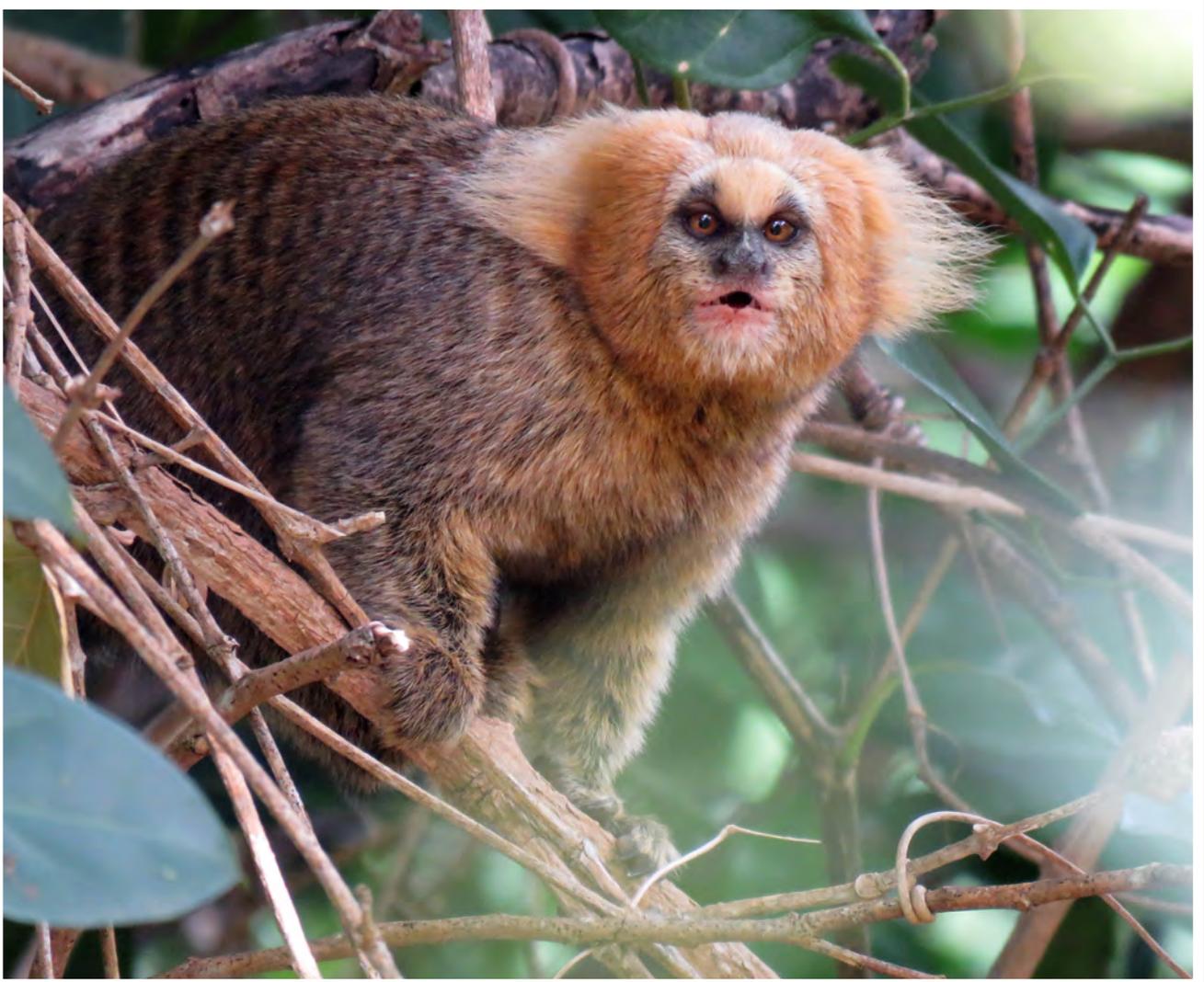


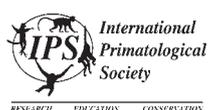
Primates in Peril

The World's 25 Most Endangered Primates
2022–2023



Edited by

Russell A. Mittermeier, Kim E. Reuter, Anthony B. Rylands,
Leandro Jerusalinsky, Christoph Schwitzer, Karen B. Strier,
Jonah Ratsimbazafy and Tatyana Humle



PRIMATES IN PERIL

The World's 25 Most Endangered Primates
2022–2023

Edited by

Russell A. Mittermeier, Kim E. Reuter, Anthony B. Rylands,
Leandro Jerusalinsky, Christoph Schwitzer, Karen B. Strier,
Jonah Ratsimbazafy and Tatyana Humle

Illustrations by

Stephen D. Nash

IUCN SSC Primate Specialist Group (PSG)
International Primatological Society (IPS)
Re:wild

- Published by:** IUCN SSC Primate Specialist Group (PSG), International Primatological Society (IPS) and Re:wild.
- Copyright:** © 2022 Re:wild
All rights reserved. No part of this report may be reproduced in any form or by any means without permission in writing from the publisher.
Inquiries to the publisher should be directed to the following address:
Russell A. Mittermeier, Chair, IUCN SSC Primate Specialist Group, Re:wild, PO Box 129, Austin, TX 78767, USA.
- Citation (report):** Mittermeier, R.A., Reuter, K.E., Rylands, A.B., Jerusalinsky, L., Schwitzer, C., Strier, K.B., Ratsimbazafy, J. and Humle, T. (eds.), 2022. *Primates in Peril: The World's 25 Most Endangered Primates 2022–2023*. IUCN SSC Primate Specialist Group, International Primatological Society, Re:wild, Washington, DC. 163pp.
- Citation (species):** Schäffler, L., Markolf, M. and Kappeler, P.M. 2022. Madame Berthe's Mouse Lemur *Microcebus berthae* Rasoloarison *et al.* 2000. In: R.A. Mittermeier, K.E. Reuter, A.B. Rylands, L. Jerusalinsky, C. Schwitzer, K.B. Strier, J. Ratsimbazafy and T. Humle (eds.), *Primates in Peril: The World's 25 Most Endangered Primates 2022–2023*, pp. 8–10. IUCN SSC Primate Specialist Group, International Primatological Society, Re:wild, Washington, DC.
- Layout:** Paula Katharina Rylands, Ubatuba, SP, Brazil.
- Illustrations:** © Stephen D. Nash, Re:wild, Washington DC, and Department of Anatomical Sciences, Health Sciences Center, State University of New York at Stony Brook, NY, USA.
- Available from:** Jill Lucena, Re:wild
E-mail: jlucena@rewild.org
Website: www.imate-sg.org
- Printed by:** Tray Inc.
Glen Burnie, MD, USA.
- ISBN:** 978-1-7372851-5-1
- Cover photo:** The Buffy-headed Marmoset, *Callithrix flaviceps*, in the Brazilian Atlantic Forest. Photograph by Geraldo Lucas Amaral.

CONTENTS

Preface	1
The World's 25 Most Endangered Primates 2022–2023	3
Madagascar	
Madame Berthe's Mouse Lemur, <i>Microcebus berthae</i>	9
Sahafary Sportive Lemur, <i>Lepilemur septentrionalis</i>	13
Blue-eyed Black Lemur, <i>Eulemur flavifrons</i>	17
Coquerel's Sifaka, <i>Propithecus coquereli</i>	23
Africa	
Rondo Dwarf Galago, <i>Paragalago rondoensis</i>	31
Golden-bellied Mangabey, <i>Cercocebus chrysogaster</i>	35
Southern Patas Monkey, <i>Erythrocebus baumstarki</i>	38
Roloway Monkey, <i>Cercopithecus roloway</i>	43
Niger Delta Red Colobus, <i>Piliocolobus epieni</i>	49
Nigeria-Cameroon Chimpanzee, <i>Pan troglodytes ellioti</i>	53
Asia	
Javan Slow Loris, <i>Nycticebus javanicus</i>	61
Sangihe Tarsier, <i>Tarsius sangirensis</i>	67
Purple-faced Langur, <i>Semnopithecus vetulus</i>	71
Golden-headed Langur, <i>Trachypithecus poliocephalus</i>	77
Raffles' Banded Langur, <i>Presbytis femoralis</i>	81
Guizhou Snub-nosed Monkey, <i>Rhinopithecus brelichi</i>	85
Gaoligong Hoolock Gibbon, <i>Hoolock tianxing</i>	89
Tapanuli Orangutan, <i>Pongo tapanuliensis</i>	93
Neotropics	
Buffy-headed Marmoset, <i>Callithrix flaviceps</i>	101
Ka'apor Capuchin, <i>Cebus kaapori</i>	107
Ecuadorian White-fronted Capuchin, <i>Cebus aequatorialis</i>	111
Groves' Titi Monkey, <i>Plecturocebus grovesi</i>	117
Brown Howler Monkey, <i>Alouatta guariba</i>	121
Brown-headed Spider Monkey, <i>Ateles fusciceps</i>	127
Geoffroy's Spider Monkey, <i>Ateles geoffroyi</i>	135
Other Species Considered	142
Affiliations	157

PREFACE

We present here the 11th edition of *The World's 25 Most Endangered Primates*, this one for 2022–2023. The consultation for this list was held in an open meeting on the evening of 12 January 2022, during the IPS-SLAPrim Joint Meeting (XXVIII Congress of the International Primatological Society - IPS and IV Congress of the Latin American Society of Primatology - SLAPrim) in Quito, Ecuador (9–15 January 2022). This session was attended by more than 100 people and we subsequently consulted with many experts to refine the information on those species that were selected. Note also that since the Quito IPS Congress, originally planned for 2020, was not held until January 2022, the 2020–2022 list of the World's 25 Most Endangered Primates wound up being this list for 2022–2023.

Using the information obtained over the past six months, we have updated the profiles for those species remaining on the list from the 2018–2020 (2022) edition and for those from previous editions that were returned to the list, and we have added additional profiles for newly listed species. Of note, the 2018–2020 edition was the last that was published before the onset of the COVID-19 pandemic.

This publication is a joint initiative of the IUCN SSC Primate Specialist Group, the International Primatological Society and Re:wild.

We are most grateful to the people and organizations who have provided major support for the conservation of endangered primates over the years, both those listed in this report and many others as well. In particular, we would like to thank Jon Stryker and Slobodan Randjelović for their support through the Arcus Foundation and in other ways, to Annette Lanjouw of the Arcus Foundation for major support of great ape and gibbon conservation, and to the Mohamed bin Zayed Species Conservation Fund for supporting numerous primate projects since 2009. Special thanks also to the Margot Marsh Biodiversity Foundation for their support of primate conservation since 1996, both through the provision of grants from the foundation itself and through the Primate Action Fund of the Primate Program at Re:wild. Besides providing the wherewithal to publish this report, the foundation has funded training workshops and field courses held at multiple biennial congresses of the International Primatological Society, besides helping primatologists to attend the meetings to discuss *The World's 25 Most Endangered Primates* lists. Much of the work on the administration of these grants is done by Ella Outlaw, Anthony Rylands and Jill Lucena of the Re:wild Primate Program and by William R. Konstant, a Re:wild Associate.

We thank all of those who contributed to the final 2022–2023 version. They are also listed as authors on the individual species accounts to which they contributed.

Ekwoke Abwe, Felipe Alfonso-Cortes, André C. Alonso, Mónica Alzamora, Aubin Andriajaona, Herizo T. Andrianandrasana, Aristide Andrianarimisa, Andie Ang, Márcia M. Assis Jardim, Renata B. Azevedo, Carolyn A. Bailey, Hamilton F. Barreto, Raone Beltrão-Mendes, Richard Bergl, Hosnah Bezara Hortensia, Júlio César Bicca-Marques, Jean P. Boubli, Gerson Buss, Thomas M. Butynski, Gustavo Rodrigues Canale, Tatiane dos Santos Cardoso, Rodrigo Salles Carvalho, Laura Cervera, Óscar M. Chaves, Susan M. Cheyne, Lounès Chikhi, Fanny Cornejo, Sam Cotton, Tim R.B. Davenport, Yvonne A. De Jong, Stella de la Torre, Andrea Dempsey, Mary P. Dinsmore, Sarisha Trindade do Carmo, Osiris Doumbe, Andrew Dunn, Paul Dutton, Timothy M. Eppley, María Fernanda Solórzano, Stephen F. Ferrari, Chefor Fotang, Cynthia L. Frasier, Nathalia Fuentes, Paul A. Garber, Mary Katherine Gonder, Sery Gonedelé Bi, Marcelo Gordo, Sidney Gouveia, Karol M. Gutiérrez-Pineda, Panut Hadisiswoyo, Fei Hanlan, John A. Hart, Rio Heriniaina, Daniel Hending, Alma Hernández-Jaramillo, Zelinda B. Hirano, Claudia Igayara-Souza, Rachel Ashegbofe Ikemeh, Inaoyom Imong, Sabrina Jabbar, Leandro

Jerusalinsky, Serge A. Kamgang, Peter M. Kappeler, Inza Koné, Martin Kowalewski, Wanda Kuswanda, Diogo Lagroteria, Chien Lee, Zan Hui Lee, Neahga Leonard, Richard Lewis, Edward E. Louis Jr., Zhang Lu, Matthias Markolf, Eduardo Marques, Jesus Martinez, Reiko Matsuda Goodwin, W. Scott McGraw, Edward McLester, Fabiano R. de Melo, Sérgio Lucena Mendes, Ana Cristina Mendes-Oliveira, Erik Meijaard, Pedro G. Méndez-Carvajal, Sebastián Montilla, Alba Lucía Morales-Jiménez, Citlalli Morelos-Juárez, Bethan Jane Morgan, Jo A. Myers Thompson, Tilo Nadler, K. Anna I. Nekaris, Leonardo G. Neves, Vincent Nijman, Amadou Ngouh, John F. Oates, Luciana I. Oklander, Richard L. Passaro, Fan Pengfei, Andrew Perkin, George (PJ) Perry, Eduardo J. Pinel Ramos, Herinandrasana Pollensio, Marcio Port-Carvalho, Gilberto Pozo-Montuy, Didik Prasetyo, Helder Queiroz, Martina Raffel, Brigitte M. Raharivololona, Gilbert Rakotoarisoa, Felix Rakotondraparany, Valérie F. Rakotomalala, Jeannin Nicolas Rakotondrazandry, Romeo Rakotondrina, Fidy Ralainasolo, Doménico R. Randimbiharirinina, Guy H. Randriatahina, Noa E. Rasoanaivo, Lucile Rasoamazava, Solofonirina Rasoloharijaona, Jonah Ratsimbazafy, Lucile Mialisoa Raveloarimalala, Faranky Ravelomandrato, Herimalala Raveloson, André Luis Ravetta, Lena M. Reibelt, Baoping Ren, Jhon Rigobert, Esteban Rivera, Rizaldi, Melissa E. Rodríguez-Menjívar, Noel Rowe, Rasanayagam Rudran, Nadine Ruppert, Ronald Sánchez-Porras, Jordi Salmona, Livia Schäffler, Daniela Schrudde, Christoph Schwitzer, Timothy M. Sefczek, Tukur Seibokuro, Thiago B.F. Semedo, Brandon Semel, Meredith Semel, Arif Setiawan, Sam Shanee, Myron Shekelle, Denise Spaan, Travis S. Steffens, Roswitha Stenke, Jatna Supriatna, Phan Duy Thuc, Jen Tinsman, Diego G. Tirira, Mônica M. Valença-Montenegro, Orlando Vital, Sylviane Volampeno, Patrick O. Waeber, Robert Wallace, Serge Wich, Leslie Wilmet, Karla P. Zaldaña-Orantes, John Zaonarivelo, Jiang Zhou.

THE WORLD'S 25 MOST ENDANGERED PRIMATES 2022–2023

Here we report on the 11th edition of the biennial listing of a consensus of the 25 primate species considered to be among the most endangered worldwide and most in need of conservation measures. The previous edition (Schwitzer *et al.* 2019)¹ – published in 2019 and spanning 2018–2020 – was the last to be published before the onset of the global COVID-19 pandemic. However, since the Quito IPS Congress, originally planned for 2020, was not held until January 2022, the 2018–2020 Top 25 actually wound up being the list for 2018–2022. Following the publication of the 2018–2020 list, we conducted an in-depth analysis of the traceable impacts of the 25 Most Endangered Primates lists since their inception in 2000 (Reuter *et al.* 2021)².

The 2022–2023 list of the World's 25 Most Endangered Primates has six species from Africa, four from Madagascar, eight from Asia, and seven from the Neotropics (Table 1). Madagascar and Brazil both have four, Indonesia has three, China, Colombia, Ecuador, Nigeria, Panama, and Tanzania have two, and Argentina, Belize, Cameroon, Costa Rica, Côte d'Ivoire, El Salvador, Ghana, Guatemala, Honduras, Democratic Republic of the Congo, Mexico, Myanmar, Nicaragua, Peru, Singapore, Sri Lanka, and Vietnam each have one.

