critically Endangered ape, the Sumatran orangutan, *Pongo abelii*.

2. PROJECT OBJECTIVES/AIMS

My aim was to determine distance to forest edge influences the energetic costs and water loss of thermoregulation in Sumatran orang-utans in secondary tropical forest at Sikundur in Sumatra, Indonesia.

1. Assess the relationship between ambient air temperature and body temperature, metabolic rate and water loss for juvenile, adult female, and adult male orangutans under typical conditions for Sikundur, based on an endotherm model.

2. Predict orangutan metabolic rate and water loss based on microclimate conditions for specific locations at Sikundur, using the NicheMapR endotherm model.
3. Assess the impact of edge-related microclimate variations on orangutan metabolism and water balance by comparing model outputs of metabolic rates and water loss between the forest edge and interior for each of the age-sex categories.

3. BRIEF OVERVIEW OF STUDY LOCATION AND METHODS

I conducted this study in the Sikundur region of North Sumatra, Indonesia, within the Gunung Leuser National Park. After consulting with local landowners, and obtaining relevant permissions to collect data, I identified eight sampling locations, four at the forest boundary within smallholder plantations and four 2 km into the forest from the edge. For all of these points, I collected ground measurements (~1.5m) of temperature, °C, and light intensity, lux, at hourly intervals for the period Aug – Oct 2019 using HOBO pendant data loggers, and I collected data on canopy structure, including tree height, bole height, tree density and canopy connectivity from 25x25m vegetation plots.

I modelled orangutan energetics using the ellipsoid function of the endotherm model in the NicheMapR package [10] in R version 4.0 [11]. I identified input parameters for body mass, hair density, hair diameter, fur thickness, fur reflectivity, oxygen extraction efficiency and basal metabolic rates for adult male, adult female, and juvenile orangutans from published sources in the literature, or where published data were not available, from I used values from phylogenetically similar species.

I first ran simulations for a series of ambient temperatures from 0-50°C in 1° steps, with a wind speed of 1 m/s and a relative humidity of 90% (to reflect typical conditions at the site). I identified the upper critical temperature, UCT, as the point at which the model can no longer find a solution (i.e., the animal can no longer maintain their body temperature). Next, I used the microclimate model in NicheMapR to generate hourly climate predictions for the average mid-point of the canopy for each location and identified the number of days in which air temperature was predicted to exceed the UCT and the total proportion of time when temperatures were above the UCT. I used the microclimate predictions as climate inputs for the endotherm model to simulate orangutan energetics for each age-sex class at each location to identify differences between the forest edge and interior. Finally, I identified the relationship between predicted air temperature, °C, and predicted water loss, g/h, for each age-sex class using a linear regression.

4. KEY RESULTS/MAIN FINDINGS OR OUTCOMES

The model was no longer able to find a solution at air temperatures of 32°C and above for all age/sex classes. Body temperature began to increase at 7°C for adult females and 9°C for adult males and juveniles. Metabolic rate remains relatively constant until the point where the model fails. Water loss rates start to increase rapidly for adult females roughly 2°C before adult males and juveniles (10°C for females, compared to 12°C for males and juveniles).

The overall mean predicted BMR in Sikundur was 93.81W for adult males, 76.59W for adult females and 59.25W for juveniles. Core temperature was 38°C (the maximum allowed value) for all three classes. Water loss rates were highest for adult males (mean = 79.04g/h), followed by females (mean = 68.44g/h), while juveniles had the lowest (mean = 50.59g/h). Predicted fur temperatures were lowest for males (mean = 25.08°C), followed by females (mean = 25.33°C), and highest for juveniles (mean = 25.69°C).

Predicted temperatures exceeded the upper critical threshold of 32°C on more days per year and for higher proportions of time at edge locations compared with interior locations. Temperatures exceeded 32°C on an average of 325.5 days and 0.07% of the time for edge locations, and an average of 224 days per year and for 0.04% of the time for interior locations. Estimated metabolic rates are at their highest around midday (between 10am and 2pm) and are similar between edge and interior locations for adults, while juveniles have a higher estimated metabolic rate in the afternoon at edge locations. Mean estimated water loss rates and dorsal fur temperatures were higher at edge locations than interior locations with both BMR inputs for all age/sex classes. The model predicts a higher rate of increase in water loss with increasing temperature for males compared with females and juveniles. For every 1°C increase in air temperature, estimated water loss increases by 4.74g/h for males, 3.70g/h for females, and 2.94g/h for juveniles.

5. IMPLICATIONS OF PROJECT/DISCUSSION OF RESULTS

We have shown that thermal stress is higher at forest edges, and water balance is an important mechanism which underlies orangutan relationships with climate. Fur temperatures and water loss rates were higher at the forest edge compared with the interior for all age-sex classes, while estimated metabolic rate was highest at the edge for juveniles only. Estimated differences in metabolic rate and water loss were more pronounced for an adult male compared with both adult female and juvenile orangutans (mean difference of 0.11W and 1.27 g/h for MR and water loss respectively in males, compared with 0.06W and 0.96 g/h in females and 0.03W and 0.8g/h in juveniles). This means that physiological stress is higher at the forest edge, and that adult males are more vulnerable to this thermal stress than females or juveniles and will therefore be disproportionately affected by climate change. This will have implications for reproductive success and population structure.

32°C was identified as the upper threshold air temperature above which orangutans were likely to be experiencing notable thermal stress. When temperatures exceed this threshold, animals cannot maintain their optimal body temperature through physiological thermoregulation alone (i.e., through increased metabolism, sweating, or panting). Although the upper threshold is exceeded less in the forest interior compared with the edge, it is still exceeded on average 225 days per year, meaning that orangutans are exposed to potentially stressful conditions at least once on many days of the year. Based on these results, it appears that orangutans at Sikundur are currently tolerating extremely warm temperatures for short periods regularly, however it is unclear to what extent these sub-optimal conditions are negatively impacting their fitness.

Increased thermal stress in individuals results in reduced fitness by increasing enforced resting time, with knock-on effects for activity budgets. Increased enforced resting time will reduce the amount of time available for movement and foraging activities [12]. This will have negative effects at the population level through reduced individual fitness. Conversely, orangutans will have to move and forage more to locate adequate resources and meet their energy requirements due to lower quality food resources in disturbed and fragmented forests and the increased costs

of thermoregulation following climate change [13]. This means that the combined effects of forest disturbance and climate change on orangutan energy budgets will limit their future ability to survive in Sikundur and other human-modified forests.

Temporal, as well as spatial, variation in climate is important in determining climate change impacts. This has been overlooked in previous climate change work on orangutans, which has incorporated only mean annual temperatures from WorldClim data [13,14,15]. Average annual temperatures recorded in Sikundur are well below the upper threshold of 32°C (ranging from 24.97 – 27.52°C), however maximum temperatures frequently exceed it. These extremes are not captured by annual temperature averages, and previous models are therefore likely to underestimate orangutan exposure to the most severe effects of climate change and its resulting impacts. Microclimate models can be used to overcome this and incorporate temporal climate variation into predictive models. Biophysical models can be combined with dynamic energy budget and time budget models to produce more dynamic and physiologically grounded predictions of extinction risk from disturbance and climate change.

6. ACKNOWLEDGEMENTS

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IPS Research Grant Report

Sharmi Sen

Examining causes and consequences of variation in male reproductive strategies in wild geladas

Sharmi Sen, Department of Anthropology, University of Michigan

INTRODUCTION

Male reproduction is a zero-sum game, where each fertilization gained by one male comes at another male's expense. Therefore, in social systems where females can be monopolized, natural selection tends to favor competitive and aggressive male behaviors that facilitate access to fertile females. However, in many species we also routinely see behaviors that are affiliative such as male-female "friendships". This research project aims to understand the reproductive payoffs of these different male strategies (aggressive and affiliative) in a wild population of geladas (*Theropithecus gelada*). More specifically, for my doctoral dissertation, I examined how the aggressive male infanticidal strategy varies between individuals and ultimately affects reproductive success in geladas.