Eight of these primates are listed as among the world's most endangered primates for the first time – those listed with an asterisk in Table 1. The remaining 17 species and subspecies have been listed in previous versions of the 25 most endangered primates. Fourteen primates were dropped from the previous list, 2018–2020 (see Table 2).

The changes made in this list compared to the previous iteration (2018–2020) were not because the situation of the 14 species that were dropped (Table 2) has improved. In some cases, the situation has in fact worsened. By making these changes we intend rather to highlight other, closely related species enduring equally bleak prospects for their survival.

During the discussion of the 2022–2023 list at the IPS-SLAPrim Joint Meeting (XXVIII IPS Congress and IV SLAPrim Congress) in Quito, a number of other highly threatened primates were considered for inclusion. For all of these, the situation in the wild is as precarious as it is for those that finally made it on the list, thus they have been included as 'Other Species Considered' (p. 142).

¹ Schwitzer, C., Mittermeier, R.A., Rylands, A.B., Chiozza, F., Williamson, E.A., Byler, D., Wich, S., Humle, T., Johnson, C., Mynott, H., and McCabe, G. (eds.). 2019. *Primates in Peril: The World's 25 Most Endangered Primates 2018–2020*. IUCN SSC Primate Specialist Group (PSG), International Primatological Society (IPS), Global Wildlife Conservation (GWC), and Bristol Zoological Society, Washington, DC. 130pp.

² Reuter, K.E., Mittermeier, R.A., Schwitzer, C., McCabe, G.M., Rylands, A.B., Jerusalinsky, L., Konstant, W.R., Kerhoas, D., Ratsimbazafy, J., Strier, K.B., Webber, A.D., Williamson, E.A. and Wise, J. 2021. The 25 most endangered primates list: impacts on conservation fundraising and policy. In: E. Freedman, S.S. Hiles and D. Sachsman (eds.), *Communicating Endangered Species: Extinction, News and Public Policy*, pp.101–115. Routledge, Abingdon, UK.

Table 1. The World's 25 Most Endangered Primates: 2022–2023. * First time on the list.

MADAGASCAR		
<i>Microcebus berthae</i>	Madame Berthe's Mouse Lemur	Madagascar
<i>Lepilemur septentrionalis</i>	Sahafary Sportive Lemur	Madagascar
<i>Eulemur flavifrons</i>	Blue-eyed Black Lemur	Madagascar
<i>Propithecus coquereli</i> *	Coquerel's Sifaka	Madagascar
AFRICA		
<i>Paragalago rondoensis</i>	Rondo Dwarf Galago	Tanzania
<i>Cercocebus chrysogaster</i> *	Golden-bellied Mangabey	Democratic Republic of the Congo
<i>Erythrocebus baumstarki</i> *	Southern Patas Monkey	Tanzania
<i>Cercopithecus roloway</i>	Roloway Monkey	Côte d'Ivoire, Ghana
<i>Piliocolobus epieni</i>	Niger Delta Red Colobus	Nigeria
<i>Pan troglodytes ellioti</i> *	Nigeria-Cameroon Chimpanzee	Cameroon, Nigeria
ASIA		
<i>Nycticebus javanicus</i>	Javan Slow Loris	Indonesia (Java)
<i>Tarsius sangirensis</i> *	Sangihe Tarsier	Indonesia (Sulawesi)
<i>Semnopithecus vetulus</i>	Purple-faced Langur	Sri Lanka
<i>Trachypithecus poliocephalus</i>	Golden-headed Langur	Vietnam
<i>Presbytis femoralis</i> *	Raffles' Banded Langur	Peninsular Malaysia, Singapore
<i>Rhinopithecus brelichi</i>	Gray Snub-nosed Monkey	China
<i>Hoolock tianxing</i>	Skywalker or Gaoligong Hoolock	China, Myanmar
<i>Pongo tapanuliensis</i>	Tapanuli Orangutan	Indonesia (Sumatra)
NEOTROPICS		
<i>Callithrix flaviceps</i> *	Buffy-headed Marmoset	Brazil
<i>Cebus kaapori</i>	Ka'apor Capuchin	Brazil
<i>Cebus aequatorialis</i>	Ecuadorian Capuchin	Ecuador, Peru
<i>Plecturocebus grovesi</i> *	Groves' Titi Monkey	Brazil
<i>Alouatta guariba</i>	Brown Howler Monkey	Argentina, Brazil
<i>Ateles fusciceps</i>	Brown-headed Spider Monkey	Colombia, Ecuador, Panama
<i>Ateles geoffroyi</i>	Geoffroy's Spider Monkey	Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Colombia (?)

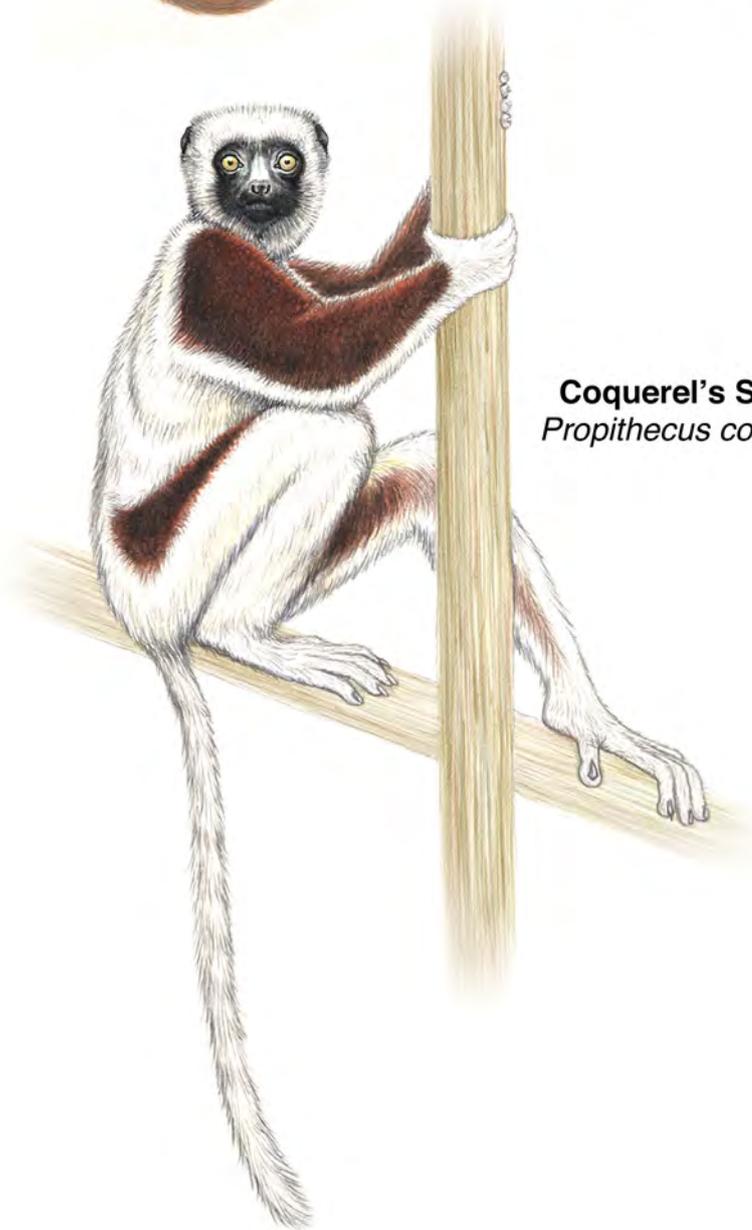
Table 2. Primate species included on the 2018–2020 list that were removed from the 2022–2023 list.

MADAGASCAR		
<i>Microcebus manitatra</i>	Bemanasy Mouse Lemur	Madagascar
<i>Hapalemur alaotrensis</i>	Lac Alaotra Bamboo Lemur	Madagascar
<i>Lepilemur jamesorum</i>	Manombo Sportive Lemur	Madagascar
<i>Indri indri</i>	Indri	Madagascar
<i>Daubentonia madagascariensis</i>	Aye-aye	Madagascar
AFRICA		
<i>Rungwecebus kipunji</i>	Kipunji	Tanzania
<i>Colobus vellerosus</i>	White-thighed Colobus	Benin, Côte d'Ivoire, Ghana, Nigeria, Togo
<i>Piliocolobus rufomitratu</i>	Tana River Red Colobus	Kenya
<i>Pan troglodytes verus</i>	Western Chimpanzee	Benin (?), Burkina Faso (?), Côte d'Ivoire, The Gambia (Extinct), Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Nigeria, Senegal, Sierra Leone, Togo (?)
ASIA		
<i>Simias concolor</i>	Pig-tailed Langur	Indonesia (Sumatera)
<i>Trachypithecus geei</i>	Golden Langur	Bhutan, India (Assam)
NEOTROPICS		
<i>Saguinus bicolor</i>	Pied Tamarin	Brazil
<i>Callithrix aurita</i>	Buffy-tufted-ear Marmoset	Brazil
<i>Plecturocebus olallae</i>	Olalla's Titi	Bolivia

Madame Berthe's Mouse Lemur
Microcebus berthae



Blue-eyed Black Lemur
Eulemur flavifrons



Coquerel's Sifaka
Propithecus coquereli



Sahafary Sportive Lemur
Lepilemur septentrionalis

MADAGASCAR



MADAGASCAR

© Russell Mittermeier



MADAME BERTHE'S MOUSE LEMUR

Microcebus berthae Rasoloarison, Goodman and Ganzhorn, 2000

Madagascar
(2012, 2022)

Livia Schäffler, Matthias Markolf and Peter M. Kappeler

Madame Berthe's Mouse Lemur (*Microcebus berthae*) was discovered in Kirindy Forest of the Centre National de Formation, d'Études et de Recherche en Environnement et Forestier (CNFEREF) in 1992 (Schmid and Kappeler 1994). With a mean adult body mass of 31 g, it is the smallest known primate (Rasoloarison *et al.* 2000). Its range is confined to the central Menabe region of western Madagascar (Rasoloarison *et al.* 2000), where it is restricted to the dry deciduous forests of Kirindy and Ambadira. It is absent from the Reserve Spéciale Andranomena (Schäffler and Kappeler 2014). *Microcebus berthae* is the rarest lemur in the central Menabe region. Not all the remaining forest there is suitable due to its specific habitat and dietary requirements (Dammhahn and Kappeler 2009), and it is sensitive to anthropogenic activities (Schäffler and Kappeler 2014).

Microcebus berthae is sympatric with the more widely distributed *M. murinus*, and ecological differentiation in the two mouse lemurs is evidently insufficient to prevent competitive exclusion (Ganzhorn and Kappeler 1996, Schwab and Ganzhorn 2004, Dammhahn and Kappeler 2008, 2009, 2010). Interactions with two other sympatric cheirogaleids, *Mirza coquereli* and *Cheirogaleus medius*, however, stabilize mouse lemur coexistence on a landscape scale by providing *M. berthae* with refuges from competition with its congener. At the community level, the densities of the two mouse lemur species are correlated in opposite directions with those of *Mirza* and *Cheirogaleus* – when they are abundant, *M. berthae* does better.

It is categorized as Critically Endangered on the IUCN Red List of Threatened Species – habitat loss and degradation due to slash-and-burn agriculture is causing a continuing decline in the species' area of occupancy and extent of occurrence (Markolf *et al.* 2020). A population decrease of more than 80% over ten years is expected as a direct consequence of ongoing habitat destruction. Data on the species' population size and distribution are currently being updated. There are no captive populations of this species.

As the protection of the remaining forest patches and the restoration of habitat quality and connectivity are critical to preserve biodiversity in the central Menabe region, several conservation and education programs are being implemented by NGOs using *M. berthae* as a flagship species. Development projects, reforestation, and restoration campaigns have been initiated as well.

The Aire Protégée Menabe Antimena (APMA), with the key core areas being the Kirindy and Ambadira forests, unfortunately still lacks effective law enforcement. Since the protected area's designation in 2015, slash-and-burn practices have destroyed about 30% of its forests (Markolf *et al.* 2020). The loss of revenue from tourism during the COVID-19 pandemic has hampered adequate forest protection, and the absence of foreign researchers has further fueled deforestation. Effective protection of the APMA will require addressing not only the needs of a growing human population, but also the need to reduce the exploitation of natural resources.



The region suffers from a lack of sustainable agriculture, agroforestry, and livestock farming (Frank and Schäffler 2019) and there are numerous other problems to solve if we are to preserve the remaining habitat of the iconic Madame Berthe's Mouse Lemur.

- Dammhahn, M. and Kappeler, P.M. (2008). Small-scale coexistence of two mouse lemur species (*Microcebus berthae* and *M. murinus*) within a homogeneous competitive environment. *Oecologia* 157: 473–483.
- Dammhahn, M. and Kappeler, P.M. (2009). Females go where the food is: does the socio-ecological model explain variation in social organisation of solitary foragers? *Behav. Ecol. Sociobiol.* 63: 393–352.
- Dammhahn, M. and Kappeler, P.M. (2010). Scramble or contest competition over food in solitarily foraging mouse lemurs (*Microcebus* spp.): new insights from stable isotopes. *Am. J. Phys. Anthropol.* 141: 181–189.
- Frank, A.K. and Schäffler, L. (2019). Identifying key knowledge gaps to better protect biodiversity and simultaneously secure livelihoods in a priority conservation area. *Sustainability* 11: 5695.
- Ganzhorn, J.U. and Kappeler, P.M. (1996). Lemurs of the Kirindy forest. *Primate Report* 46: 257–274.
- Markolf, M., Schäffler, L. and Kappeler, P. (2020). *Microcebus berthae*. The IUCN Red List of Threatened Species 2020: e.T41573A115579496.
- Rasoloarison, R.M., Goodman, S.M. and Ganzhorn, J.U. (2000). Taxonomic revision of mouse lemurs (*Microcebus*) in the western portions of Madagascar. *Int. J. Primatol.* 21: 963–1019.
- Schäffler, L. and Kappeler, P.M. (2014). Distribution and abundance of the world's smallest primate, *Microcebus berthae*, in central western Madagascar. *Int. J. Primatol.* 35: 57–72.
- Schäffler, L., Saborowski, J. and Kappeler P.M. (2015). Agent-mediated spatial storage effect in heterogeneous habitat stabilizes competitive mouse lemur coexistence in Menabe Central, Western Madagascar. *BMC Ecol.* 15: 7.
- Schäffler, L., Kappeler, P.M. and Halley J.M. (2021). Mouse lemurs in an assemblage of cheirogaleid primates in Menabe Central, Western Madagascar – three reasons to coexist. *Front. Ecol. Evol.* 9: 585781.
- Schmid, J. and Kappeler, P.M. (1994). Sympatric mouse lemurs (*Microcebus* spp.) in western Madagascar. *Folia Primatol.* 63: 162–170.
- Schwab, D. and Ganzhorn, J.U. (2004). Distribution, population structure and habitat use of *Microcebus berthae* compared to those of other sympatric cheirogaleids. *Int. J. Primatol.* 25: 307–330.

MADAGASCAR

© Edward E. Louis Jr.



SAHAFARY SPORTIVE LEMUR

Lepilemur septentrionalis Rumpler and Albignac, 1975

Madagascar
(2008, 2010, 2012, 2014, 2022)

Edward E. Louis Jr., Carolyn A. Bailey, Cynthia L. Frasier, Leslie Wilmet, Aubin Andriajaona, Lucile Rasoamazava, Valérie F. Rakotomalala, Mary P. Dinsmore and Timothy M. Sefczek

Lepilemur septentrionalis is a small sportive lemur with a body weight of just 600–750 g (Louis Jr. et al. 2006) from Madagascar’s far northern region. Originally believed to have been distributed across the north of Madagascar, from Montagne d’Ambre south to the Mahavavy River close to Ambilobe (Hawkins et al. 1990, Rumpler et al. 2001), it is now evidently restricted to just a few patches of forest.

In 2007, a survey in the forests of Sahafary and the Analalava Forest Reserve estimated a population of 100 (Ravaorimanana et al. 2009). A follow-up survey in 2012 and 2013 conducted by Omaha’s Henry Doorly Zoo and Aquarium and the Madagascar Biodiversity Partnership (MBP) found only three individuals in these forests, suggesting that these populations have since been completely extirpated in the two western parts of its range. As such, the species is thought to exist now only in Montagne des Français (Louis Jr. and Zaonarivelo 2015). In a subsequent field survey conducted in August and September 2019, Omaha’s Henry Doorly Zoo and Aquarium and MBP field surveys detected 87 individuals, all of them in the central-western portions of Montagne des Français. Whether this increase is based on protective steps taken by the *Direction Régionale de l’Environnement et du Développement Durable* to conduct ranger patrols with the MBP field teams, or an artificial response to the collapse of the surrounding habitat is not known (Bailey et al. 2020).

Prior to 2010, this species had not been studied in the wild, though more is known now about its ecology (e.g., Rasoamazava et al. 2022). It inhabits tropical dry, deciduous and gallery

forest fragments (Dinsmore et al. 2016). Due to the topography of karst mountains and the deforestation from charcoal enterprises, forest habitat has become more and more disconnected in Montagne des Français, limiting migration and gene flow in the current population.

Lepilemur septentrionalis is listed as Critically Endangered on the IUCN Red List of Threatened Species (Louis Jr. et al. 2020). This must be considered one of the most restricted and least protected lemurs in Madagascar, and probably the one closest to extinction, perhaps with the exception of *Microcebus berthae*. The principal threat is forest loss due to illicit firewood and charcoal production. This species is also hunted for food incidentally at illegal charcoal enterprises. Most of the species’ habitat is already gone, but at least it now benefits from some protection given that Montagne des Français became a protected site in 2015 (Dinsmore et al. 2021a, 2021b).

This species is on the verge of extinction and in need of special attention. Although undertaking a captive breeding program would be an option, sportive lemurs have thus far proven difficult to keep in zoos due to their specialized folivorous diet. Continuing direct surveys linked to random patrols by government authorities is considered a minimum requirement for this species’ survival over the next ten years, prioritizing the forest fragments of Vangisay, Andrananakomba, and Ampamakiampafana, which contain 98% of the known population. As of 2022, this species was not being held in captivity (ZIMS 2022).

Conservation priorities for this species center on restoration and reforestation efforts to establish



habitat corridors between the Andranonakoba, Ambavala, and Ambatove forest fragments in Montagne des Français to allow for immigration between these lemur subpopulations. Furthermore, ranger patrols by the regional Eaux et Forêt gendarmerie, VOI (*Vondron'Olona Ifotany or Communauté de Base*) and local non-profit organizations should be increased in these areas to eliminate all human-related disturbances. Research priorities should include annual census surveys of the species' remaining population. Research is also needed to confirm yearly population fluctuations and whether population increases detected between the two previous censuses (Ranaivoarisoa et al. 2013 and Bailey et al. 2020) were positive recruitment or simply the concentration of individuals into the eastern half of Montagne des Français due to habitat loss.

- Bailey, C.A., Sefczek, T.M., Robertson, B.A.D., Rasoamazava, L., Rakotomalala, V.F. Andriamadison, J.D.N. Randrianasolo, F., Andriaona, A. and Louis Jr., E.E. (2020). A re-evaluation of the northern sportive lemur (*Lepilemur septentrionalis*) population at Montagne des Français, and a review of its current state of conservation in the protected area. *Primate Conserv.* (34): 53–59.
- Dinsmore, M.P., Louis Jr., E.E., Randriamahazomanana, D., Hachim, A., J. Zaonarivelo, J.R. and Strier, K.B. (2016). Variation in habitat and behavior of the northern sportive lemur (*Lepilemur septentrionalis*) at Montagne des Français, Madagascar. *Primate Conserv.* (30): 73–88.
- Dinsmore, M.P., Strier, K.B. and Louis Jr., E.E. (2021a). Anthropogenic disturbances and deforestation of northern sportive lemur (*Lepilemur septentrionalis*) habitat at Montagne des Français, Madagascar. *Primate Conserv.* (35): 125–138.
- Dinsmore, M.P., Strier, K.B. and Louis, Jr., E.E. (2021b). The influence of seasonality, anthropogenic disturbances, and cyclonic activity on the behavior of northern sportive lemurs (*Lepilemur septentrionalis*) at Montagne des Français, Madagascar. *Am. J. Primatol.* 83(12): e23333.
- Hawkins, A.F.A., Chapman, P., Ganzhorn, J.U., Bloxam, Q.M.C., Barlow, S.C. and Tonge, S.J. (1990). Vertebrate conservation in Ankarana Special Reserve, northern Madagascar. *Biol. Conserv.* 54: 83–110.
- Louis Jr., E.E., Engberg, S.E., Lei, R., Geng, H., Sommer, J.A., Randriamampionona, R., Randriamanana, J.C., Zaonarivelo, J.R., Andriantompohavana, R., Randria, G., Prosper, Ramaromilanto, B., Rakotoarisoa, G., Rooney, A. and Brenneman, R.A. (2006). Molecular and morphological analyses of the sportive lemurs (Family Megaladapidae: Genus *Lepilemur*) reveals 11 previously unrecognized species. *Spec. Publ. Mus. Texas Tech Univ.* 49: 1–47.
- Louis Jr., E.E., Bailey, C.A., Frasier, C.L., Sefczek, T.M., Raharivololona, B., Schwitzer, C., Ratsimbazafy, J., Wilmet, L., Andriaona, A., Rasoamazava, L., Rakotomalala, V.F.

- and Dinsmore, M. (2020). *Lepilemur septentrionalis*. The IUCN Red List of Threatened Species 2020: e.T11622A115567059.
- Louis, Jr., E.E. and Zaonarivelo, J.R. (2015). Northern sportive lemur *Lepilemur septentrionalis* (Rumpler and Albignac, 1975). In: C. Schwitzer et al. (eds.), *Primates in Peril: The World's 25 Most Endangered Primates 2014–2016*, pp. 36–37. Arlington, VA: IUCN SSC Primate Specialist Group (PSG), International Primatological Society (IPS), Conservation International (CI), and Bristol Zoological Society.
- Ranaivoarisoa, J.F., Zaonarivelo, J.R., Lei, R., Johnson, S.E., Wyman, T.M., Mittermeier, R.A. and Louis Jr., E.E. (2013). Rapid Survey and Assessment of the northern sportive lemur, *Lepilemur septentrionalis*, in northern Madagascar. *Primate Conserv.* (27): 23–31.
- Rasoamazava, L., Rakotomalala, V.F., Sefczek, T.M., Frasier, C.L., Dinsmore, M.P., Rasoloharijaona, S. and Louis, E.E., Jr. (2022). Feeding ecology of *Lepilemur septentrionalis* in the dry forest of Montagne des Français, northern Madagascar. *Folia Primatol.* doi.org/10.1163/14219980-20210702
- Ravaorimanana, I., Zaramondy, A., Rabarivola, C. and Rumpler, Y. (2009). Northern sportive lemur. In: R.A. Mittermeier et al. (eds.), *Primates in Peril: The World's 25 Most Endangered Primates 2008–2010*, pp. 21–22. Arlington, VA: IUCN SSC Primate Specialist Group (PSG), International Primatological Society (IPS), and Conservation International (CI).
- Rumpler, Y., Ravaoarimanana, B., Hauwy, M. and Warter, S. (2001). Cytogenetic arguments in favour of a taxonomic revision of *Lepilemur septentrionalis*. *Folia Primatol.* 72: 308–315.
- ZIMS. (2022). Zoological Information Management Software. Available online: <https://zims.species360.org>.

MADAGASCAR

© Sam Cotton



BLUE-EYED BLACK LEMUR

Eulemur flavifrons (Gray, 1867)

Madagascar
(2008, 2010, 2012, 2022)

Guy Randriatahina, Sam Cotton, Dan Hending, Christoph Schwitzer,
Jen Tinsman and Sylviane Volampeno

Eulemur flavifrons is a medium-sized lemur. It is sexually dichromatic but the eyes of both sexes are blue to blue-gray. It is one of the very few primates in the world that consistently has blue eyes, hence the English common name.

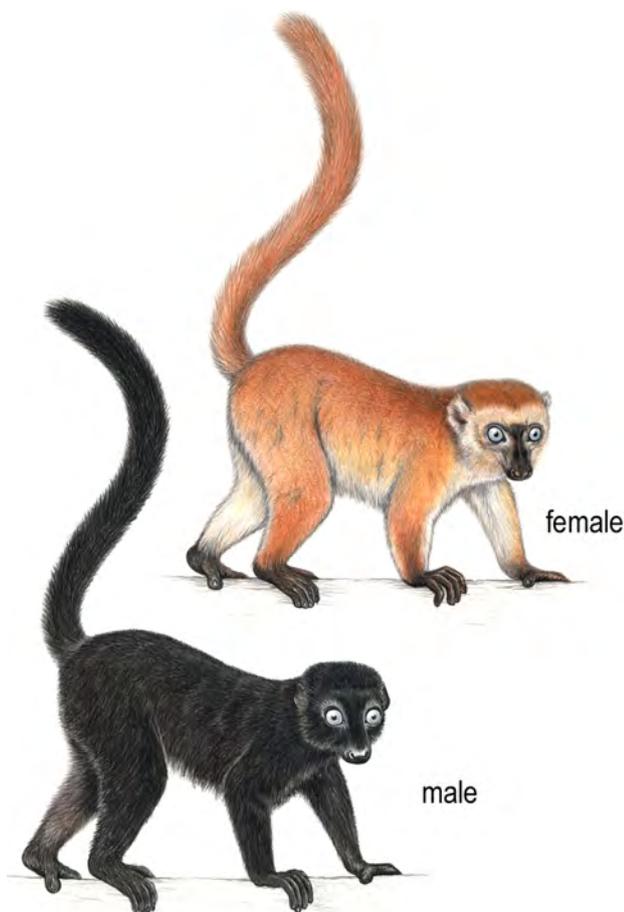
Following its description in 1867, the taxonomic status of this lemur was debated until genetic analysis confirmed that it was indeed distinct (Rabarivola 1998, McLain *et al.* 2012). The Blue-eyed Black Lemur has a very limited distribution in northwestern Madagascar. Due to the lack of locality data for the few museum specimens collected, nothing was known of its status in the wild until its 'rediscovery' in November 1983, when it was located in northwestern Madagascar, in forests north of Befotaka and south of Maromandia, just south of the Sambirano domain (Tattersall 1982, Koenders *et al.* 1985). It is now known to occur on the Sahamalaza Peninsula as well as in a stretch of forest on the adjacent mainland, extending from around Befotaka in the south to the Manongarivo mountains in the north. The Maevarano River serves as the southern boundary of the species' range, the Sandrakota River as the eastern boundary, and the Manongarivo River and its tributary, the Antsahakolana River, as the northern boundary (Rabarivola *et al.* 1991, Andrianjakarivelo 2004, Randriatahina and Rabarivola 2004, Tinsman *et al.* 2020). A recent range revision by Tinsman *et al.* (2020) estimated the Extent of Occurrence to be 3,475 km².

This lemur inhabits more or less disturbed primary and secondary subtropical, sub-humid forests, in a transition zone between the Sambirano region to the north and the western dry, deciduous

forests to the south. It occurs from sea level to 1,200 m (Randriatahina and Rabarivola 2004). Its home range size and the way it uses its range differs between primary and secondary forest fragments. Schwitzer *et al.* (2007a) reported an average home range of 6.8 ha in primary forest, and 13.0 ha in secondary forest. These larger home ranges and the lower densities of *E. flavifrons* in secondary forest suggest that it is less suitable habitat for the species than primary forest. Parasite prevalence seems to be higher in secondary than in primary forest and appears high when compared to data from other lemurs, suggesting that *E. flavifrons* on the Sahamalaza Peninsula is generally under pressure, possibly due to the high degree of fragmentation and degradation of the remaining forest habitat (Schwitzer *et al.* 2010).

During a 12-month study, *E. flavifrons* ate parts of 72 different plant species from 35 families; 52.3% were fruits, and 47.7% were leaves. The animals also fed on flowers, insects, insect excretions and fungi (Polowinsky and Schwitzer 2009). At certain times of the year, the species may feed on large quantities of cicadas.

Population densities of 24 individuals/km² have been estimated in the eastern part of the species' range (Andrianjakarivelo 2004) and 97 individuals/km² in the Ankarafa Forest on the Sahamalaza Peninsula (Volampeno *et al.* 2011), but the latter figure seems to be unusually high compared to other sites throughout the species' range. Group size ranges from 4 to 11 (Andrianjakarivelo 2004, Randriatahina and Rabarivola 2004, Schwitzer 2004, Volampeno *et al.* 2011).



The Blue-eyed Black Lemur has a bimodal activity pattern, with peaks during the morning and evening twilight. It is cathemeral, with activity bouts during the day and night year-round. Nocturnal illumination and the proportion of illuminated lunar disk are positively associated with the amount of nocturnal activity. Total daily activity, as well as nocturnal activity, is higher in secondary forest than in primary forest (Schwitzer *et al.* 2007b).

Eulemur flavifrons is listed as Critically Endangered on the IUCN Red List of Threatened Species (Volampeno *et al.* 2020). The principal threat to its survival is forest destruction due to slash-and-burn agriculture, selective logging, mining and *feu de la colère* (deliberately-set fires to express people's discontent, usually with the authorities or government policy) (Seiler *et al.* 2010). It is hunted for food, especially in the eastern part of its range, and captured live for the local pet trade (Reuter and Schaefer 2017b). Andrianjakarivelo (2004) found a density of up to 570 traps/km² in certain areas. In recent surveys of *E. flavifrons*, evidence of hunting or slash-and-burn agriculture was present in all locations surveyed (Tinsman *et al.* 2020). Brown and Yoder (2015) estimated that there will be an 88% reduction in the species' range from 2000 to 2080 due to climate change alone. Moreover, Volampeno *et al.* (2015) predicted the extinction of *E. flavifrons* from the Ankarafa forest on the Sahamalaza Peninsula within a few decades if habitat destruction and fragmentation continue.

Parts of the range of *E. flavifrons* received official protected area status in 2007 as the Sahamalaza-Îles Radama National Park, including the Sahamalaza Peninsula and some mainland coastal forests to the north and east (Lernould 2002, Schwitzer and Lork 2004, Schwitzer *et al.* 2006, 2009). The Sahamalaza Peninsula is also a UNESCO Biosphere Reserve.

As of 2022, there were 59 individuals in captivity (ZIMS 2022). Breeding in captivity, however, has been limited, with only a small number of successful breeding pairs after some initial success with the founder generation. In these settings, obesity can also be a problem (Schwitzer 2003, Volampeno *et al.* 2020).

Research priorities include estimating the number and density of Blue-eyed Black Lemurs remaining, both on the mainland and on the Sahamalaza Peninsula, and determining if the hybrid zone between *E. flavifrons* and its sister species *E. macaco* still exists (Tinsman et al. 2020).

Conservation efforts are underway on the Sahamalaza Peninsula. The *Association Européenne pour l'Etude et la Conservation des Lémuriens* (AEECL) has run a community-based conservation program there since 2000. The program promotes alternative livelihoods and improved, sustainable farming techniques. It also provides primary and secondary education in this very remote region of the country (AEECL 2022). AEECL has been promoting ecotourism to the Sahamalaza-Îles Radama National Park and has established a tourist camp near the Ankarafa forest, where visitors can observe the Blue-eyed Black Lemur. The Ankarafa forest is also home to a field station from which lemur monitoring and forest patrols are conducted along with experimental research on different methods of reforestation and forest restoration (Cotton 2021, Hending et al. 2021). Previous reforestation initiatives to counter *E. flavifrons* habitat loss in Sahamalaza have been largely unsuccessful (Saunders 2017). The recent construction of a permanent seedling nursery in the field station is, therefore, a key step in the reforestation and restoration of the Ankarafa forest complex (and beyond). The nursery serves as a research base in which to refine propagation protocols and provide seedling stock, as well as providing permanent employment and alternative, sustainable, livelihoods for local people. Current reforestation locations are strategically prioritized towards areas that yield maximum benefits for Blue-eyed Black Lemurs in terms of increased connectivity between fragments and forest core-to-edge ratios (Von Bülow et al. in prep).

Outside the Sahamalaza-Îles Radama National Park, Mikajy Natiara has been working to conserve the Blue-eyed Black Lemurs of Andilambologno forest, located east of the Route Nationale 6, near the town of Maromandia. The pressures there are higher than in the protected area and include slash-and-burn agriculture. Mikajy Natiara has trained local rangers, who are now patrolling the forest, and conducts environmental outreach and

community projects. Mikajy Natiara also plans to build a research camp in nearby Mahitsihazo village to better protect the Blue-eyed Black Lemurs of Andilambologno forest (Mikajy Natiara 2022).

Additional conservation efforts are needed in Manongarivo Special Reserve, which covers the largest remaining parcel of forest in the Blue-eyed Black Lemur's range. The reserve's rugged terrain and remote location make patrolling difficult, and human incursion into the forest for hunting, agriculture, and cattle grazing are common (Tinsman et al. 2020). Increased financial support for Madagascar National Parks rangers and clear boundary markers would help protect the Blue-eyed Black Lemur. Measures to support the communities in and surrounding Manongarivo are also critical for long-term success. A program similar to AEECL's work in Sahamalaza or Mikajy Natiara's work in Andilambologno forest could reduce these communities' reliance on the Manongarivo Reserve. Further, a proposed expansion of Manongarivo Special Reserve (MEFT and MEM 2008) would place a good proportion of the Blue-eyed Black Lemur's mainland distribution range under protection (Tinsman et al. 2020).