Male geladas gain reproductive opportunities by becoming the dominant leader by taking over a group of multiple females and their offspring (Pappano 2013; Pappano and Beehner 2014). New dominant leader males are known to commit infanticide (Beehner and Bergman 2008), however the extent to which infanticide occurs within groups can be highly variable (Sen, 2023). Male reproduction is thus a function of whether or not the male committed infanticide, the number of fertile females in the group, combined with how long he remains the dominant leader (tenure length). We used long term data (collected over 14 years) by the Simien Mountains Gelada Research Project in combination with detailed demographic, life-history and hormonal (along with paternity data which is forthcoming) from individually known leader males (collected over 15 months by the co-PI), we first examined what factors lead to variation in infanticide behavior in dominant males in our study population. Second, we quantified physical attributes that could affect reproductive success in geladas. These include androgen and glucocorticoid levels using fecal samples collected from individual leader males (measured through a biotin labelled enzyme-immunoassays validated in this species, Sen et al. 2022). Future research will focus on measuring paternity of individual leader males and closely examining the social strategies that males employ to increase reproductive success. This would be done by quantifying male-female social relationships through behavioral observations and recording the occurrence of infanticide.

PROJECT OBJECTIVES/AIMS

1. Demographic factors influencing variation in infanticide occurrence following takeovers in geladas

We examined infanticide as a male reproductive strategy and variation in infanticide occurrence in dominant leader male geladas. We took an integrative approach to examine how maternal attributes, group attributes, seasonal variables, and the arrival of a new dominant male all together affect offspring mortality using 14 years of data from our study site. Then, we zoomed in on takeovers specifically to examine which factors rescue infants from infanticidal threats.

2. Role of male hormonal attributes on infanticide behavior in male geladas

Multiple studies on vertebrates have documented the increase in androgen and glucocorticoid levels during time periods when males face challenges from conspecifics via multiple ways - to either gain access to females and/or rise in rank within the dominance hierarchy (challenge hypothesis) as well as during intergroup encounters where males protect territory or resources (Schoof and Jack 2013; Mitani and Watts 2005). Here, we expected that males that commit infanticide will exhibit higher androgen and glucocorticoid levels than males that don't. Second, we expected variation in infanticide behavior (in terms of the degree to which males commit infanticide) to be reflected in male hormone levels in the first year of tenure when infanticide typically occurs in this study system.

3. Paternity analysis using microsatellite markers

One of my final research goals was to examine the reproductive payoffs of different male reproductive strategies (e.g., infanticide vs non-infanticide). This entailed genotyping fecal DNA samples from adult males, females, and infants to measure paternity. I was supposed to conduct this lab work using fragment analysis at the University of Michigan to genotype individuals using microsatellite markers. This project was delayed due to COVID-19 and due to the University of Michigan sequencing core that conducted fragment analysis shutting down permanently towards the end of 2019. To find a suitable alternative to fragment analysis, I conducted a pilot experiment in 2021, validating a new genotyping by sequencing method using a refined panel of microsatellite markers for cercopithecine primates. I developed the protocol for successful amplification, cleaning, and sequencing of gelada fecal DNA samples and am currently conducting the bioinformatic analyses for this project. Data from this project will be used to answer critical questions about the evolution of male reproductive strategies as well as the socioecology of female geladas in the future.

BRIEF OVERVIEW OF STUDY LOCATION AND METHODS IF/AS RELEVANT

This was an interdisciplinary research project that employed methods in endocrinology, genetics, as well as behavioral analysis using 14 years of data on individually known adult male geladas living in the Simien Mountains National Park, Ethiopia (collected as part of the long-term Simien Mountains Gelada Research project, see map), along with more targeted sampling during my dissertation fieldwork spanning two field seasons (2018-2019 and 2019-2020). During this time, I collected 685 fecal hormone samples from leader and former leader males to quantify androgen and glucocorticoid levels, fecal DNA samples from 164 infants and 94 candidate males to ascertain paternity fecal hormone, and 370 hours of behavioral observation on the interactions between 11 leader males and their unit females.

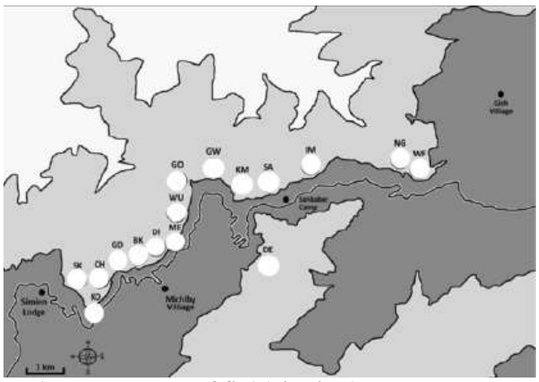

Figure 1: Map of fieldsite in SMNP,

This research was conducted with the permission of the Ethiopian Wildlife Conservation Authority (EWCA). We also followed the American Society of Primatologists/International Primatological Society Code of Best Practices for Field Primatology for carrying out this research. Below, I outline progress made on the different projects that stemmed from my PhD work which are at various stages of completion.

KEY RESULTS/MAIN FINDINGS OR OUTCOMES

1. Demographic factors influencing variation in infanticide occurrence following takeovers in geladas

We found that offspring that experienced dominant male replacements (takeovers) before 18 months (age of weaning) have reliably higher mortality than offspring experiencing no takeover. Interestingly, even though takeovers are the key drivers of infant mortality in this population, 46.7% of takeovers did not result in offspring death even when new males had the opportunity to commit infanticide. Infant age at takeover and number of cycling females are the strongest predictors of infant survival - infants are more likely to survive if they are older during takeovers and if there are more cycling females available for the new male to reproduce with. I also found that former leaders were more likely to be present in the unit after a takeover when there are more vulnerable offspring in the unit. Our results suggest that although takeovers increase offspring mortality overall, new dominant males may not commit infanticide when there are reproductive opportunities already present at takeover. This project comprised the third chapter of my PhD thesis and is currently in prep for submission to Behavioral Ecology and Sociobiology.

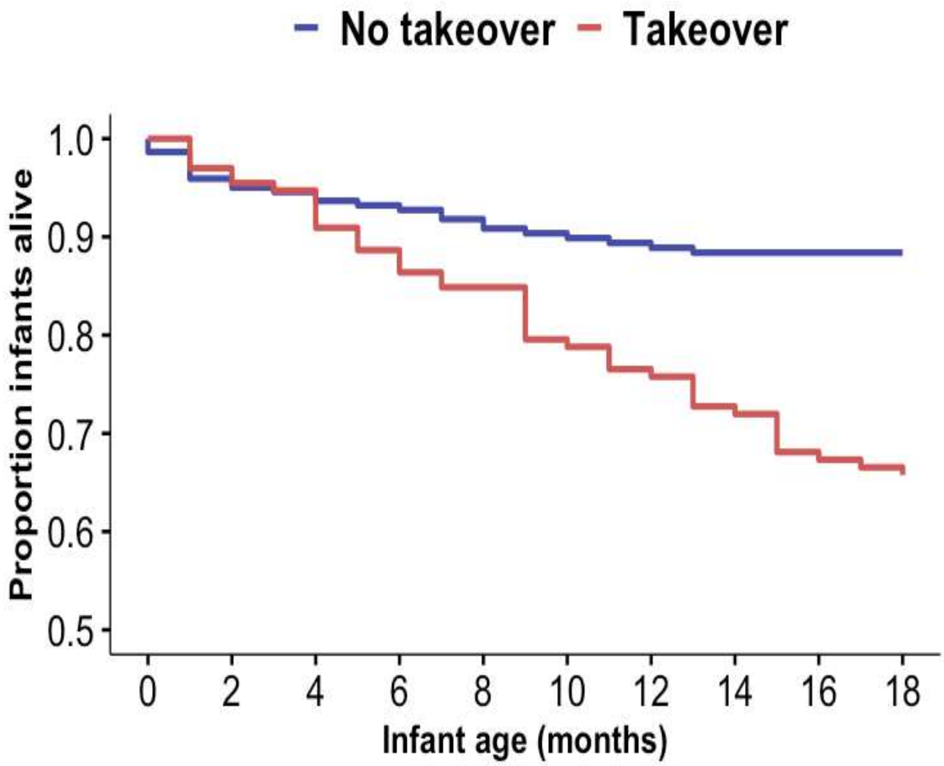

Figure 2: Kaplan Meier survival curves illustrate that post-takeover infants were more likely to die than those that did not experience a takeover.