- AEECL. (2022). The Lemur Conservation Association. Available online: <https://aeeccl.org>.
- Andrianjakarivelo, V. (2004). Exploration de la zone en dehors de la péninsule Sahamalaza pour l'évaluation rapide de la population d'*E. m. flavifrons*. Unpublished report. Antananarivo: WCS Madagascar. 31pp.
- Brown, J.L. and Yoder A.D. (2015). Shifting ranges and conservation challenges for lemurs in the face of climate change. *Ecol. Evol.* 5(6): 1131–1142.
- Cotton, S. (2021). *Growing links for lemurs: towards an effective reforestation of Sahamalaza-Iles Radama National Park*. Final Report. Gland: IUCN.
- Hending, D., Randrianarison, H., Holderied, M., McCabe, G. and Cotton, S. (2021). The kapok tree (*Ceiba pentandra* (L.) Gaertn, Malvaceae) as a food source for native vertebrate species during times of resource scarcity and its potential for reforestation in Madagascar. *Austral Ecol.* 46: 1440–1444.
- Koenders, L., Rumpler, Y., Ratsirarson, J. and Peyrieras, A. (1985). *Lemur macaco flavifrons* (Gray, 1867): a rediscovered subspecies of primate. *Folia Primatol.* 44: 210–215.
- Lernould, J.-M. (2002). Un programme international de recherche et de conservation pour le lémur aux yeux

- turquoise (*Eulemur macaco flavifrons*). *Lemur News* 7: 30–33.
- McLain, A.T., Meyer, T.J., Faulk, C., Herke, S.W., Oldenburg, J.M., Bourgeois, M.G., Abshire, C.F., Roos, C. and Batzer, M.A. (2012). An Alu-based phylogeny of lemurs (Infraorder: Lemuriformes). *PLoS One* 7(8): e44035.
- Mikajy Natiora. (2022). Lemur Conservation Network. Available online: <https://www.lemurconservationnetwork.org/organization/mikajy-natiora/>
- Polowinsky, S.Y. and Schwitzer, C. (2009). Nutritional ecology of the blue-eyed black lemur (*Eulemur flavifrons*): integrating *in situ* and *ex situ* research to assist the conservation of a critically endangered species. In: M. Clauss, A. Fidgett, G. Janssens, J.-M. Hatt, T. Huisman, J. Hummel, J. Nijboer and A. Plowman (eds.), *Zoo Animal Nutrition*, Volume IV, pp. 169–178. Fuerth: Filander Verlag.
- Rabarivola, C. (1998) Etude génétique comparative de populations insulaires et 'continentales' de *Eulemur macaco*. Utilisation simultanée des dermatoglyphes, de marqueurs sanguins et de l'ADN (RAPD) pour étudier la différenciation de *E. m. macaco* et *E. m. flavifrons*. Doctoral dissertation, Université d'Antananarivo, Antananarivo.
- Rabarivola, C., Meyers, D. and Rumppler, Y. (1991). Distribution and morphological characters of intermediate forms between the black lemur (*Eulemur macaco macaco*) and Sclater's lemur (*Eulemur macaco flavifrons*). *Primates* 32: 269–73.
- Randriatahina, G.H. and Rabarivola, J.C. (2004). Inventaire des lémuriers dans la partie nord-ouest de Madagascar et distribution d'*Eulemur macaco flavifrons*. *Lemur News* 9: 7–9.
- Reuter, K.E. and Schaefer, M.S. (2017). Illegal captive lemurs in Madagascar: comparing the use of online and in-person data collection methods. *Am. J. Primatol.* 79: e22541.
- Saunders, J.S. (2017). Is Reforestation an Effective Conservation Strategy for the Threatened Vertebrate Fauna of the Sahamalaza Peninsula, Northwest Madagascar? Masters dissertation, University of Bristol, Bristol.
- Schwitzer, C. (2003). Energy Intake and Obesity in Captive Lemurs (Primates, Lemuridae). Doctoral dissertation, Universität zu Köln, Köln.
- Schwitzer, C. (2004). *Sahamalaza field trip 28.09.-19.11.2003*. Report to the board of AEECL. Köln: Zoologischer Garten Köln.
- Schwitzer, C. and Lork, A. (2004). "Projet Sahamalaza-Iles Radama" Ein internationales Schutzprojekt für den Sclater's Maki (*Eulemur macaco flavifrons* Gray, 1867). *Z. des Kölner Zoo* 47: 75–84.
- Schwitzer, C., Schwitzer, N., Randriatahina, G.H., Rabarivola, C. and Kaumanns, W. (2006). "Programme Sahamalaza": New perspectives for the *in situ* and *ex situ* study and conservation of the blue-eyed black lemur (*Eulemur macaco flavifrons*) in a fragmented habitat. In: C. Schwitzer, S. Brandt, O. Ramilijaona, M. Rakotomalala Razanahoera, D. Ackermann, T. Razakamanana and J. U. Ganzhorn (eds.), *Proceedings of the German-Malagasy Research Cooperation in Life and Earth Sciences*, pp. 135–149. Berlin: Concept Verlag.
- Schwitzer, N., Randriatahina, G.H., Kaumanns, W., Hoffmeister, D. and Schwitzer, C. (2007a). Habitat utilization of blue-eyed black lemurs, *Eulemur macaco flavifrons* (Gray, 1867), in primary and altered forest fragments. *Primate Conserv.* (22): 79–87.
- Schwitzer, N., Kaumanns, W., Seitz, P.C. and Schwitzer, C. (2007b). Cathemeral activity patterns of the blue-eyed black lemur *Eulemur macaco flavifrons* in intact and degraded forest fragments. *Endang. Species Res.* 3: 239–247.
- Schwitzer, C., Polowinsky, S.Y. and Solman, C. (2009). Fruits as foods – common misconceptions about frugivory. In: M. Clauss, A. Fidgett, G. Janssens, J.-M. Hatt, T. Huisman, J. Hummel, J. Nijboer and A. Plowman (eds.), *Zoo Animal Nutrition*. Volume IV, pp. 131–168. Fuerth: Filander Verlag.
- Schwitzer, N., Clough, D., Zahner, H., Kaumanns, W., Kappeler, P. and Schwitzer, C. (2010). Parasite prevalence in blue-eyed black lemurs (*Eulemur flavifrons*) in differently degraded forest fragments. *Endang. Species Res.* 12: 215–225.
- Seiler, M., Randriatahina, G.H. and Schwitzer, C. (2010). Ongoing threats to lemurs and their habitat inside the Sahamalaza-Iles Radama National Park. *Lemur News* 15: 7–9.
- Tattersall, I. (1982). *The Primates of Madagascar*. New York, NY: Columbia University Press.
- Tinsman, J.C., Eschmann, C.L., Solofondranohatra, J.S., Ralainirina, J.R., Holderied, M. and McCabe, G. (2020). Range and conservation updates for the Critically Endangered blue-eyed black lemur *Eulemur flavifrons* and the Vulnerable black lemur *Eulemur macaco*. *Oryx* 54(6): 819–827.
- Volampeno, M.N., Masters, J.C. and Downs, C.T. (2011). A population estimate of blue-eyed black lemurs in Ankarafa forest, Sahamalaza-Iles Radama National Park, Madagascar. *Folia Primatol.* 81: 305–314.
- Volampeno, M.S., Randriatahina, G.H., Kalle, R., Wilson, A.L. and Downs, C.T. (2015). A preliminary population viability analysis of the critically endangered blue-eyed black lemur (*Eulemur flavifrons*). *Afr. J. Ecol.* 53(4): 419–427.
- Volampeno, S., Randriatahina, G., Schwitzer, C. and Seiler, M. (2020). *Eulemur flavifrons*. The IUCN Red List of Threatened Species 2020: e.T8211A115563094.
- Von Bülow, J., Cotton, S. and Abrahams, M.I. (in prep). Applying a Novel GIS-Based Method to Determine Optimal Reforestation Sites in the Ankarafa Fragment Complex, Sahamalaza-Iles Radama National Park, Madagascar.
- ZIMS. (2022). Zoological Information Management Software. Available online: <https://zims.species360.org>.

MADAGASCAR

© Russell Mittermeier



COQUEREL'S SIFAKA

Propithecus coquereli (A. Grandidier, 1867)

Madagascar
(2022)

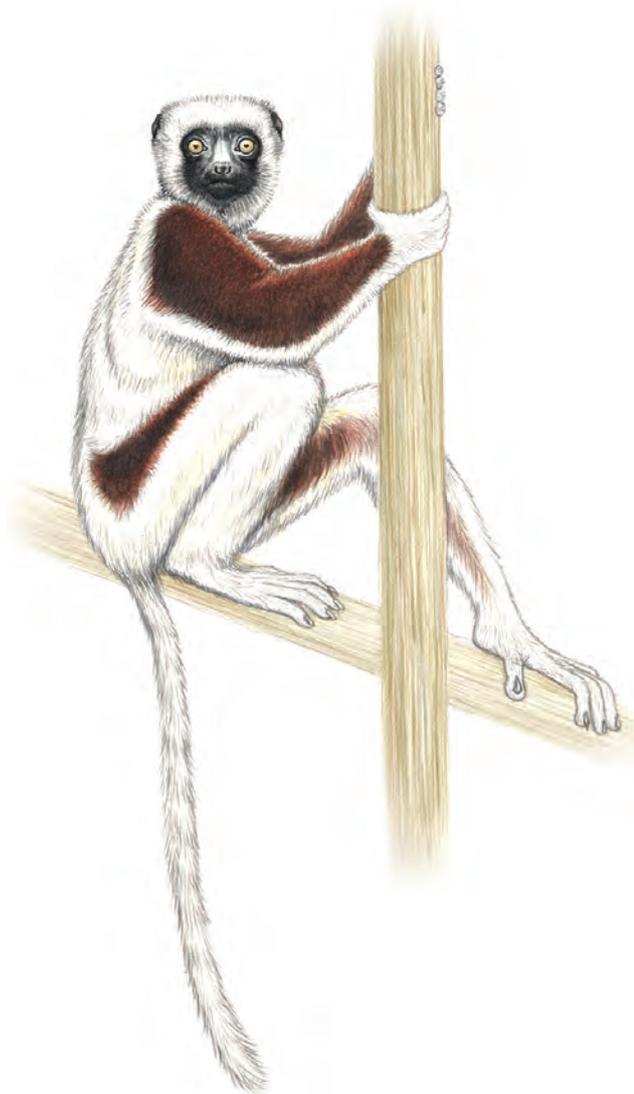
Jordi Salmons, Solofonirina Rasoloharijaona, Lounès Chikhi, Travis S. Steffens,
Timothy M. Eppley and Gilbert Rakotoarisoa

Propithecus coquereli is endemic to the tropical, dry, lowland forests of northwestern Madagascar. Historically, the species has been reported in the Sofia region between the Betsiboka and Maevarano watersheds (Tattersall 1982, Wilmé *et al.* 2006, Mittermeier *et al.* 2010). Its southeastern and eastern boundaries are, however, less clear and would need extensive field efforts to be properly defined (Salmons *et al.* 2014). To date, the southernmost known occurrence is southeast of Maevatanana along the east bank of the Betsiboka (Rakotonirina *et al.* 2014), and the easternmost occurrence is located near Antetemasy (just west of Befandriana Nord). *Propithecus coquereli* is known to occur in eleven protected areas: Anjajavy Reserve, Anjiamangirana, Ankarafantsika National Park, Bongolava forest corridor, Bora Special Reserve, Mariarano, Marosakoa and Namakia, Mifoko, Narindra peninsula, and Bombetoka-Beloboka (Salmons *et al.* 2014, Goodman *et al.* 2018).

This diurnal, vertical clinger-and-leaper is most commonly found in mixed deciduous, dry forests, secondary forests, plantations, brush-and-scrub, and in mosaics of fragmented forests (Salmons *et al.* 2014). It has also been seen in coastal mangroves (Donati *et al.* 2019, Chell *et al.* 2020). Coquerel's Sifaka feeds mostly on young leaves, flowers, fruit, bark and dead wood in the wet season, and on mature leaves and buds in the dry season (Richard 1974, McGoogan 2011). As many as 98 different plant species have been recorded in its diet (Richard 1978a, 1978b, McGoogan 2011). As with other western sifaka species, *P. coquereli* regularly descends to the ground where its locomotion is often characterized as 'dancing', a mixture of chassé and leaping. In the forests of Ankarafantsika, it occurs in

groups of 3–10, using home ranges of 4–33 ha (Petter 1962a, 1962b, Albignac 1981, McGoogan 2011). Sexual maturity is reached at roughly 2.5 years of age for both sexes. A gestation period of 162 days normally leads to a single offspring and births are clustered in the months of June and July (Richard 1978b, 1987). Infants become completely independent by about six months of age and reach adult size by one year (Mittermeier *et al.* 2010 and references therein). Infanticide and cannibalism, the context of which remains to be clarified, has been reported in Mariarano (Ramsay *et al.* 2020).

Coquerel's Sifaka is listed as Critically Endangered on the IUCN Red List of Threatened Species (Louis Jr. *et al.* 2020) based on a suspected reduction of the population of 80% in the past and upcoming 30 years. The main threats to this species are habitat loss and fragmentation (Waeber *et al.* 2015) and hunting (Garcia and Goodman 2003, Borgerson *et al.* 2019). High recent (1996–2016) deforestation rates in the Bongolava (39.0%) and Ankarafantsika (11.7%) protected areas (Goodman *et al.* 2018), and the probability of increased deforestation in unprotected lowland forests (Schüßler *et al.* 2020) suggest alarming deforestation rates across *P. coquereli*'s distribution. Slash-and-burn agriculture and annual grassland burning to create fresh pasture for livestock are the principal causes of forest loss in northwestern Madagascar, but trees are also cut to produce charcoal as well as planks for building (Waeber *et al.* 2015). Combined, these practices threaten all of its remaining habitats, even those that are officially protected (Goodman *et al.* 2018). Wildlife hunting and consumption (including lemurs) is



common around Ankarafantsika (Borgerson *et al.* 2019) and *P. coquereli* hunting has been reported repeatedly (Nicoll and Langrand 1989, Garcia and Goodman 2003) despite taboos on hunting sifakas. In some areas, local traditions place taboos on hunting or eating sifakas, but human immigration from other regions likely change such long-held customs (Nicoll and Langrand 1989, Borgerson *et al.* 2019). The species is suspected to have been completely extirpated from Bora Special Reserve after it was delisted as a protected area by the Malagasy government following high levels of degradation (Louis Jr. *et al.* 2020).

The latest extensive field survey, conducted between 2009 and 2011, confirmed the presence of the species in many of the remaining forest fragments in its range (Salmona *et al.* 2014). The Extent of Occurrence is estimated to be less than 28,000 km² (Louis Jr. *et al.* 2020). Its Area of Occupancy is expected to be much smaller due to the high fragmentation of its habitat. No systematic surveys have been carried out across its large range over the past 10 years. Kun-Rodrigues *et al.* (2014) found highly variable densities (between 5 and 100 individuals/km²) and a negative edge effect, across the Ankarafantsika National Park. The negative edge effect penetrated up to 625 m into the forest and was associated with home range sizes more than double the size of those in the interior (McGoogan 2011). Steffens and Lehman (2018) found sifakas only in the largest forest patches (19–118 ha) of the Ambanjabe mosaic landscape (Western Ankarafantsika) and reported their absence in forests smaller than 12 ha. Ramilison *et al.* (2021), on the other hand, reported Coquerel's Sifaka in forest patches in Mariarano that were as small as 2.5 ha. The majority of encounters were in habitat edge zones, most groups were sighted in introduced Mango trees (*Mangifera indica*), and many sightings were in villages and fields. The latter result echoes the seeming ubiquity of *P. coquereli* across its range (Salmona *et al.* 2014) with its presence in all sites visited. Salmona *et al.* (2014) also reported that they frequently use secondary forests, plantations, and introduced Mango and Tamarind trees.

In 2009–2010, the Ankarafantsika population was considered to be the largest remaining across its range, estimated at around 47,000 individuals (Kun-Rodrigues *et al.* 2014). Kun-Rodrigues *et al.* (2014) suggested that it had been declining prior to their survey, and that it would likely continue declining, especially following the uncontrolled fires in 2021. Steffens *et al.* (2020) recorded sifakas in only two of the nine sites they surveyed along the periphery of Ankarafantsika National Park. In a comparative analysis of how diurnal lemurs cope with different landscape metrics, Eppley *et al.* (2020) found that *P. coquereli* relies on large forest blocks. Using species distribution models, Brown and Yoder (2015) inferred that *P. coquereli* is unlikely to face drastic range contraction from climate change alone between 2000 and 2080.