2. Role of male hormonal attributes on infanticide behavior in male geladas

Next, I examined if variation in infanticide behavior observed in our leader males is mediated by hormones – specifically any surges in androgen and glucocorticoid levels in the first year following a takeover. I performed enzymeimmunoassays to quantify androgen and glucocorticoid levels in fecal samples collected from 79 adult leader males from 2006 - 2020 (n = 2463 fecal hormone samples) at the Beehner Endocrinology Laboratory. Contrary to our expectations, we did not find increased production of fecal glucocorticoid metabolite levels (fGCMs) or fecal androgen metabolite levels (fAMs) in leader males following takeovers when they committed infanticide. In addition to examining this data with respect to infanticide behavior in geladas, we also will conduct more analysis to examine the effects of seasonality and social behavior on male androgen and GCs throughout their tenure as leaders.

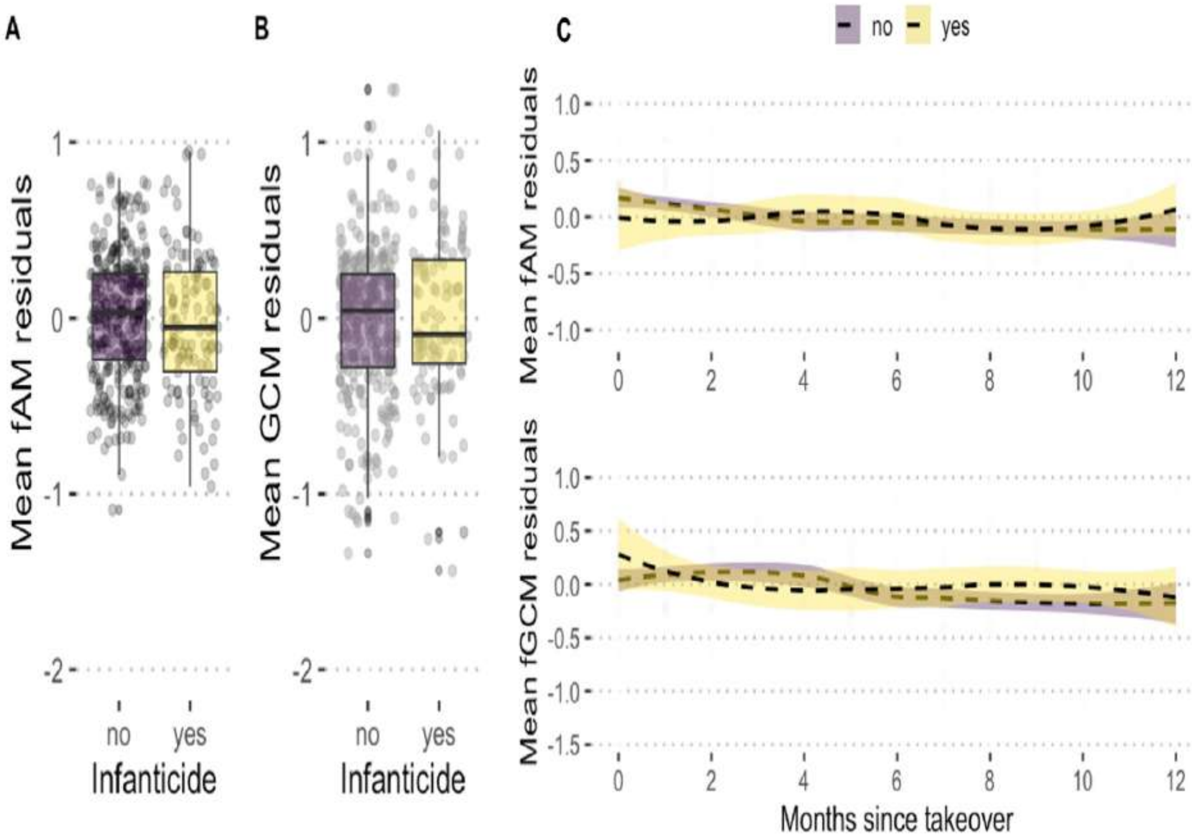

Figure 3: Panel A shows no difference in overall mean androgen and glucocorticoid residuals between leader males (that commit infanticide and that do not, despite having the opportunity to do so). Panel B shows no difference in mean residual fAMs and fGCMs in the two categories of males when observed across 12 months following a takeover.

IMPLICATIONS OF PROJECT

Taken together, our results suggest that male geladas may forego infanticide when there are reproductive opportunities present in the social units and hormones do not mediate the variation in infanticidal behavior. Using long term behavioral data along with paternity estimates, we will next probe into how this variation in infanticide affects social relationships with females and male reproductive success. This research would be one of the most comprehensive studies examining the proximate mechanisms and ultimate consequences underlying variation in infanticide behavior in a wild primate. Results from this study will also provide valuable insights about the evolution of male reproductive strategies and will also enhance our understanding about the adaptive significance of male-female social bonds in a long-lived species.

ACKNOWLEDGEMENTS

I would like to thank our Ethiopian collaborators, the former and current wildlife wardens and wildlife experts at the Ethiopian Wildlife Conservation Authority (EWCA). This research would not have been possible without our wonderful team of long-term Ethiopian research assistants and staff, former camp managers and research assistants who have assisted with the collection of data from our study population over the years. Finally, I would like to thank the funding agencies for providing financial support to perform this research (IPS, the Leakey Foundation, National Science Foundation, University of Michigan, and the American Society of Mammologists).

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IPS Research Grant Report

Tom Roth

Investigating cognitive biases for symmetry and sexual dimorphism in zoo housed Bornean orangutans (Pongo pygmaeus)

TOM S. ROTH (Leiden University, The Netherlands; Supervisor: Prof.Dr. Mariska Kret)

Research Grant

1. BACKGROUND/INTRODUCTION

Facial characteristics such as sexual dimorphism and symmetry are important for mate choice in humans[1] and non-human primates[2] because such traits might signal information about mate quality. Therefore, individuals might also show cognitive biases towards such traits, which can help them to identify or focus on potential mates in their environment. However, up until now these biases have not been systematically investigated in other primate species.

Orangutans (*Pongo* spp.) are an interesting taxon to investigate the interplay between cognitive biases and mate choice for two main reasons. First, male orangutans can be categorized in two distinct morphs: unflanged males and flanged males. Unflanged males experience a period of arrested development; they are sexually mature and produce offspring, but do not possess secondary sexual characteristics. In contrast, flanged males have fully developed secondary sexual characteristics, such as an extremely large body size, long hair, a large throat sac, and conspicuous flanges on the sides of their faces[5]. Second, female orangutans have a clear mate preference for flanged males, which is reflected in the fact that they exclusively mate with flanged males during their ovulatory period[6]. Furthermore, flanged males do not tolerate each other, as they are competitors, but do tolerate the presence of unflanged males. Thus, orangutan males clearly differ in their appearance and these differences are reflected in females' mate preferences.

2. PROJECT OBJECTIVES/AIMS

1. Investigate whether zoo-housed Bornean orangutans have an immediate attention bias towards (i) males with large flanges and (ii) males with symmetrical faces.
2. Investigate whether zoo-housed Bornean orangutans choose to be exposed to pictures of flanged males over unflanged males.
3. Investigate whether zoo-housed Bornean orangutans have a looking time bias towards flanged males over unflanged males.