In 2022, 60 individuals of this species were being held in a small number of zoos around the world (ZIMS 2022), more than 50 in registered captive facilities in Madagascar, and even more held in illegal facilities that are not registered with the government (Reuter and Schaefer 2017, LaFleur *et al.* 2019). It is difficult to maintain healthy indriids in captivity (Zehr *et al.* 2014, Cassady *et al.* 2018). Sifakas in captivity outside of Madagascar (*P. coquereli* and *P. coronatus*) frequently suffer from gastrointestinal and diarrheal diseases, decreased longevity, low infant survivorship, and decreased reproductive success (Zehr *et al.* 2014, Cassady *et al.* 2018).

Propithecus coquereli has the highest mitochondrial (Dloop sequence) and nuclear (microsatellites) genetic diversity among the northern and northwestern sifakas, that includes *P. perrieri* and *P. tattersalli* (Bailey *et al.* 2016). It has the highest genome-wide heterozygosity of all assembled sifaka species genomes (*P. tattersalli*, *P. coquereli*, *P. diadema*, *P. verreauxi*; Guevara *et al.* 2021). These estimates are in line with its large geographic range and potentially large population size. It appears to be genetically structured in at least four distinct populations (Mariano, Ankarafantsika, Anjamangirana, and Bora), suggesting a strong effect of major rivers (Mahajamba and Sofia) and large tracts of grassland in limiting gene flow among the forests where it is found (Bailey *et al.* 2016). These populations also show genetic signals that imply changes in habitat connectivity (fragmentation)

or population decline (Bailey *et al.* 2016, Guevara *et al.* 2021), which suggests that the demography of *P. coquereli* is impacted by both the historical human shift to extensive agropastoralism practices in the region (Voarintsoa *et al.* 2017) and late Quaternary climate fluctuations. The viability of the population is at high risk of being compromised if habitat availability keeps decreasing, especially given the long generation time of 10–20 years and that a decade ago there were only 47,000 individuals left in Ankarafantsika (Kun-Rodrigues *et al.* 2014), not all of which are reproductive. Generation time estimates are tentative, however, and partly based on data from Verreaux's Sifaka, *P. verreauxi* (Lawler *et al.* 2009, Morris *et al.* 2011; see Salmona *et al.* 2017 for details).

Except for Ankarafantsika National Park, most forests where this species is found have not been surveyed for at least a decade, and the south-eastern and eastern limits of *P. coquereli*'s distribution are still unclear (Salmona *et al.* 2014). Clarifying *P. coquereli*'s south-eastern range is an urgent prerequisite to inclusive conservation and will require extended survey efforts in remote areas. To date, population sizes have only been estimated in Ankarafantsika (Richard 1978b, Albignac 1981, Kun-Rodrigues *et al.* 2014), and systematic surveys of all known localities are needed. Accurate estimates of habitat size and deforestation will allow scientists to estimate the overall population size of the species and the demographic trends—critical for proper conservation status assessments.

The prioritization of sites suitable for conserving the species should be updated (considering especially the population genetic structure and the potential barriers to dispersal) to enable the conservation of the species' genetic diversity, and to ensure and re-establish connectivity among historically connected populations. Further fine-scale population genetic studies should be conducted, to ascertain the current level of connectivity between sites and the impacts on the viability of the remaining sifaka populations in the wild. Research efforts should also focus on the dichotomy of forest edge use – avoidance in Ankarafantsika and preference in Mariano (McGoogan 2011, Kun-Rodrigues *et al.* 2014, Ramilison *et al.* 2021). Local traditions placing

taboos on hunting and eating sifakas may play a pivotal role, and should be leveraged (Lingard et al. 2003, Jones et al. 2008).

Current conservation projects targeting Coquerel's Sifakas and their habitat include the long-term endeavors of Madagascar National Parks and the more recent efforts of Planet Madagascar and Operation Wallacea. They include fire management, monitoring patrols, forest restoration, and community development.

- Albignac, R. (1981). Lemurine social and territorial organization in a north-western Malagasy forest (restricted area of Ampijoroa). In: A. Chiarelli and R. Corrucini (eds.), *Primate Behavior and Sociobiology*, pp. 25–29. Berlin: Springer Verlag.
- Bailey, C.A., McLain, A.T., Paquette, S.R., McGuire, S.M., Shore, G.D., Lei, R., Randriamanana, J.C., Rabekinjaja, J.D., Rakotoarisoa, G., Razafindrakoto, A. and Brenneman, R. (2016). Evaluating the genetic diversity of three endangered lemur species (genus: *Propithecus*) from northern Madagascar. *J. Primatol.* 5(1): 132.
- Borgerson, C., Randrianasolo, J.F., Anjaranirina, E.J.G. and Golden, C.D. (2019). Wildlife hunting in complex human-environmental systems: how understanding natural resource use and human welfare can improve conservation in the Ankarafantsika National Park, Madagascar. *Madag. Conserv. Dev.* 14(1): 37–45.
- Brown, J.L. and Yoder, A.D. (2015). Shifting ranges and conservation challenges for lemurs in face of climate change. *Ecol. Evol.* 5(6): 1131–1142.
- Cassady, K., Cullen, J.M. and Williams, C.V. (2018). Mortality in Coquerel's sifakas (*Propithecus coquereli*) under human care: a retrospective survey from the Duke Lemur Center 1990–2015. *J. Zoo Wildl. Med.* 49(2): 315–323.
- Chell, C., Corral, M.E., Grant, I., Laskai, C.J., Gough, H., Rakotomalala, S.D., Ward, S.J. and Thompson, C. (2020). A brief observation of endangered Coquerel's sifaka (*Propithecus coquereli*) feeding on red mangrove (*Rhizophora mucronata*) vegetation in a mangrove environment, northwest Madagascar. *Int. J. Primatol.* 41: 562–565.
- Donati, G., Eppley, T.M., Ralison, J., Youssouf, J. and Ganzhorn, J.U. (2019). Lemurs in mangroves and other flooded habitats. In: A.A. Barnett, I. Matsuda and K. Nowak (eds.), *Primates in Flooded Habitats: Ecology and Conservation*, pp. 29–32. Cambridge: Cambridge University Press.
- Eppley, T.M., Santini, L., Tinsman, J.C. and Donati, G. (2020). Do functional traits offset the effects of fragmentation? The case of large-bodied diurnal lemur species. *Am. J. Primatol.* 82: e23104.
- Garcia, G. and Goodman, S.M. (2003). Hunting of protected animals in the Parc National d'Ankarafantsika, north-western Madagascar. *Oryx* 37(1): 115–118.
- Goodman, S.M., Raheerilalao, J. and Wohlhauser, S. (2018). *The Terrestrial Protected Areas of Madagascar: Their History, Description, and Biota. Volume III: Western and Southwestern Madagascar – Synthesis*. Chicago: University of Chicago Press.
- Guevara, E.E., Webster, T.H., Lawler, R.R., Bradley, B.J., Greene, L.K., Ranaivonasy, J., Ratsirarson, J., Harris, R.A., Liu, Y., Murali, S., Raveendran, M., Hughes, D.S.T., Muzny, D.M., Yoder, A.D., Worley, K.C. and Rogers, J. (2021). Comparative genomic analysis of sifakas (*Propithecus*) reveals selection for folivory and high heterozygosity despite endangered status. *Sci. Adv.* 7(17): eabd2274.
- Jones, J.P., Andriamarovololona, M.M. and Hockley, N. (2008). The importance of taboos and social norms to conservation in Madagascar. *Conserv. Biol.* 22(4): 976–986.
- Kun-Rodrigues, C., Salmona, J., Besolo, A., Rasolondraibe, E., Rabarivola, C., Marques, T.A. and Chikhi, L. (2014). New density estimates of a threatened sifaka species (*Propithecus coquereli*) in Ankarafantsika National Park. *Am. J. Primatol.* 76(6): 515–528.
- LaFleur, M., Reuter, K. and Schaefer, M. (2019). Tourism and lemurs: the fate of diurnal indriids at popular tourist destinations. *Lemur News* 22: 54–56.
- Lawler, R.R., Caswell, H., Richard, A.F., Ratsirarson, J., Dewar, R.E. and Schwartz, M. (2009). Demography of Verreaux's sifaka in a stochastic rainfall environment. *Oecologia* 161(3): 491–504.
- Lingard, M., Raharison, N., Rabakonandrianina, E., Rakotoarisoa, J.A., and Elmqvist, T. (2003). The role of local taboos in conservation and management of species: the radiated tortoise in southern Madagascar. *Conserv. Soc.* 1(2): 223–246.
- Louis Jr., E.E., Bailey, C.A., Sefczek, T.M., King, T., Radespiel, U. and Frasier, C.L. (2020). *Propithecus coquereli*. The IUCN Red List of Threatened Species 2020: e.T18355A115572275.
- McGoogan, K.C. (2011). Edge Effects on the Behaviour and Ecology of *Propithecus coquereli* in Northwest Madagascar. Doctoral dissertation, University of Toronto, Toronto.
- Mittermeier, R.A., Louis Jr., E.E., Richardson, M., Schwitzer, C., Langrand, O., Rylands, A.B., Hawkins, F., Rajaobelina, S., Ratsimbazafy, J., Rasoloarison, R., Roos, C., Kappeler, P.M. and MacKinnon, J. (2010). *Lemurs of Madagascar*. 3rd edition. Arlington, VA: Conservation International.
- Morris, W.F., Altmann, J., Brockman, D.K., Cords, M., Fedigan, L.M., Pusey, A.E., Stoinski, T.S., Bronikowski, A.M., Alberts, S.C. and Strier, K.B. (2011). Low demographic variability in wild primate populations: fitness impacts of variation, covariation, and serial correlation in vital rates. *Am. Nat.* 177(1): E14–E28.
- Nicoll, M.E. and Langrand, O. (1989). *Madagascar: Revue de la Conservation et des Aires Protégées*. Gland, Switzerland: World Wildlife Fund (WWF).
- Petter, J.-J. (1962a). Recherches sur l'écologie et l'éthologie des lémuriens malgaches. *Mem. Mus. Natl. Hist. Nat. Hist.*, Ser. A 27: 1–146.
- Petter, J.-J. (1962b). Ecological and behavioral studies of Madagascar lemurs in the field. *Ann. N. Y. Acad. Sci.* 102: 267–281.
- Rakotoarisoa, G. (2012). Génétique et dynamique des populations de *Propithecus coquereli* dans les fragments forestiers d'Anjamangirana, Ankarafantsika, Mariarano

- et Bora, du Nord-Ouest de Madagascar. Doctoral dissertation, Université d'Antananarivo, Antananarivo.
- Rakotonirina, L.H.F., Randriatsara, F., Rakotoarisoa, A.H., Rakotondrabe, A.R., Razafindramanana, J., Ratsimbazafy, J. and King, T. (2014). A preliminary assessment of sifaka (*Propithecus*) distribution, chromatic variation and conservation in western central Madagascar. *Primate Conserv.* (28): 43–53.
- Ramilison, M.L., Andriatsitohaina, B., Chell, C., Rakotondravony, R., Radespiel, U. and Ramsay, M.S. (2021). Distribution of the critically endangered Coquerel's sifaka (*Propithecus coquereli*) across a fragmented landscape in NW Madagascar. *Afr. J. Ecol.* 59(2): 350–358.
- Ramsay, M.S., Morrison, B. and Stead, S.M. (2020). Infanticide and partial cannibalism in free-ranging Coquerel's sifaka (*Propithecus coquereli*). *Primates* 61(4): 575–581.
- Reuter, K.E. and Schaefer, M.S. (2017). Illegal captive lemurs in Madagascar: Comparing the use of online and in-person data collection methods. *Am. J. Primatol.* 79: e22541.
- Richard, A.F. (1974). Intra-specific variation in the social organization and ecology of *Propithecus verreauxi*. *Folia Primatol.* 22(2–3): 178–207.
- Richard, A.F. (1978a). Variability in the feeding behavior of a Malagasy prosimian, *Propithecus verreauxi*: Lemuriformes. In: G.G. Montgomery (ed.), *The Ecology of Arboreal Folivores*, pp. 519–533. Washington, D.C.: Smithsonian Institution Press.
- Richard, A.F. (1978b). *Behavioral Variation: Case Study of a Malagasy Lemur*. Lewisburg, PA: Bucknell University Press.
- Richard, A.F. (1987). Malagasy prosimians: female dominance. In: B. Smuts, D. Cheney, R. Seyfarth, R. Wrangham and T.T. Struhsaker (eds.), *Primate Societies*, pp. 25–33. Chicago, IL: University of Chicago Press.
- Salmona, J., Jan, F., Rasolondraibe, E., Besolo, A., Ousseni, D.S., Beck, A., Zaranaina, R., Rakotoarisoa, H., Rabarivola, C.J. and Chikhi, L. (2014). Extensive survey of the endangered Coquerel's sifaka *Propithecus coquereli*. *Endang. Species Res.* 25(2): 175–183.
- Salmona, J., Heller, R., Quéméré, E. and Chikhi, L. (2017). Climate change and human colonization triggered habitat loss and fragmentation in Madagascar. *Mol. Ecol.* 26(19): 5203–5222.
- Schübler, D., Mantilla-Contreras, J., Stadtmann, R., Ratsimbazafy, J.H. and Radespiel, U. (2020). Identification of crucial stepping stone habitats for biodiversity conservation in northeastern Madagascar using remote sensing and comparative predictive modeling. *Biodiv. Conserv.* 29: 2161–2184.
- Steffens, T.S. and Lehman, S.M. (2018). Lemur species-specific metapopulation responses to habitat loss and fragmentation. *PLoS One* 13: e0195791.
- Steffens, T.S., Maheritafika, H.M.R., Hildebrand, J. and Aylward, M. (2020). Lemur distribution and resident attitudes towards forest loss and degradation in Ankarafantsika National Park, Madagascar. *Primate Conserv.* (34): 61–70.
- Tattersall, I. (1982). *The Primates of Madagascar*. New York: Columbia University Press.
- Voarintsoa, N.R.G., Wang, L., Railsback, L.B., Brook, G.A., Liang, F., Cheng, H. and Edwards, R.L. (2017). Multiple proxy analyses of a U/Th-dated stalagmite to reconstruct paleoenvironmental changes in northwestern Madagascar between 370 CE and 1300 CE. *Palaeogeogr. Palaeoclimatol. Palaeoecol.* 469: 138–155.
- Waeber, P.O., Wilmé, L., Ramamonjisoa, B., Garcia, C., Rakotomalala, D., Rabemananjara, Z.H., Kull, C.A., Ganzhorn, J.U. and Sorg, J.P. (2015). Dry forests in Madagascar: neglected and under pressure. *Int. For. Rev.* 17(2): 127–148.
- Wilmé, L., Goodman, S.M. and Ganzhorn, J.U. (2006). Biogeographic evolution of Madagascar's microendemic biota. *Science* 312(5776): 1063–1065.
- Zehr, S.M., Roach, R.G., Haring, D., Taylor, J., Cameron, F.H. and Yoder, A.D. (2014). Life history profiles for 27 strepsirrhine primate taxa generated using captive data from the Duke Lemur Center. *Sci. Data*. 1: 140019.
- ZIMS. (2022). Zoological Information Management Software. Available online: <https://zims.species360.org>.