3. BRIEF OVERVIEW OF STUDY LOCATION AND METHODS IF/AS RELEVANT

This project was conducted at two Dutch zoos: Apenheul Primate Park and Ouwehands Zoo. In both zoos, individuals live in varying group compositions and switch enclosures regularly. They receive food multiple times per day and have ad libitum access to water.

To fulfil the objectives, we used multiple cognitive tasks. For the first objective, we used the dot-probe task, a task that is widely used in humans but is also suitable for testing attentional biases in primates. For a description, see van Rooijen et al.[7] For the second objective, we used a preference task that has previously been used to test rhesus macaques[8]: individuals could select between two colored dots, each associated with another picture category (randomized between sessions). For the third objective, we used a preferential looking paradigm[9] combined with eye-tracking (Apenheul) or with two monitors and videorecording (Ouwehands). In each trial, we showed paired stimuli of flanged and unflanged males, and location was randomized across trials.

This study employed only non-invasive methods and animals were never harmed or punished in any way during the study. Participation was completely voluntary, animals were tested in a social setting, and animals were never deprived of food or water. The care and housing of the orangutans was adherent to the guidelines of the EAZA Ex-situ Program (EEP). Furthermore, our research complied with the ASAB guidelines, was carried out in accordance with the national regulations, and was approved by the zoological management of the zoo.

4. RESULTS/MAIN FINDINGS OR OUTCOMES

Objective 1

We found no evidence for an immediate attentional bias towards either large flanges or symmetrical faces in either of the three orangutans that participated in the dot-probe task; their reaction times were similar on congruent and incongruent trials, indicating no attentional bias.

Objective 2

We found no evidence for a preference for flanged males over unflanged males in the preference task. Actually, all six of the participating orangutans selected flanged and unflanged stimuli at chance level (Figure 1). We did, however, find an energy trade-off and a color preference: individuals were more likely to select the dot that was placed lower on the screen and were more likely to select red dots than green dots.

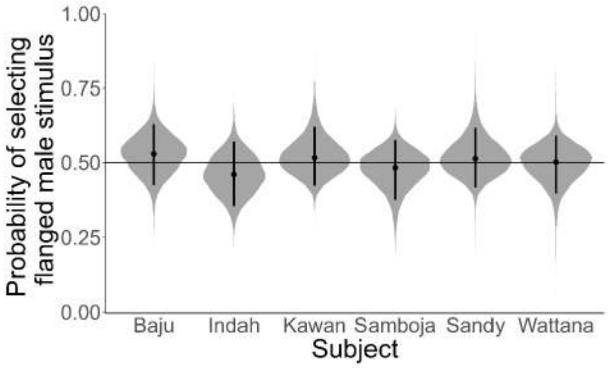

Figure 1 – Results of the preference test per individual. All individuals selected flanged and unflanged stimuli at

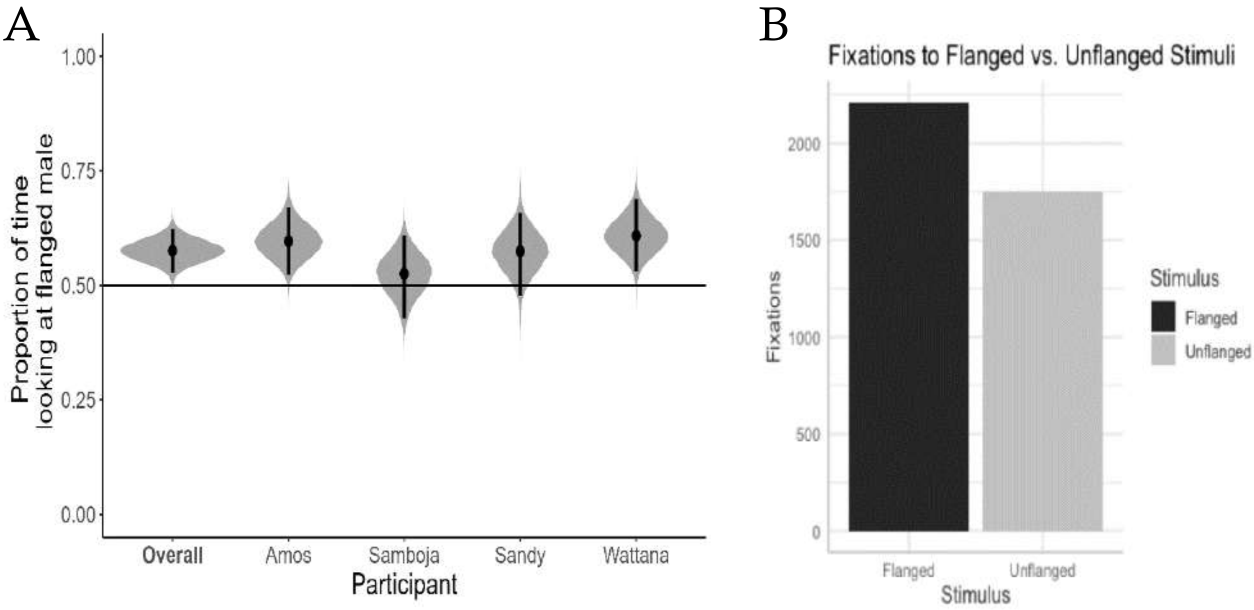

Figure 2 – Results of the looking time task for (A) eye-tracking (only Experiment 1) and (B) the two-monitor setup (courtesy of Julia van Nieuwpoort).

<u>Objective 3</u>
We did find a substantial looking time bias towards flanged males over unflanged males across two eye-tracking experiments and in our two-monitor setup (Figure 2). First, in the eye-tracking experiment we found an overall looking time bias towards flanged males in both of the experiments (Bayesian GLMM; 58% in Exp. 1, 60% in Exp. 2). In Experiment 1, this bias was apparent for three out of the four participating individuals, while it was apparent for all four in Experiment 2. Furthermore, we replicated this result in the two-monitor setup: across three individuals we found that they fixated significantly more often on flanged stimuli than unflanged stimuli (Frequentist GLMM: 56%).

5. IMPLICATIONS OF PROJECT/DISCUSSION OF RESULTS

Our results have shown that Bornean orangutans show a looking time bias towards flanged males in a preferential looking paradigm, but no immediate attentional biases or choice biases towards male flanges and/or facial symmetry in touchscreen tasks. Our results of the preferential looking task align with previous work on rhesus macaques[4] that found a similar attentional bias for secondary sexual characteristics. We extend these findings to a great ape species, and show that presence of mate-relevant traits might indeed affect visual attention.

However, we have not found any biases in the touchscreen tasks, even though we expected them to be present. This raises questions about the validity of our methods. Looking back, we suspect that the touchscreen tasks that we used were not ideal for orangutans. Bornean orangutans have historically been exposed to extremely long periods of food scarcity[10]. As a consequence, they are extremely well-equipped to saving energy. For example, orangutans have very low levels of daily energy expenditure compared to other mammals[11]. Whereas sensitivity
to food rewards has not been systematically studied yet, it is to be expected that Bornean orangutans are extremely sensitive to and focused on food rewards.

This is also what we noticed in the touchscreen task. At the end of each trial, individuals would receive a reward, in order to keep them motivated. However, it sometimes seemed that the anticipation of a reward distracted them from the task. Interestingly, we did not encounter the same problem during the eye-tracking experiment, where individuals received a reward continuously throughout the trial. This design might have avoided continuous anticipation of reward, thereby increasing involvement in the task. Concluding, a more biocentric[12] approach might be necessary to investigate cognition in orangutans. Potentially, tasks that rely on investment of effort will be more suitable, given the energy-efficient lifestyle of orangutans.

ACKNOWLEDGEMENTS

First, I of course want to thank all the orangutans who voluntarily participated in my experiments. In addition, I want to thank the International Primatological Society and the Dr. J.L. Dobberke Foundation for funding my research project. I also want to thank the zoological management of Apenheul (T. Bionda & L. van den Berg) and Ouwehands (J. Kok) for allowing me to perform my studies. Furthermore, I want to thank all the animal caretakers involved in this project at both Apenheul and Ouwehands. Their time investment made it possible to continue despite the restrictions caused by COVID19. In Apenheul: B. Klein, C. Schout, D. de Pagter, D. Eenink, F. Rijsmus, M. Verheij, N. Brands, P. Verwoert, S. Francis, T. Swennenhuis, and V. Ketelaar. In Ouwehands: D. Vaartjes, J. de Meijer, K. Renes, M. Klopman, M. Meijer, M. de Wit, and O. van Leeuwen.

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IPS Research Grant Report

Jayashree Mazumder

Tool-aided foraging behaviour by *Macaca fascicularis umbrosus* of Nicobar islands

Jayashree Mazumder
Ph.D. IISER Mohali, Humanities and Social Science Department, India
Email: jmazumder.91@gmail.com

BACKGROUND: The last two decades have seen an increasing interest in tool-use studies on non-human animals. However, most of the studies conducted on tool use have broadly focused on apes, especially chimpanzees and orangutans, or capuchin monkeys, and have discussed elaborately how tools are manufactured and used by them [1,2]. These studies revealed many similarities in tools and tool technology among these primate species living across various geographical locations. One such example is the use of sticks in the form of "spears" which is seen in chimpanzees and orangutans [3,4]. But there are studies conducted on apes that have revealed dissimilarity in the functional perspective of tools arising due to speciation [5]. Thus, tool-making technology might remain the same as the tool morphologically, but its functional perspective changes according to the species' need [5].

The use of tools is a strategy to facilitate access to specific sources that would be otherwise hard to access [6]. Accordingly, various studies have shown how environmental conditions can impact the use of tools. Recently, a study, for instance, showed how tool-assisted foraging on shellfish among a population of long-tailed macaques caused the decline of the shellfish population, which, in turn, led to a decrease in tool use performed by these monkeys [7]. Studies on non-human primate tool use have described the existence of a sub-culture or culture in which tools and certain behaviour related to tool use and tool manufacture have been attributed to the materialistic aspect of culture [8]. Overall, these studies on non-human primates have examined the origin of material culture, suggesting that social learning might be behind this cultural variation in tool-use as social learning facilitates the propagation of knowledge across generations over time. However, these studies have focused on apes (chimpanzees and orangutans in particular) or capuchin monkeys, while information on tool use in Old World monkeys is still scant. To address this issue, my project explored in detail the ecological factors that can explain the evolution of tool use among Nicobar long-tailed macaques (*Macaca fascicularis umbrosus*). More specifically, this research examined if ecological factors drive tool-aided foraging strategies among Nicobar long-tailed macaques (*Macaca fascicularis umbrosus*), and investigate what types of raw materials are used by this species and how they manufacture and use tools.

PROJECT OBJECTIVES/AIMS: Examining how tool-use abilities spread in populations of non-human primates more distantly related to humans can provide a broader perspective on the evolutionary origins of this behaviour. To this end, the primary goal of my research project was to
(1) Document the types of tool variants used by the macaques, and
(2) Document if ecology affected individual/ group preferences/differences in tool use.

BRIEF OVERVIEW OF STUDY LOCATION:

The study was conducted between December 2018 and March 2019. During the study period, four groups were selected, namely BQ (coastal) and CR (forest) from Great Nicobar Island, and EU (coastal) and FV (forest) populations from Katchal were selected. Later on, depending on the frequency of tool use, which suited the study purpose, only two populations of Nicobar long-tailed macaques (one wild forest and one coast dwelling) population were selected, and it was named Group-FV and BQ. The study was approved by IISER Mohali Research Committee, and the permit (No. CWLW/WL/134/332) was issued by the Andaman and Nicobar Forest Department, India.

KEY RESULTS:

The island's ecology: Both islands had very different habitats. More specifically, the Great Nicobar Island had comparatively fewer coconut trees, was hilly, and beaches were long yet narrow. Katchal Island, on the other hand, had coconut trees, along with flat terrain and short beaches with high currents in the coastal regions. Line survey was conducted to estimate the differences in the abundance of plant species between the two islands. Ten trails were made on each island, with each trail ranging between 444-558m and covering a total of 5.1km and 4.9km for the Great Nicobar

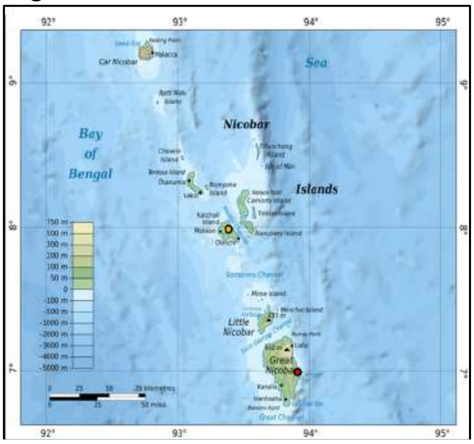

Fig. 1 Field site [9]. FV group: Yellow BQ group: Red

and Katchal islands, respectively. A total of 17 plants commonly foraged by the long-tailed macaque were surveyed [10]. According to the vegetative survey conducted on the two islands, it was evident that the ecology differed from one another. In Great Nicobar Island, the most common plant was screw pine (*Pandanus* sp.), followed by palm (*Areca* sp.) and coconut (*Cocos* sp.). For Katchal, the scenario was very different. The most abundant plant species was coconut (*Cocos* sp.) followed by a herbal shrub called *Melatosoma malabathricum* (Fig. 2). Likewise, the types of objects being manipulated varied across the island or groups. Since Katchal had a more abundant source of food supply to the macaques, tool use or object manipulation was more commonly seen among the coastal population of Great Nicobar. This means that the coastal macaques adapted their behaviour according to the ecological settings and were observed to use tools or manipulate objects more often than those living in the forest of Katchal.

Object manipulation and tool use: During the study, I recorded six different behavioural contexts of tool use or object manipulation: foraging (i.e., food processing), hygiene, communication, play, self-directed and self-hygiene behaviour (for definitions of the different contexts, see [11]). Overall, eight types of objects were identified, some of which can be classified as tools. These are: resonance rod, play object, working platform, pounding substrate, leaves as grip pad and wiper, stimulation tool, dental groom, and scraping tool. A total of 60 cases of tool use or object manipulation have been observed among 16 individuals: 7 adult males, 2 adult females, 4 subadults and 3 juveniles. Fig 3 describes their tool-aided or object-manipulating behaviours and raw materials used.

IMPLICATIONS OF PROJECT/DISCUSSION OF RESULTS:

The proposed research studied the tool-aided (manufacture and use) behaviour among Nicobar long-tailed macaques to understand the raw material selection, tool manufacture, and tool use processes on two islands. This was very important as past research did not examine the extent to which similarities in tool use behaviours exist between groups or species or whether ecological factors influence the similarities in tool selection and manufacture among long-tailed macaques. Addressing this issue provided an important insight into how different macaque populations might have evolved similar tool-use skills. The study also shows that Nicobar long-tailed macaques are adapted to a wide range of ecosystems. This high adaptability is likely due to their behavioural flexibility, making them an excellent tool-use study model. Furthermore, investigating multiple groups across multiple isolated islands provides a unique opportunity to examine how behavioural similarities or dissimilarities may arise among species due to environmental pressures. My research helps to bridge the study gap on non-human primate tool aided behaviour by geographically highlighting the behavioural traits in primate tool-technology and factors influencing the differences across species or groups.

ACKNOWLEDGEMENT:

I want to thank the following people and bodies for being a part of this project: the funding bodies: IISER Mohali (Pilot project grant 2017), IPS (Research grant 2018), Leakey Foundation (Doctoral

Research grant 2019); Andaman and Nicobar forest department; Dr. Parth R Chauhan (Ph.D. Guide) and Dr. Stefano S. K. Kaburu for their guidance; IISER Mohali dissertation committee; islanders and my research team – Nirmal Nath Upadhyay, Kiran, and Diksha.