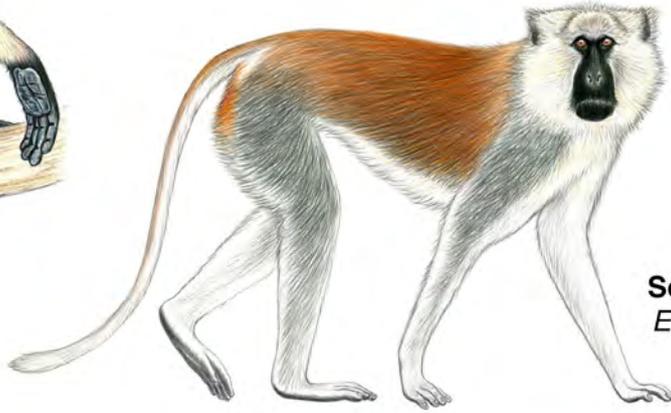
**Niger Delta
Red Colobus**
*Piliocolobus
epieni*



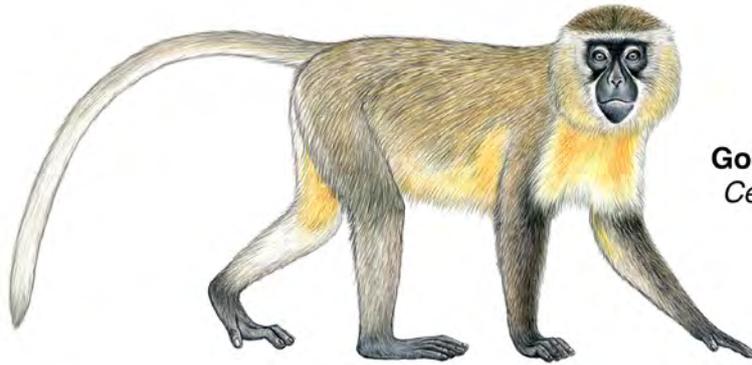
Rondo Dwarf Galago
Paragalago rondoensis



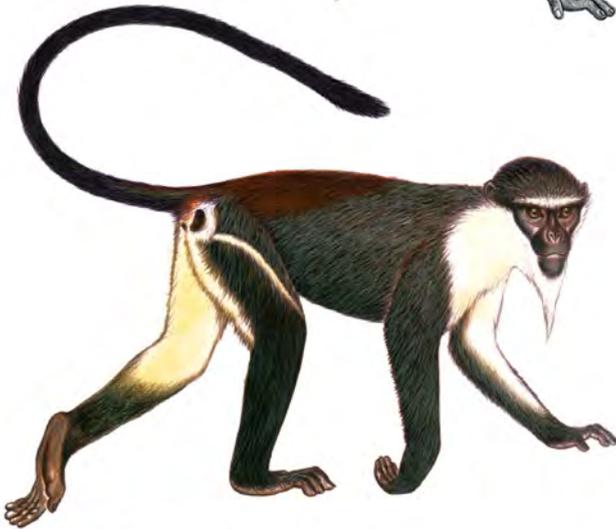
Southern Patas Monkey
Erythrocebus baumstarki



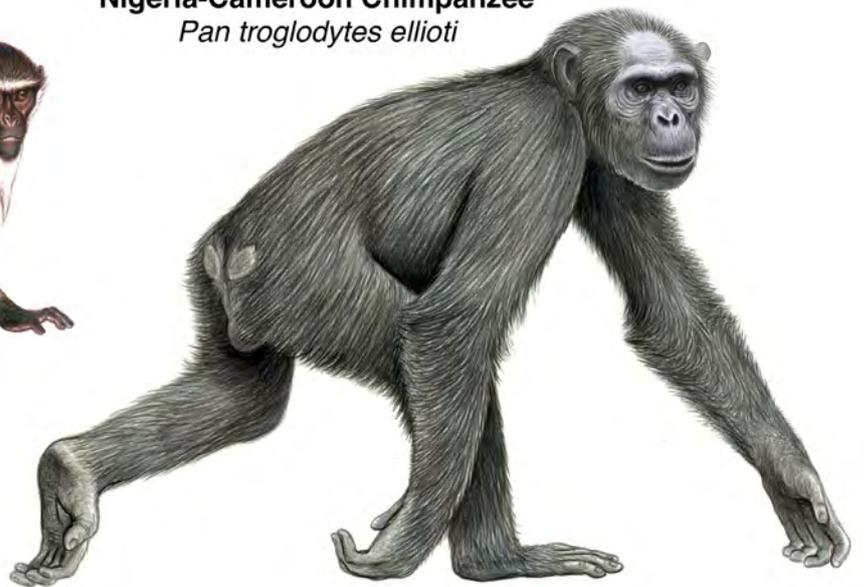
Golden-bellied Mangabey
Cercocebus chrysogaster



Nigeria-Cameroon Chimpanzee
Pan troglodytes ellioti



Roloway Monkey
Cercopithecus roloway



AFRICA



AFRICA

© Andrew Perkin



RONDO DWARF GALAGO

Paragalago rondoensis (Honest in Kingdon, 1997)

Tanzania
(2006–2014, 2018, 2022)

Andrew Perkin

Weighing approximately 60 g, the Rondo Dwarf Galago is the smallest of all galagos (Perkin and Honess 2013). It is distinct from other dwarf galagos in its diminutive size, a bottle-brush-shaped tail, its reproductive anatomy, and its distinctive “double unit rolling call” (Perkin and Honess 2013). Current knowledge indicates that *P. rondoensis* is endemic to the coastal forests of Tanzania. There are three spatially distinct sub-populations. One is in southeast Tanzania near the coastal towns of Lindi and Mtwara. The second is approximately 400 km north, in pockets of forest around the capital city of Dar es Salaam. The third sub-population is in Sadaani National Park, approximately 100 km north of Dar es Salaam. There is emerging data (vocal and penile morphological), however, that suggests the northern and southern populations may be phylogenetically distinct.

Rondo Dwarf Galagos have a mixed diet of insects and fruit. They often feed close to the ground, moving by vertical clinging and leaping in the shrubby understory. They build daytime sleeping nests, usually in the canopy (Bearder *et al.* 2003). As with many small primates, *P. rondoensis* is probably subject to predation from owls and other nocturnal predators, such as genets, palm civets and snakes. The presence of these predators invokes intense episodes of alarm calling (Perkin and Honess 2013).

Across its known range, the Rondo Dwarf Galago can be found in sympatry with a number of other galagos, including two much larger species in the genus *Otolemur*: Garnett’s Greater Galago *O. garnettii* (Least Concern: De Jong *et al.* 2019a) and the Thick-tailed Galago, *O. crassicaudatus* (Least Concern: Masters and Bearder 2019). In

the northern parts of its range (for example, in Zaraninge forest, the Pugu/Kazimzumbwi Forest Reserve [FR] and the Pande Game Reserve [GR]), the Rondo galago is sympatric with the Zanzibar Galago, *Paragalago zanzibaricus* (Near Threatened: Perkin *et al.* 2020) and in the southern parts of its range (for example, in Rondo, Litipo and Noto), it is sympatric with Grant’s Galago, *P. granti* (Least Concern: De Jong *et al.* 2019b).

Paragalago rondoensis, considered Endangered on the IUCN Red List of Threatened Species (Perkin 2020), has an extremely limited and fragmented range across a number of remnant patches of Eastern African Coastal Dry Forest (Burgess and Clarke 2000) in Tanzania. These are at Zaraninge forest (06°08’S, 38°38’E) in Sadaani National Park (Perkin 2000), Pande GR (06°42’S, 39°05’E), Pugu/Kazimzumbwi (06°54’S, 39°05’E) (Perkin 2003, 2004), Rondo Nature Reserve (NR) (10°08’S, 39°12’E), and the Litipo (10°02’S, 39°29’E) and Ziwani (10°20’S, 40°18’E) forest reserves (Honest 1996, Honest and Bearder 1996). New sub-populations were identified in 2007 near Lindi town in Chitoo FR (09°57’S, 39°27’E) and the Ruawa FR (09°44’S, 39°33’E) and, in 2011, in Noto Village FR (09°53’S, 39°25’E) (Perkin *et al.* 2011, 2013) and, of the northern population, at the Ruvu South FR (06°58’S, 38°52’E). Specimens of *P. rondoensis*, originally described as *Galagoides demidoffi phasma*, were collected by Ionides from the Rondo Plateau, southeast Tanzania in 1955, and by Lumsden from Nambungu, near Kitangari, (approximately 10°40’S, 39°25’E) on the Makonde Plateau, Newala District in 1953. There are doubts as to the persistence of the species on the Makonde Plateau, which has been extensively cleared for agriculture. In 1992, surveys there failed to detect any extant populations (Honest



1996). Distribution surveys have been conducted in the southern (Honest 1996; Perkin *et al.* unpubl. data) and northern coastal forests of Tanzania (29 surveyed) and Kenya (seven surveyed) (Perkin 2000, 2003, 2004. Perkin *et al.* 2013). Absolute population sizes remain undetermined, but recent surveys have provided density estimates of: 3–6/ha at the Pande GR (Perkin 2003) and 8/ha at the Pugu FR (Perkin 2004). Relative abundance has also been estimated from encounter rates: 3–10/hr at Pande GR and Pugu/ Kazimzumbwi FR (Perkin 2003, 2004), and 3.94/hr at Rondo FR (Honest 1996). There is a clear and urgent need for further surveys to determine population sizes in these dwindling forest patches.

The major threat facing the Rondo Dwarf Galago is loss of habitat. All sites are subject to some level of agricultural encroachment, charcoal manufacture, and/or logging. In 2008, the known Area of Occupancy of *P. rondoensis* was <101.6 km², but new data on forest area change indicates this figure has fallen to 87.4 km². In the Pande GR (2.4 km²), Chitoo (5 km²), and Rondo (25 km²) forest reserves, forest cover remained the same between 2008 and 2014. However, forest cover between 2008 and 2014 declined in the Zaraninge forest from 20 km² to 15 km², in Pugu/Kazimzumbwi FR from 33.5 km² to 8 km², in Ruawa FR and Litipo FR from 4 km² to 3 km², and in Ziwani FR from 7.7 km² to 1 km². Two newly discovered Areas of Occupancy are Ruvu South, in which forest cover fell from 20 km² to 5 km², and Noto, in which forest cover fell from 21 km² to 20 km² in the same time period (Burgess and Clarke 2000, Doggart 2003, Perkin *et al.* unpubl. data).

As habitat availability decreases, the population trend must also be assumed to be declining, the rate varying according to the level of protection of each forest fragment. All sites, except the Pande GR, Zaraninge (in Saadani National Park) and the Rondo NR, are national or local authority forest reserves and, as such, nominally, but in practice minimally, protected. Since 2008, protection of two forests has increased: the Noto plateau forest, formerly open village land, as part of a newly created village forest reserve, and the Rondo Forest Reserve has now been declared a new nature reserve. Both are important for Rondo Dwarf Galago conservation considering

their relatively large size. Given current trends in charcoal production for nearby Dar es Salaam, the forest reserves of Pugu and Kazimzumbwi were predicted to disappear over the next 10–15 years (Ahrends 2005). Recorded forest loss in Pugu/Kazimzumbwe and Ruvu South has been attributed to the rampant charcoal trade. Pande, as a Game Reserve, is relatively secure, and Zareninge forest, being in a national park, is the most protected part of the range of *G. rondoensis*. In the south, the Noto, Chitoa and Rondo populations are the most secure, as they are buffered by tracts of woodland. The type population at Rondo is buffered by woodland and *Pinus* plantations managed by the Rondo Forestry Project, and is now a nature reserve. Litipo and Ruawa forest reserves are under threat from bordering village lands. Ziwani is now mostly degraded scrub forest, thicket and grassland.

The following conservation actions are recommended to safeguard the future of this species: 1) continued monitoring of habitat loss rates, 2) surveying new areas for remnant populations, 3) implementation of community-based conservation and awareness, 4) assessment of population status and phylogenetic relationships between the sub-populations and confirmation of suspected phylogenetic distinctions. Until such time that the latter has been carried out, each subpopulation must be considered to be of high conservation value.

- Ahrends, A. (2005). Pugu Forest: going, going... *The Arc Journal*. 17: 23.
- Bearder, S.K., Ambrose, L., Harcourt, C., Honess, P., Perkin, A.W., Pullen, S., Pimley, E. and Svoboda, N. (2003). Species-typical patterns of infant care, sleeping site use and social cohesion among nocturnal primates in Africa. *Folia Primatol.* 74: 337–354.
- Burgess, N.D. and Clarke G.P. (2000). *Coastal Forests of Eastern Africa*. Switzerland and Cambridge, UK: IUCN Gland.
- De Jong, Y.A., Butynski, T.M., Perkin, A.W. and Svensson, M. (2019a). *Otolemur garnettii*. The IUCN Red List of Threatened Species 2019: e.T15644A17963837.
- De Jong, Y.A., Butynski, T.M. and Perkin, A.W. (2019b). *Paragalago granti*. The IUCN Red List of Threatened Species 2019: e.T91970347A17962454.
- Doggart, N. (ed.). 2003. Pande Game Reserve: A Biodiversity Survey. Tanzania Forest Conservation Group, *Technical Paper 7*. Dar es Salaam, Tanzania.
- Honess, P.E. (1996). Speciation Among Galagos (Primates, Galagidae) in Tanzanian Forests. Doctoral thesis, Oxford: Oxford Brookes University, Oxford, UK.
- Honess, P.E. and Bearder, S. (1996). Descriptions of the dwarf galago species of Tanzania. *Afr. Primates*. 2(2): 75–79.
- Masters, J. and Bearder, S. (2019). *Otolemur crassicaudatus*. The IUCN Red List of Threatened Species 2019: e.T15643A17963699.
- Perkin, A.W. (2000). *A Field Study of the Conservation Status and Diversity of Galagos in Zaraninge Forest, Coast Region, Tanzania*. Report, WWF-Tanzania, Dar es Salaam, Tanzania.
- Perkin, A.W. (2003). Mammals. In: N. Doggart (ed.), *Pande Game Reserve: A Biodiversity Survey*, p.95. Dar es Salaam, Tanzania: Tanzania Forest Conservation Group.
- Perkin, A.W. (2004). Galagos of the Coastal Forests and Eastern Arc Mtns. of Tanzania – Notes and Records. *Tanzania Forest Conservation Group, Technical Paper 8*. Dar es Salaam, Tanzania.
- Perkin, A.W. (2020). *Paragalago rondoensis*. The IUCN Red List of Threatened Species 2020: e.T40652A17962115.
- Perkin, A.W. and Honess, P.E. (2013). *Galagoides rondoensis* Rondo Dwarf Galago. In: T.M. Butynski, J. Kingdon and J. Kalina (eds.), *Mammals of Africa. Volume II: Primates*, pp. 450–452. London: Bloomsbury Publishing.
- Perkin, A.W., Samwel, B. and Gwegime, J. (2011). Going for gold in the Noto Plateau, SE Tanzania. *Arc Journal*. 26: 14–16.
- Perkin, A.W., Honess, P.E. and Butynski, T.M. (2013). *Galagoides orinus* Mountain Dwarf Galago. In: T.M. Butynski, J. Kingdon and J. Kalina (eds.), *Mammals of Africa. Volume II: Primates*, pp. 452–454. London: Bloomsbury Publishing.
- Perkin, A.W., Butynski, T.M. and de Jong, Y.A. (2020). *Paragalago zanzibaricus* (errata version published in 2020). The IUCN Red List of Threatened Species 2020: e.T8790A179843811.

AFRICA

© Edward McLester



GOLDEN-BELLIED MANGABEY

Cercocebus chrysogaster Lydekker, 1900

Democratic Republic of the Congo
(2022)

Edward McLester, John A. Hart and Jo A. Myers Thompson

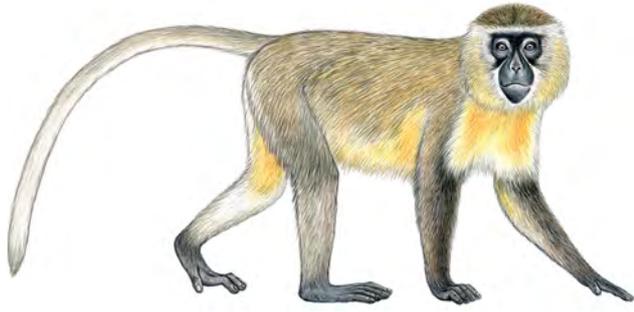
More than 120 years after being first described, the Golden-bellied Mangabey remains one of Africa's least-known primates. Previously considered Data Deficient, it is now listed as Endangered on the IUCN Red List of Threatened Species (Hart and Thompson 2020). Found only in a limited range in the central Congo basin, Golden-bellied Mangabeys are highly threatened throughout their distribution and face continuing, and potentially rapid, declines.

The largest of the seven *Cercocebus* mangabeys, these monkeys are characterized by vivid yellow-orange fur that covers the belly and abdomen. Golden-bellied Mangabey ecology is poorly known and there have been no detailed behavioral studies of this species in the wild. Almost all insight is limited to anecdotes reported prior to the year 2000 and preliminary data recorded in 2021 from two habituated groups at LuiKotale (a study site of the Max Planck Institute of Animal Behavior) in Lokolama sector, bordering the southern sector of the Salonga National Park (SNP). Group sizes typically number 50–70 individuals (Ehardt and Butynski 2013). Home ranges are also relatively large for cercopithecine monkeys in tropical forest (approximately 20–25 km²) and are comparable and may exceed those of sympatric bonobo (*Pan paniscus*) communities (McLester and Fruth in prep.) Individuals travel almost exclusively terrestrially and generally climb arboreally only to sleep, forage in large fruit trees, or during heavy rainfall. The diet consists primarily of fruit, with considerable time also spent feeding on seeds and insects that are obtained from the ground, particularly in large patches of leaf litter. Similar to Agile Mangabeys (*C. agilis*) north of the Congo River, Golden-bellied Mangabeys are notable for relatively high rates of mammal consumption, with adult males observed regularly catching and

eating Blue Duikers (*Philantomba monticola*) at LuiKotale (McLester 2022).