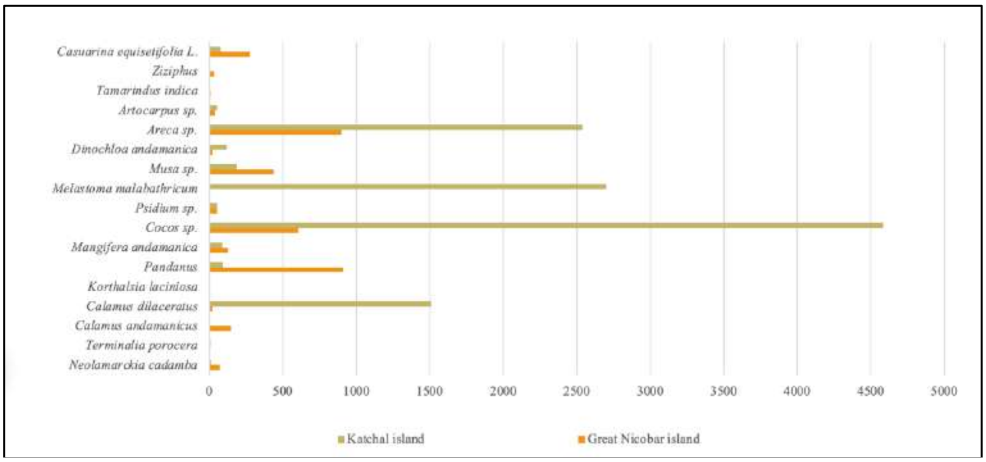

Fig. 2. Distribution of plants in Great Nicobar and Katchal islands, India. Only plants that were commonly foraged by the macaques are included.

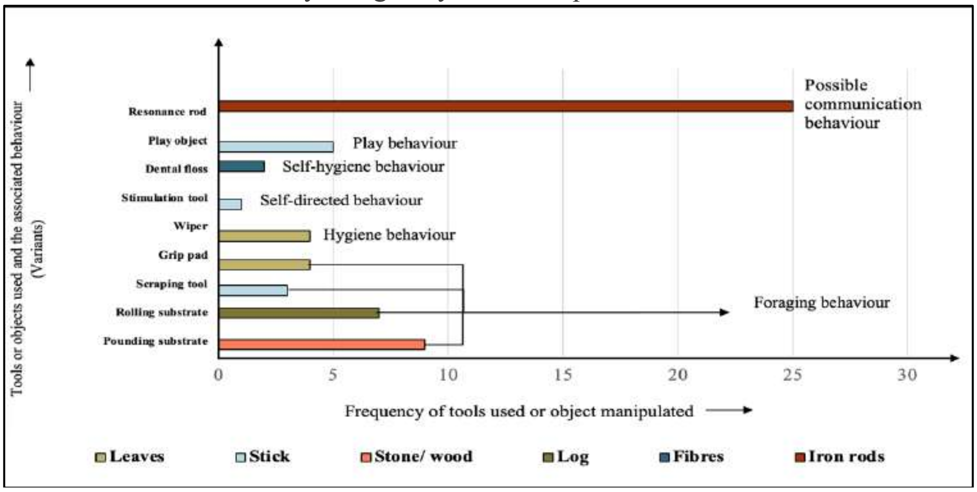

Fig 3. Frequency of tools and objects used, and associated behaviour displayed by Nicobar long-tailed macaques at Campbell Bay, Great Nicobar Island, India.

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IPS Research Grant Report

Tainara Sobroza

Sounds, Cities and "Sauins": the effect of acoustic environment in pied tamarin (*Saguinus bicolor*) (Primates: Callitrichidae) communication behavior

Tainara V. Sobroza
Instituto Nacional de Pesquisas da Amazônia, Brazil
Research grant

paper now available: https://doi.org/10.1080/03949370.2023.2248591

Introduction

Many species depend on sounds to communicate with conspecifics about essential behaviors such as foraging, defense, territorial activities, and mate attraction (Bradbury and Vehrencamp 2011). However, sounds caused by human activities are loud and may mask natural acoustic communication. Animals use a variety of strategies to optimize sound propagation to circumvent this problem (Brumm et al. 2004), like moving to quieter areas (Duarte et al. 2011) or changing the acoustic parameters of their calls, such as frequency and timing (Brumm et al. 2004). Other animals increase and shift the peaks of vocal activity through the day to avoid overlapping with environmental noise (Fuller et al. 2007). A further option for animals in noisy environments could be to complement acoustic communication with another modality, such as chemical (olfaction), or to shift to a different communication modality (Partan 2017).

The pied tamarin (*Saguinus bicolor*), or "*sauin*" as it is known locally, is a primate with a narrow geographic range in central Brazilian Amazonia. Ongoing habitat loss is restricting individual groups to isolated forest fragments within the city of Manaus, with consequent effects on gene flow, inbreeding depression, and loss of individuals by road-kill (Gordo et al. 2013). Among the suggestions for securing viable populations of *sauins* is creating ecological corridors to connect different urban forest fragments and reserves. We know that the pied tamarin is capable of surviving in such urban areas, but there may also be challenges. In particular, how does the noise of a city of 2-million people affect this monkey's communication behavior? Accordingly, my study addressed the following questions:

Figure 1. Pied tamarin individual followed in an urban fragment from Manaus, Brazil, during the study.

- Do pied tamarins increase their vocal activity (estimated as occurrence and calling rate) in response to environmental noise?
- Do pied tamarins shift their vocal activity through the day to match quieter periods?
- Do pied tamarins shift the acoustic parameters of their long calls in response to noise?
- Do pied tamarins use more the quieter areas of their ranges?
- Do pied tamarins scent mark more often in noisier areas?

Methods The study was conducted in the urban area of Manaus, Amazonas state, Brazil. Nine groups of pied tamarins were followed in five forest fragments and in one continuous forested area near the city. Data collection took place between November 2018 and mid-December 2019. With the help of a field assistant, in different months, I followed each group for ten consecutive days from ~6:30-17:00. I observed seven of the groups using radio telemetry. In the field, during five-minute behavioral samples, I collected data on the number of long calls, all occurrences of scent markings, and a GPS point. With a sound level meter I estimated environmental noise in two manners: 1) while following the pied tamarins during the behavioral sampling - to associate with specific behaviors; 2) immediately after the ten days of fieldwork in randomly selected points inside their home ranges - to associate with the use of space by pied tamarins. The average environmental noise in all sampled areas was 59.19 ± SD 5.9 dB. Since the use of space is often related to resource availability, I also estimated the relative abundance of fruits in such randomly selected points inside each home range.

Results

Long call occurrence (i.e., if the long call occurred or not) was positively related to noise levels, while the calling rate (i.e., the number of long calls) did not differ in response to noise. Also, pied tamarins did not shift their daily pattern of vocal activity in response to noise. When analyzing specific acoustic features, I found that frequency features of calls (dominant frequency and lowest frequency) did not change in response to environmental noise, nor did call duration. However, syllable repetition rate (number of syllables/call duration) decreased with increasing noise levels. In addition, the pied tamarins used quieter areas of their home range more intensely, although this pattern occurred only in places where the number of fruits was high. Finally, pied tamarins scent-marked more often when environmental noise amplitude was higher.

Figure 2. Tainara recording and estimating environmental noise with a sound level meter in the home range of a pied tamarin group.

Discussion

In this survey, I found that when noise levels were higher, the probability that pied tamarins emitted a single long call also increased. Long calls are used for group cohesion and may also help in navigation (Sobroza 2017). It could well be that when sound levels surpass a discomfort threshold, pied tamarins move to quieter areas. Indeed, I found that tamarins use more the more silent areas of their ranges, but only when they contain enough food. Many studies have shown that loud noises can induce escape responses that influence patterns of both short- and long-range movements such as the use of space, dispersion, and migration (Duarte et al. 2011, Ware et al. 2015,).

Contrary to predictions, I found no positive association between environmental noise levels and the calling rate. Possibly pied tamarins do not have to increase (or suppress) their calling rate because sound levels did not achieve a threshold that would induce a behavioral response. I also did not corroborate the hypothesis that pied tamarins shift their vocal activity through the day in response to environmental noise, possibly because sound levels in most of the study locations showed low temporal variation and were non-intermittent across the day. Such regularity may lead to habituation by the pied tamarins.

In noisier places, pied tamarins reduced the syllable repetition rate, meaning that they emitted slower long calls, with more time between syllables or more prolonged syllables. A longer inter-syllable duration could allow pied tamarins to call in short periods of silence, a feature also observed with captive cotton-top tamarins (Egnor et al. 2007). If the syllables function as a unity of information (Miller et al. 2003), a longer syllable could also be beneficial as it would facilitate detection by receivers. I did not find a difference in frequency features of long calls in response to environmental noise levels, possibly because pied tamarins' sounds are already high-pitched, with dominant frequencies that can reach 11 kHz.

Pied tamarins exhibited more scent marking in noisier contexts. Because the number of long calls did not decline significantly in noisier areas, these observations do not indicate a shift between communication channels but rather suggest that multimodal signals may enhance effective communication. In great apes, both social and ecological factors affect multimodal communication (Fröhlich and van Schaik 2018). This study represents the first time an ecological effect on multimodal communication has been reported for a Neotropical Primate.

In summary, pied tamarins do not increase calling rate in response to environmental noise, but sound levels enhance the chance that a single long call occurs. Long calls are important for group cohesion during movement. It is possible that the tamarins experiencing high levels of environmental noise emit one single call with a proper acoustic structure (i.e., lower syllable repetition rate and possibly higher amplitude), and move to quieter areas of their ranges. I also found a strong ecological effect of environmental noise on multimodal signaling, suggesting that scent marking can act as a backup signal in noisy conditions. Overall, our result is also interesting for conservation: as long as urban fragments are connected (Barr 2016), pied tamarin individuals are likely to cope with city noise and communicate effectively.

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IPS Conservation Report

Tanvir Ahmed

The Galante Family Winery Conservation Scholarship 2022

International Primatological Society

Awardee: Tanvir Ahmed

Wildlife Research and Conservation Unit, Nature Conservation Management, Bangladesh
Email address: shaikot2023jnu@gmail.com

Purpose of the scholarship:

To participate in a training program on primate population genetics at the Primate Genetics Laboratory, German Primate Center, Germany.

Background:

I am an early-career wildlife biology professional based in Bangladesh. Since mid-2015, I have been studying primates in the country, with a special focus on the Endangered Phayre's Langur (*Trachypithecus phayrei*). Broadly my research interests include primate ecology, behavior, systematics, population genetics, and conservation science. I was awarded the Galante Family Winery Conservation Scholarship of the International Primatological Society (IPS) to participate in a 28-day long training at the Primate Genetics Laboratory of the German Primate Center (DPZ), in Germany.

The objective of participation in the training program was to learn the basics of field methods, laboratory techniques, protocols, and data analysis procedures of primate genetics under the instructions of the renowned scientist Professor Dr. Christian Roos. The funding from IPS was utilized to travel from my home country Bangladesh to the DPZ in Germany, food, and accommodation during the training period. The laboratory costs were covered by the host institute.

Under the permission of the Bangladesh Forest Department, my teammates collected 25 non-infectious and non-invasive fecal samples of primates from the Lawachara National Park and a local animal welfare center in northeast Bangladesh. The samples were kept in tubes with 90% ethanol for 3 to 10 days at room temperature. While traveling from Dhaka, Bangladesh to the DPZ, I carried the samples under the no objection certificate of the national authority of CITES. These samples were used during my training and the generated genetic data will be conserved for the future.

Timeline of the training:

The training was initially planned for 28 days and later, 6 days were extended on a need-based. It started on 18 August and continued till 22 September 2022.

Figure 1: First visit to the German Primate Center, Göttingen, Germany

Figure 2: Extracting DNA from fecal samples at the Primate Genetics Laboratory of the German Primate Center, Göttingen, Germany

Figure 3: The ending session of the training with Prof. Dr. Christian Roos and Dr. Rodrigo Costa Araújo at the German Primate Center, Göttingen, Germany.

Implications of the training on my career:

Participating in the training program, I got a strong baseline on primate genetics which will ultimately benefit my career in the long term. The gained knowledge and experiences will be very useful to initiate research and conservation initiatives on the globally threatened primates in Bangladesh and beyond. As I have shared my experiences with my team in Bangladesh, they got encouraged to enhance their capacity to contribute more to primate conservation. In collaboration with them and my advisor in the training, I already made a long-term research plan for the conservation research on the langurs in Bangladesh.

Acknowledgment:

I thank Bangladesh Forest Department for supporting me with permissions and Nature Conservation Management (NACOM) for permitting me to join the training program. I acknowledge Mr. Sabit Hasan, Mr. Shimul Nath, Mr. Sajib Biswas, Mr. Md. Sabbir Ahammed, and Mr. Atikul Islam Mithu for helping with fecal sample collections. I am grateful to my advisor and instructors, and colleagues at DPZ for their kind support during the training. Finally, I sincerely acknowledge the International Primatological Society for the Galante Family Winery Conservation Scholarship without which participation in the training would not be possible for me.

IPS Education Grant Report

Karla Ramirez

IPS GRANT REPORT

PRIMATES OF THE NEIGHBOURHOOD (PRIMATES EN EL BARRIO): IMPROVING KNOWLEDGE OF LOCALLY THREATENED PRIMATES OF THE PERUVIAN RAINFOREST THROUGH SCIENCE PROJECTS IN URBAN AND RURAL SCHOOLS OF THE SAN MARTIN REGION, PERU

KARLA RAMIREZ - COMUNACIENCIA

Lawrence Jacobsen Education Development Grant 2022

1. BACKGROUND/INTRODUCTION

San Martin Region is one of the regions in Peru with the highest rates of deforestation (DAR, 2021). This means constant loss and fragmentation of primates´ habitat impacting their already fragmented populations. Currently there are groups of monkeys living between rural and urban areas in constant growth. Local conservation and reforestation initiatives are developing an optimist scenario for the conservation of their habitat. It is necessary that local people commit to conservation action in the long term. There are organisations that are doing research and conservation in the area and constant production of new scientific information. However, local schools are not often connected within these scientific and conservation developments, these are not covered in their science curriculum and neither student or teachers are involved in the scientific process behind nature conservation in their localities. This is not a surprise given that Peru is one of the countries with lowest scientific literacy at high school level (OECD, 2018).

2. PROJECT OBJECTIVES/AIMS

The main objective was to improve knowledge among high school students from San Martin Region, Peru, about local environmental issues with emphasis in the ecology and threats of the sympatric monkeys living in the area, while developing positive attitudes towards science and nature conservation initiatives.

3. BRIEF OVERVIEW OF STUDY LOCATION AND METHODS IF/AS RELEVANT

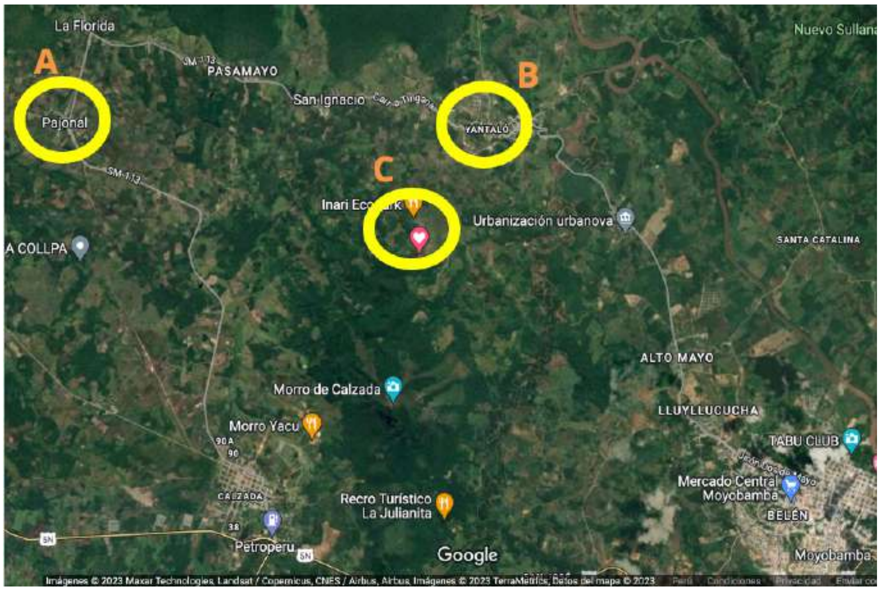
The education project was implemented in the Alto Mayo Valley, Moyobamba Province, San Martin Region, Peru.