Golden-bellied Mangabeys are endemic to the Democratic Republic of the Congo (DRC). The species is known to occur in two widely separated subpopulations (a western and an eastern population – Ehardt and Butynski 2013, Hart and Thompson 2020). Surveys conducted between 1994 and 2007 (Inogwabini and Thompson 2013) and 2016–2018 (Bessone *et al.* 2019, 2020) identified the western population as occurring within an area of 68,000 km², bordered by the Lokolo River to the north, the Luilaka River to the east, the Kasai and Sankuru rivers to the south, and the Congo River to the west. The eastern range covers an area of about 12,000 km² with identified populations known between the Sankuru and Lubefu rivers in an area locally termed the Kipula Block (Thompson and Hart 2015). Eastern and western populations are separated by at least 300 km. There is no evidence to support the suggestion by Erhardt and Butynski (2013) that the two populations are connected by a forest corridor along the Lukenie or Sankuru rivers. The total range for both the western and eastern populations is around 80,000 km². However, Golden-bellied Mangabey occurrence is highly patchy within this large range, and their distribution and abundance remain poorly known over many areas.

The western sub-population includes portions of the southern sector of the SNP, which is the only protected area in which Golden-bellied Mangabeys occur. Known occurrence within the southern sector of SNP is patchy, with observations restricted to the northern and eastern areas of the park (n = 22 observations from about 4,000 km of line transects and recces



covering 93.5% of the sector) (Bessone *et al.* 2019). There are no records of *C. chrysogaster* from the southwestern area of SNP's southern sector or from the northern sector of SNP (J. Eriksson, F. Maisels and G. Reinartz pers. comm.).

The typical elevational range for this species is 300–500 m and habituated groups at LuiKotale almost exclusively use high and dry terra firma vegetation at ≥ 400 m and rarely venture into swamps or riparian areas (McLester and Fruth in prep.). Approximately 60% of the habitat in the western distribution is permanent swamp or seasonally flooded and riparian forest, within which areas of terra firma forest comprise an even lower percentage (Inogwabini and Thompson 2013). In the absence of any detailed estimates of population density, limited habitat choice and large home range sizes suggest densities are likely to be low.

Golden-bellied Mangabeys are in decline throughout their distribution. In the past 20 years, at least 32% of the total potential habitat has been lost and an estimated 40% of the population extirpated (Hart and Thompson 2020). A major threat is unsustainable hunting, with high numbers of Golden-bellied Mangabeys killed for the commercial bushmeat trade in both the western and eastern populations. In the western population, surveys from 2001 to 2007 found Golden-bellied Mangabeys comprised as much as 70% of bushmeat available in some markets (Inogwabini and Thompson 2013). Surveys of markets in the eastern range conducted in 2010 found this species represented about 10% of all bushmeat recorded. That number fell considerably by 2015, when the Golden-bellied Mangabey population was also reported to have declined significantly in some localities (Thompson and Hart 2015). Hunting varies across the distribution. Rates of human activity in the northern half of the southern sector of SNP, where the species were reported to be found, were lower than in the south of the sector, where no observations of Golden-bellied Mangabeys were made (Bessone *et al.* 2019). In some Lokoloma sector villages in the center of the species' distribution, Golden-bellied Mangabeys are rarely consumed as bushmeat and hunting may be reduced because larger or more conspicuous species (e.g., colobus monkeys) are easier targets for hunters (N. Bondjengo and B. Fruth, unpubl.

data). In other areas, hunting is likely exacerbated because Golden-bellied Mangabeys are considered to be agricultural pests (Inogwabini and Thompson 2013).

Golden-bellied Mangabeys are threatened by habitat loss due to both small-scale and larger industrial logging operations. Inogwabini *et al.* (2013) reported that west of the Lake Mai-Ndombe, where the species no longer occurs, local communities reported its disappearance over the course of two decades following the arrival of intensive logging. Currently, small-scale logging is particularly widespread in the western range, further decreasing the availability of suitable habitat for this species. In total, more than 30% of the remaining habitat has been ceded to logging concessions (Hart and Thompson 2020).

The illegal pet trade is also a threat and captive individuals are frequently seen in both the western and eastern subpopulations, as well as in Kinshasa (Hart and Thompson 2020). The trade appears to extend internationally. In 2021, for example, a single shipment confiscated in Zimbabwe contained eleven individuals that were being smuggled to South Africa. John Hart (pers. obs.) observed captive infants for sale on the streets of Kinshasa as recently as February 2022. These observations are an alarming indicator of the threat this species is under, given that captive infants are likely a by-product of adult individuals killed for bushmeat.

Golden-bellied Mangabeys are one of Africa's most threatened but least known primates. To effectively address ongoing declines, research is needed on their distribution, population sizes, and ecology as well as the impact of hunting and habitat transformation. Recently initiated studies of habituated groups at LuiKotale should provide the first detailed insight into the behavioral ecology of this species and can directly inform conservation planning by providing data on habitat use, ranging behavior, and dispersal patterns.

Effective protection of SNP is a high conservation priority given that it is the only protected area in the species' range. At present, land conversion and commercial logging are relatively uncommon

in the SNP but illegal hunting remains a significant threat, especially associated with villages that do not practice agriculture and for which bushmeat is the only source of income. The park is also threatened by an increase in uncontrolled commercial hunting (Bessone *et al.* 2019). Across the distribution, there is a critical need to confirm where Golden-bellied Mangabeys still occur, along with an improved understanding of where (and why) they are absent across their large range. This will be essential to focus resources on an effective conservation strategy.

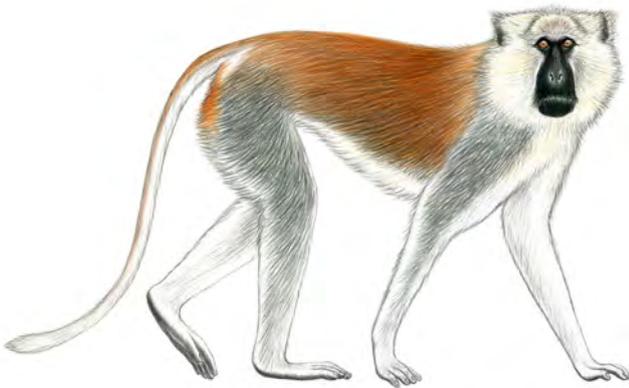
- Bessone, M., Bondjengo, N., Hausmann, A., Herbing, I., Hohmann, G., Kühl, H., Mbende, M., N'Goran, P., Soliday, V. and Fruth, B. (2019). Inventaire de la biodiversité dans le bloc sud du parc national de la Salonga et développement d'une stratégie de suivi écologique pour améliorer la protection de la faune et de la flore menacées dans le parc. Unpublished report produced by L'Institut Congolais pour la Conservation de la Nature, World Wildlife Fund, Berlin, Germany: The Max Planck Institute for Evolutionary Anthropology, and Ludwig-Maximilians-Universität.
- Bessone, M., Kühl, H.S., Hohmann, G., Herbing, I., N'Goran K.P., Asanzi, P., Da Costa, P.B., Dérozier, V., Fotsing, E.D.B., Beka, B.I., Iyomi, M.D., Iyatshi, I.B., Kafando, P., Kambere, M.A., Moundzoho, D.B., Wanzalire, M.L.K. and Fruth, B. (2020). Drawn out of the shadows: surveying secretive forest species with camera trap distance sampling. *J. Appl. Ecol.* 57: 963–974.
- Ehardt, C.L. and Butynski, T.M. (2013). *Cercocebus chrysogaster* Golden-bellied Mangabey. In: T.M. Butynski, J. Kingdon and J. Kalina (eds.), *Mammals of Africa. Volume 2: Primates*, pp. 174–177. London, UK: Bloomsbury Publishing.
- Hart, J.A. and Thompson, J. (2020). *Cercocebus chrysogaster*. The IUCN Red List of Threatened Species 2020: e.T4207A17956177.
- Inogwabini, B.-I. and Thompson, J.A.M. (2013). The golden-bellied mangabey *Cercocebus chrysogaster* (Primates: Cercopithecidae): distribution and conservation status. *J. Threat. Taxa.* 5: 4069–4075.
- Inogwabini, B.-I., Nzala, A.B. and Bokika, J.C. (2013). People and bonobos in the southern Lake Tumba landscape, Democratic Republic of Congo. *Am. J. Hum. Ecol.* 2: 44–53.
- McLester, E. (2022). Golden-bellied mangabeys (*Cercocebus chrysogaster*) consume and share mammalian prey at LuiKotale, Democratic Republic of the Congo. *J. Trop. Ecol.* 5pp. doi.10.1017/S026646742200013X
- Thompson, J.A.M. and Hart, J. (2015). Biological Inventory and Survey of Bonobos within the Lukenie-Sankuru-Lusambo Forest Block, Democratic Republic of Congo. Unpublished report to USFWS. Kinshasa: Lukuru Foundation.

SOUTHERN PATAS MONKEY

Erythrocebus baumstarki Matschie, 1906

Kenya (Extirpated), Tanzania
(2022)

Thomas M. Butynski and Yvonne A. de Jong



A detailed review of the taxonomic arrangement of the patas monkeys (*Erythrocebus*) is long overdue. The Southern Patas Monkey (*Erythrocebus baumstarki*) was described by Matschie in 1906 from east of Ikoma in central-northern Tanzania. Elliot (1913) appears to be the last to recognize *baumstarki* as a species. Subsequently, this taxon has been treated as either a synonym or subspecies of *Erythrocebus patas*. Only recently has *baumstarki* been reinstated as a species (Gippoliti 2017) based on its unique pelage coloration and pattern, and geographic isolation (De Jong and Butynski 2020, 2021, De Jong et al. 2020).

Erythrocebus baumstarki is a large, slender, long-limbed, semi-terrestrial guenon that typically lives in one-male, multi-female groups. The natural history of *E. baumstarki* is poorly known. Its geographically closest relative, the Eastern Patas Monkey (*Erythrocebus patas pyrrhonotus*), has been studied in Uganda and Kenya and, at this time, is used as a proxy for the natural history of *E. baumstarki*.

In East Africa, *E. p. pyrrhonotus* prefers open, short grass, acacia woodlands and wooded savannas, where it occurs at low densities (0.03–1.50 individuals/km²). This monkey rarely sleeps in the same area on successive nights and has long day ranges (1,380–7,500 m) and large home ranges (23–52 km²; Hall 1965, Chism and Rowell 1988, Isbell 1998, Isbell and Chism 2007, Isbell 2013). These characteristics, together with its typically shy and flighty behavior and ability to run at high speed (55 km/hour; Hall 1965), makes *Erythrocebus* especially difficult to locate and observe (Makacha and Sirolli 2005, De Jong et al. 2008, Loishooki et al. 2016). Like *E. p.*

pyrrhonotus in central Kenya, *E. baumstarki* is an ecological specialist, being highly dependent on large areas of healthy Whistling Thorn Acacia (*Acacia drepanolobium*), its primary food plant, and probably also upon the on-going mutualistic interactions between ants (*Crematogaster* spp.) and *A. drepanolobium*.

In the early 20th century, *E. baumstarki* occupied large parts of the Serengeti-Mara Ecosystem and Amboseli Ecosystem of southern Kenya and northern Tanzania (De Jong *et al.* 2008, 2009, 2020, De Jong and Butynski 2020, 2021). It seems that, at present, *E. baumstarki* remains only in the protected areas of the western Serengeti (Serengeti National Park [14,750 km²], Grumeti Game Reserve [428 km²], Ikorongo Game Reserve [567 km²], Ikona Wildlife Management Area [255 km²]), with the western Serengeti National Park being the stronghold (De Jong and Butynski 2021).

The geographic distribution of *E. baumstarki* in the early 20th century was about 66,000 km². This has declined roughly 85% to around 9,700 km² at present (post-2009). It was extirpated from Kenya in about 2015 and from the Kilimanjaro Region of Tanzania in about 2011. The present Extent of Occurrence (EOO) is roughly 2,150 km². The total number of individuals remaining in the wild is probably between 100 and 200, including between 50 and 100 mature individuals (De Jong and Butynski 2021). There is no captive population.

Erythrocebus baumstarki is listed as Critically Endangered on the IUCN Red List of Threatened Species based on its small EOO, fragmented distribution, rapid decline in distribution and abundance, small population size, and small effective population size. All of these parameters are expected to continue to worsen as the causes are ongoing and unlikely to be reversed in the foreseeable future (De Jong and Butynski 2020, 2021).

The ultimate threat to *Erythrocebus*, and to the other primates in Tanzania and Kenya, is the rapidly growing human population, which is doubling about every 25–30 years. The main proximate threats are the widespread unsustainable exploitation of natural resources by humans,

primarily due to agricultural expansion and intensification (both crops and livestock), charcoal production, fire, and development activities (settlements, roads, dams, power-lines), which have resulted in widespread habitat degradation, loss, and fragmentation, and extreme declines in wildlife populations (Homewood *et al.* 2001, Makacha and Sirolli 2005, BurnSilver *et al.* 2008, Ogutu *et al.* 2014, 2016, Loishooki *et al.* 2016).

Throughout the historic range of *E. baumstarki*, *A. drepanolobium* woodlands continue to rapidly disappear due to over-use by livestock and conversion to cropland. Other major concerns are competition with people and livestock for habitat and water, particularly during droughts, hunting by poachers and domestic dogs (*Canis familiaris*), climate change, and loss of genetic variation. Although these threats apply mostly to regions outside protected areas, pastoralists now move livestock illegally into the protected areas that support *E. baumstarki* (African BioServices 2019, Veldhuis *et al.* 2019).

Poaching, primarily through the use of wire snares, is a widespread and serious problem in western Serengeti (Loibooki *et al.* 2002, Holmern *et al.* 2007, Nyahongo *et al.* 2009), the region where the remaining *E. baumstarki* population occurs, and on ranches that border the Maasai-Mara National Reserve (Ogutu *et al.* 2011, 2016). Although *E. baumstarki* is not a target species for poachers, it is likely that some individuals are captured in snares (Makacha and Sirolli 2005, Loishooki *et al.* 2016, De Jong and Butynski 2020, 2021). This monkey is probably hunted in retaliation for raiding crops. The meat is eaten and the pelt used in traditional ceremonies and witchcraft (Makacha and Sirolli 2005, Loishooki *et al.* 2016).

Patas monkeys require perennial sources of drinking water (Chism and Rowell 1988, Isbell and Chism 2007, De Jong *et al.* 2008). The all-day presence of herders and livestock at increasingly scarce sources of water appears to be a serious problem for *E. baumstarki*, particularly because of the attacks by herders and dogs.

Although data are lacking, it is likely that *E. baumstarki* experiences increased exposure to parasites and diseases at water sources as they

wait, forage, and drink in an environment that is densely populated by humans and livestock. Data are also lacking on the impacts of climate change and loss of genetic diversity. Although it seems inevitable that these impacts are negative, they pale against the more immediate threats posed by human population growth and the related degradation, loss, and fragmentation of *A. drepanolobium* woodlands and water sources.

Erythrocebus baumstarki has never been the focus of conservation activities and no conservation actions are planned to secure the long-term survival of this charismatic species. Indeed, with fewer than 200 individuals remaining in the wild, an EOO of only about 2,150 km², and the absence of focused conservation actions, it appears that *E. baumstarki* will be among the first primate extinctions for continental Africa in historic times.

De Jong and Butynski (2021) recommended the following conservation actions for *E. baumstarki*: (1) Establish a network of people who will help locate all groups and then closely monitor group size and age/sex composition, home ranges, and threats; (2) Conduct detailed surveys every two years to re-assess geographic distribution, abundance, population structure, conservation status, and threats; (3) Undertake a detailed, long-term, ecological and behavioral study; (4) Implement molecular research projects to assess the level of genomic erosion; (5) Establish dedicated, reliable, wildlife water sources where *E. baumstarki* occurs; (6) Stop poaching and illegal livestock grazing, and keep domestic dogs out of the protected areas; (7) Study and monitor the impacts of browsing on *A. drepanolobium* by livestock, Savanna Elephant (*Loxodonta africana*), Black Rhinoceros (*Diceros bicornis*), and Rothschild's Giraffe (*Giraffe camelopardalis*), and assess how this affects *E. baumstarki*; (8) Bring the plight of *E. baumstarki* to wide national and international attention; and (9) Produce an 'Erythrocebus baumstarki Conservation Action Plan' and ensure that this plan is implemented by those authorities responsible for the conservation of Tanzania's biodiversity.

African BioServices (2019). Serengeti Squeeze – Interactive Maps. Available online: <https://arccg.is/0851br>.