The Alto Mayo Valley is home to at least 8 sympatric primate species, all of them are locally threatened, among which there is the critically endangered and endemic *Plecturocebus oenanthe*, also known as one of the most threatened 25 primate species. Their main threats are deforestation due to urban sprawl, agriculture, cattle ranching, highway development, hunting and clear cutting, leading to the fragmentation of their population.

Fig. 1. Project site, Moyobamba, San Martin Region map.

Methods:

The project was based on two participatory teaching methods: learning experiences (promoted by the ministry of education in Peru) and inquiry-based education. The learning experiences are a group of activities that guide students to solve a real-life situation, during school lessons, and with a final product made by the students (MINEDU, 2022). Inquiry-based education is a teaching and learning process inspired by the steps of the scientific method where students develop their own research developing higher motivation and positive attitudes towards science (Dorier y García, 2013).



Our project was developed in four sequential stages:

PROCESS – 4 stages

1 — Selection and commitment

2 Pilot Schools
I.E. 00518 Dionisio Ocampo Chavez - Yantaló
I.E. San Francisco del Pajonal - Calzada

Highschool: Year 7th and 9th

Science and Technology Curriculum

2 Science Teachers and 69 students

2 — Diagnostic

Meetings with principals and science teachers
Pre-test with students to understand their knowledge and perceptions about local environment, primates and science.

3 — Design and adaptation of the learning experience

Volunteers and NPC staff worked together to develop the sequence of lessons of the learning experience.
Meeting with the 2 science teachers to review the document and adapt it.

4 — Implementation in schools

The two science teachers implement the 8 lessons within the Science and Technology course during the 4th bimester (October - December 2022).

The learning experience itself involved an adaptation of the scientific method having observation as first stage, defining research questions as second stage, designing research methods as third stage, gathering information and analysing results as fourth stage and developing conclusions and a final divulgation product as the last stage. The learning experience had 8 lessons that were co-designed by the environmental educator, NPC team and teachers, and performed by teachers and students with the guidance of primatologists working in the area. Session 5 was a field trip to a local (future) community conservation area to apply field techniques and gather data. The students finished their project making a video presentation of their results.

The evaluation of the project included a pre-test and post-test to understand the knowledge and perceptions of students about the local environment, primates, science and conservation.

4. KEY RESULTS/MAIN FINDINGS OR OUTCOMES

We designed and applied a learning experience called learning project based on participatory teaching methods such as learning experiences and inquiry-based education. The learning experience (learning project) had 8 sessions that were applied by two science teachers within the schools´ Science and Technology curricula, between October and December 2022.

SESSION	NAME	PRODUCT
1	Getting to know our locality from its nature	Problem tree
2	Transforming our curiosity into a research question	Matrix with research question and objectives
3	We organize our data collection and begin our search	Matrix for selection of tools and research methods
4	We organize our data collection and continue our search	Data collection matrix for secondary data
5	We organize our data collection and continue our search on the field	Data collection matrices: human activities, fauna ID, interviews
6	Organizing and analysing my data 1	Frequency matrix
7	Organizing and analysing my data 1	Fauna ID analysis and conservation action matrix
8	We elaborate and present our research poster	Scientific poster and presentation

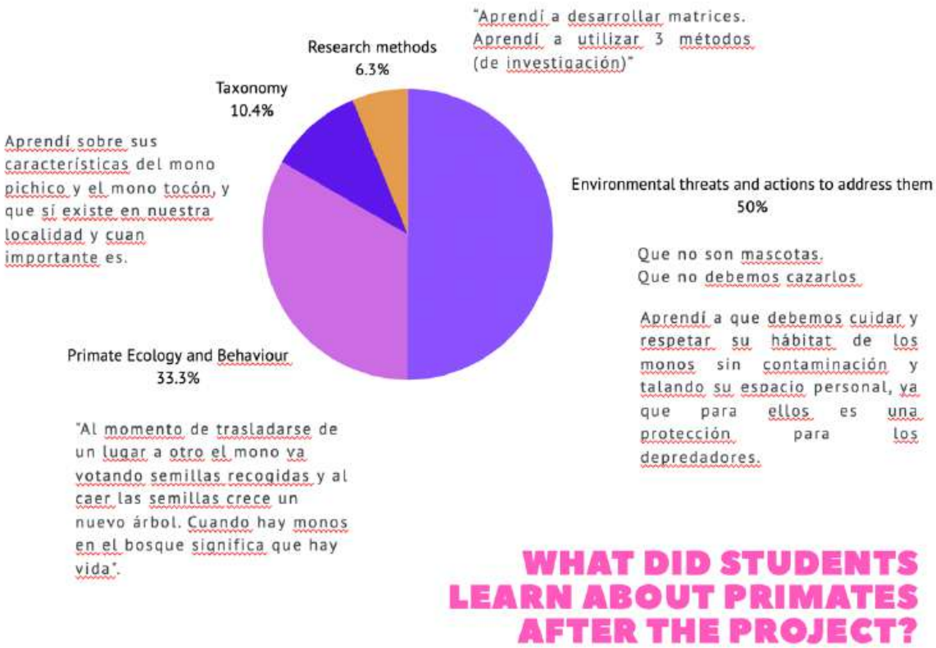
Table 1. Names and products of the 8 lessons that are part of the learning experience (learning

During the project 69 high school students were reached, 5 parents and 2 teachers from two local rural high schools in the San Martin region. The two science teachers led the classes following a script with the aid of two education and primatologist volunteers from ComunaCiencia and NPC, who also led a field session at a local conservation initiative.

Students improved their knowledge about the sympatric monkeys in their region, local conservation and research initiatives, and changed their perceptions about scientific research.

This grant also made it possible for the environmental education volunteers to run educational workshops and environmental fairs in two different locations within the San Martin Region and the neighboring Amazonas Region, reaching out to the general public.

Fig. 2. Photo collage of schools working during the project.



5. IMPLICATIONS OF PROJECT/DISCUSSION OF RESULTS

100% of students acknowledged they learned something new about their locality, primates, conservation and research initiatives.

Learning experiences, such as the learning project designed and implemented for the science course during this project, are effective in developing awareness, knowledge and self-advocacy amongst school students.

The inquiry-based method placed students and teachers closer to scientists, helping them to acknowledge the role of science in their neighbourhood.

A local conservation initiative is now known by students and teachers which protects the habitat of the Critically Endangered San Martín titi monkey (*Plecturocebus oenanthe*)

This method can be adapted to any region in Peru.

6. ACKNOWLEDGEMENTS

I would like to acknowledge, first of all, the International Primatological Society for their trust in my project. Neotropical Primate Conservation (NPC) hast always been a great support for me and now, in partnership with my organization ComunaCiencia, is taking our environmental work to another level. I would like to thank Karen and Cindy, the volunteers that committed to the project and helped developing it. It was great to meet the local conservation organization that is about to get the resolution to have a community conservation area to protect titi monkeys and who opened us the doors to take the students to their land. Finally, I would like to thank the schools' principals, science teachers, parents and students to be so willing to participate in this project and for their commitment from the first to the last lesson.

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