- BurnSilver, S.B., Worden, J. and Boone, R.B. (2008). Processes of fragmentation in the Amboseli Ecosystem, southern Kajiado District, Kenya. In: K.A. Galvin, R.S. Reid, R.H. Behnke Jr. and N.T. Hobbs (eds.), *Fragmentation in Semi-arid and Arid Landscapes: Consequences for Human and Natural Systems*, pp. 225–253. Dordrecht, Germany: Springer.
- Chism, J. and Rowell, T.E. (1988). The natural history of patas monkeys. In: A. Gautier-Hion, F. Bourlière, J.P. Gautier and J. Kingdon (eds.), *A Primate Radiation: Evolutionary Biology of the African Guenons* (pp. 412–438). Cambridge, UK: Cambridge University Press.
- De Jong, Y.A. and Butynski, T.M. (2020). *Erythrocebus baumstarki*. The IUCN Red List of Threatened Species 2020: e.T92252436A92252442.
- De Jong, Y.A. and Butynski, T.M. (2021). Is the southern patas monkey *Erythrocebus baumstarki* Africa's next primate extinction? Reassessing taxonomy, distribution, abundance, and conservation. *Am. J. Primatol.* e23316. 10.1002/ajp.23316.
- De Jong, Y.A., Butynski, T.M. and Nekaris, K.A.-I. (2008). Distribution and conservation of the patas monkey *Erythrocebus patas* in Kenya. *J. East Afr. Nat. Hist.* 97: 83–102.
- De Jong, Y.A., Butynski, T.M., Isbell, L.A. and Lewis, C. (2009). Historic and current distribution of the southern patas monkey *Erythrocebus patas baumstarki* in Tanzania. *Oryx* 43: 267–274.
- De Jong, Y.A., Rylands, A.B. and Butynski, T.M. (2020). *Erythrocebus patas*. The IUCN Red List of Threatened Species 2020: e.T174391079A17940998.
- Elliot, D.G. (1913). *A Review of the Primates. Volume 3: Anthropeidea (Miopithecus to Pan)*. Monograph Series. New York, USA: American Museum of Natural History.
- Gippoliti, S. (2017). On the taxonomy of *Erythrocebus* with a re-evaluation of *Erythrocebus poliophaeus* (Reichenbach, 1862) from the Blue Nile region of Sudan and Ethiopia. *Primate Conserv.* (31): 53–59.
- Hall, K.R.L. (1965). Behavior and ecology of the wild patas monkey (*Erythrocebus patas*) in Uganda. *J. Zool.* 148: 15–87.
- Holmern, T., Muya, J. and Røskaft, E. (2007). Local law enforcement and illegal bushmeat hunting outside the Serengeti National Park, Tanzania. *Environ. Conserv.* 34: 55–63.
- Homewood, K., Lambin, E.F., Coast, E., Kariuki, A., Kikula, I., Kivelia, J., Said, M., Serneels, S. and Thompson, M. (2001). Long-term changes in Serengeti-Mara wildebeest and land cover: pastoralism, population, or policies. *PNAS* 98: 12544–12549.
- Isbell, L.A. (1998). Diet for a small primate: Insectivory and gummivory in the (large) patas monkey (*Erythrocebus patas pyrrhonotus*). *Am. J. Primatol.* 45: 381–398.
- Isbell, L.A. (2013). *Erythrocebus patas* Patas Monkey (Hussar Monkey, Nisnas Monkey, nisnas). In: T.M. Butynski, J. Kingdon and J. Kalina (eds.), *Mammals of Africa. Volume II: Primates*, pp. 257–264. London, UK: Bloomsbury Publishing.
- Isbell, L.A. and Chism, J. (2007). Distribution and abundance of patas monkeys (*Erythrocebus patas*) in Laikipia, Kenya, 1979–2004. *Am. J. Primatol.* 69: 1223–1235.
- Loibooki, M., Hofer, H., Campbell, K.L.I. and East, M.L. (2002). Bushmeat hunting by communities adjacent to

- the Serengeti National Park, Tanzania: The importance of livestock ownership and alternative sources of protein and income. *Environ. Conserv.* 29: 391–398.
- Loishooki, A.G., Kihwele, E.S., Nasari, D.S. and Mafuru, G. (2016). Assessment of Distribution and Conservation Mitigations of the Patas Monkey (*Erythrocebus patas*) in Serengeti Ecosystem. Unpublished report by the Unit of Ecological Monitoring, Tanzania National Parks, Arusha, Tanzania.
- Makacha, S. and Sirolli, A. (2005). Status and Distribution of Ikoma Patas Monkeys *Cercopithecus (Erythrocebus) patas baumstarki* in the Serengeti National Park. Unpublished report by the Serengeti Biodiversity Project, Arusha, Tanzania.
- Nyahongo, J.W., Holmern, T., Kaltenborn, B.P. and Røskaft, E. (2009). Spatial and temporal variation in meat and fish consumption among people in the western Serengeti, Tanzania: The importance of migratory herbivores. *Oryx* 43: 258–266.
- Ogutu, J.O., Owen-Smith, N., Piepho, H.-P. and Said, M.Y. (2011). Continuing wildlife population declines and range contraction in the Mara region of Kenya during 1977–2009. *J. Zool., Lond.* 285: 99–109.
- Ogutu, J.O., Reid, R.O., Piepho, H.-P., Hobbs, N.T., Rainy, M.E., Kruska, R.L., Worden, J.S. and Nyambenge, M. (2014). Large herbivore responses to surface water and land use in an East African savanna: Implications for conservation and human-wildlife conflict. *Biodiv. Conserv.* 23: 573–596.
- Ogutu, J.O., Piepho, H.-P., Said, M.Y., Ojwang, G.O., Njino, L.W., Kifugo, S.C. and Wargute, P.W. (2016). Extreme wildlife declines and concurrent increases in livestock numbers in Kenya: What are the causes? *PLoS One* 11: e0163249.
- Veldhuis, M.P., Ritchie, M.E., Ogutu, J.O., Morrison, T.A., Beale, C.M., Estes, A.B., Mwakilema, W., Ojwang, G.O., Parr, C.L., Probert, J., Wargute, P.W., Hopcraft, J.G.C. and Olff, H. (2019a). Cross-boundary human impacts compromise the Serengeti-Mara Ecosystem. *Science* 363: 1424–1428.

AFRICA



ROLOWAY MONKEY

Cercopithecus roloway (Schreber, 1774)

Côte d'Ivoire, Ghana
(2002, 2006–2022)

Sery Gonedelé Bi, Andrea Dempsey, Inza Koné, W. Scott McGraw and John F. Oates

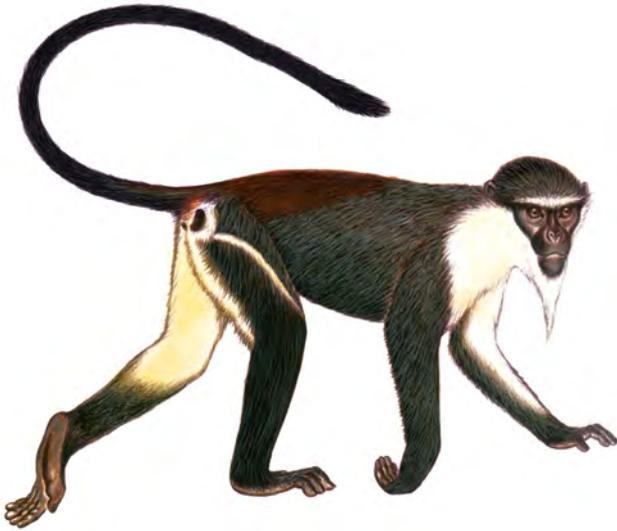
Cercopithecus roloway and its close relative *Cercopithecus diana* are very attractive, arboreal monkeys that inhabit the Upper Guinean forests of West Africa. The Roloway Monkey, which once occurred in many of the southern forests of Ghana and south-central and south-eastern Côte d'Ivoire, is distinguished from the Diana Monkey by its broad white brow line, long white beard, and yellow thighs. Because individuals with intermediate coat patterns are known from near the Sassandra River in Côte d'Ivoire, some scientists treat *roloway* and *diana* as subspecies of one species, *C. diana* (for example, Oates 2011). Of the two species, *roloway* is the more seriously threatened, and it is now classified as Critically Endangered on the IUCN Red List of Threatened Species (Koné et al. 2019).

Roloway Monkeys are upper-canopy specialists that prefer undisturbed forests. Destruction and degradation of their forest habitat due to illegal lumbering and clearing for agriculture and mining, together with relentless hunting for the bushmeat trade over many years, have reduced their population to small, isolated pockets. Miss Waldron's Red Colobus (*Piliocolobus waldroni*) once inhabited many of the same forests as the *roloway* but is now almost certainly extinct (Oates 2011). Despite existing conservation efforts, there is a strong possibility that the *roloway* monkey will also disappear in the near future.

Ghana is experiencing a 2% rate of annual deforestation and forest degradation, which translates into approximately 135,000 ha/year of forest cover loss due to anthropogenic causes (Kyere-Boateng et al. 2021). A main driver of forest cover loss is agricultural conversion. In the high forest zone, close to 110,000 ha of forest were

converted to agricultural land annually between 2000 and 2015 (O'Sullivan et al. 2018); conversion to cocoa production, in particular, accounted for 54.6% and 77.8% of closed and open forest loss, respectively (Benefoh et al. 2018). Hunting has very likely been the major cause of the crash in *roloway* populations. Wild meat is a major food source for Ghanaians, with an estimated 80% of the rural population dependent on it as their main source of animal protein (Trench 2000, Dempsey 2014). Any conservation measures to secure the future of the Roloway Monkey in Ghana must, therefore, consider the socio-economic needs of the local people and address them using an inclusive and sustainable model.

Surveys undertaken in Ghana in the early 2000's have failed to confirm the presence of Roloway Monkeys in many reserves, including the Ankasa Conservation Area, Bia National Park, Krokosua Hills Forest Reserve, Subri River Forest Reserve, Dadieso Forest Reserve, Atewa Range Forest Reserve, and Tano Offin Forest Reserve (Oates 2006, Gatti 2010, Buzzard and Parker 2012, Wiafe 2013, 2021). The only two localities in Ghana where Roloway Monkeys have been recorded by scientists or conservationists in the last decade are the community-owned forest along the Tano River (referred to as the "Ankasa-Tano Community Rain Forest") and the Cape Three Points Forest Reserve, in the southwest of the country. The Ankasa-Tano Community Rainforest consists of patches of swamp forest along the lower Tano River, adjacent to the Tanoé-Ehy forest in Côte d'Ivoire. Surveys of these forests have been conducted since 2011 under the auspices of West African Primate Conservation Action (WAPCA), a non-government organization, and several sightings of Roloway groups have



been made, along with Mona Monkeys, Spotted Monkeys, White-naped Mangabeys and Olive Colobus (WAPCA 2014, Dempsey 2014, Osei et al. 2015). WAPCA, with support from Noè, the Critical Ecosystem Partnership Fund, the French Development Agency, the Sofi Tucker Foundation and IUCN's Programme de Petites Initiatives, has supported a community-based conservation project with communities around these forests, establishing an Ankasa-Tano Community Resource Management Area (CREMA), which works to protect the forest through the sustainable management of natural resources. In 2018, a survey of the Cape Three Points Forest Reserve recorded a single sighting of *C. roloway* and, since 2019, WAPCA has been working with the local communities and government to replicate the methodologies which were successfully implemented around the Ankasa-Tano Community Rainforest. Future conservation action should be focused around Ankasa-Tano CREMA, supporting patrols, reforestation and the effective running of the elected community management committees, as well as developing additional income revenues (e.g., from palm oil and cassava), in order to complement existing organic cocoa and coconut oil businesses. Around Cape Three Point Reserve, similar support is required to maintain the newly elected CREMA, including associated activities such as patrolling, and the development of sustainable and improved community livelihoods (for instance, honey production and ecotourism). WAPCA has an ongoing project to survey the historical range of the Roloway in Ghana, and assess their distribution and abundance more accurately. In the next two years, these surveys should be conducted in Dadieso Forest Reserve, Krokosua Hills Forest Reserve, and Yoyo River Forest Reserve using camera traps and audio recorders, as well as more traditional methods.

The Roloway Monkey's status in neighboring Côte d'Ivoire is also dire. In the late 1990s, Roloway Monkeys were known or strongly suspected to exist in three forests: the Yaya Forest Reserve, the Tanoé-Ehy forest adjacent to the Ehy Lagoon, and Parc National des Îles Ehotilé (McGraw 1998, 2005, Koné and Akpatou 2005, Gonedelé Bi et al. 2013). Surveys of 18 areas between 2004 and 2008 (Gonedelé Bi et al. 2008, 2012) confirmed

the presence of Roloway Monkeys only in the Tanoé forest, suggesting that the Roloway Monkey may have been eliminated from at least two forest areas (Parc National des Îles Ehotilé and Yaya Forest Reserve) in the last dozen years. Subsequent surveys carried out in southern Côte d'Ivoire suggest a handful of Roloway Monkeys may still survive in two forest reserves along the country's coast. In June 2011, Gonedelé Bi observed one Roloway individual in the Dassioko Sud Forest Reserve (Bitty *et al.* 2013, Gonedelé Bi *et al.* 2014). In 2012, Gonedelé Bi and A.E. Bitty observed Roloway Monkeys in Port Gauthier Forest Reserve, and in October 2013, Gonedelé Bi obtained photographs of monkeys poached inside this reserve, including an image purported to be a Roloway. The beard on this individual appears short for a Roloway, raising the possibility that surviving individuals in this portion of the interfluvial region may in fact be hybrids. In any case, no sightings of Roloway Monkeys have been made in the Dassioko Sud or Port Gauthier forest reserves since 2012. These reserves are described as coastal evergreen forests, and both are heavily degraded due to a large influx of farmers and hunters from the north of the country (Bitty *et al.* 2013). Gonedelé Bi and colleagues, in cooperation with Société de Développement des Forêts (SODEFOR) and local communities, have organized regular surveys aimed at removing illegal farmers and hunters from both reserves. However, surveys made in August 2015 revealed that a logging company (Société Industrielle de Bois et Débités) had begun clearing a portion of the Port Gauthier Reserve. A recent recce survey conducted by Lezou in September 2021 indicated that the situation has become more dire. During this survey, no primates were observed, poaching signs inside the reserve were high (1.46 signs per km), and traditional hunters (Dozo) were acting as a military force inside the reserve (Lezou 2021).

Thus, the only forest in Côte d'Ivoire where Roloway Monkeys are confirmed to still exist is the Tanoé-Ehy forest adjacent to the Ehy Lagoon, and immediately across the Tano River from the Ankasa-Tano Community Rainforest in Ghana. This wet forest also harbors one of the few remaining populations of White-naped Mangabeys (*Cercocebus lunulatus*) and White-thighed Black-and-white Colobus (*Colobus*

vellerosus) in Côte d'Ivoire. An intensive camera trapping campaign in the Tanoé-Ehy Forest initiated to 'rediscover' Miss Waldron's Red Colobus began in late 2019. This initiative, supported by Re:wild, has yielded videos and photographs of Roloways, White-naped Mangabeys, White-thighed Black-and-white Colobus, but not Miss Waldron's Red Colobus, together with other arboreal vertebrates, including the Tree Pangolin (*Phataginus tricuspis*). Efforts led by I. Koné involving several organizations, including the NGOs West African Primate Conservation Action (WAPCA), Action pour la Conservation de la Biodiversité en Côte d'Ivoire (ABC-CI), Mulhouse Zoo, and SOS Forêts, helped stop a large palm oil company from causing further habitat degradation, and a community-based conservation program initiated in 2006 has helped reduce poaching in this forest (Koné 2015). Thanks to continued efforts of communities supported by the Centre Suisse de Recherches Scientifiques (CSRS) and various partners including the Association Française des Parc Zoologique (AFdPZ), WAPCA, Parcs de Noé, the Critical Ecosystem Partnership Fund (CEPF), Rainforest Trust, and Re:wild, the Tanoé-Ehy forest was recently officially designated as a community reserve, the first of its kind in Côte d'Ivoire. Hunting and chainsaw milling still occur in that forest, posing serious threats to the survival of its primate populations. Water pollution linked to gold mining at the periphery of the Tanoé-Ehy Forest represents an emerging threat. In 2021, the CSRS and several partners succeeded in stopping the launch of a gold mining project at the north-western periphery of the Tanoé-Ehy forest (Koné *et al.* 2021).

As the potential last refuge for Roloway Monkeys and one of the last refuges for White-naped Mangabeys and White-thighed Black-and-white Colobus, the protection of the Tanoé-Ehy Forest in Côte d'Ivoire and the adjacent Ankasa-Tano Community Rain Forest in Ghana should be the highest conservation priority. By any measure, the Roloway Monkey must be considered one of the most Critically Endangered monkeys in Africa and is evidently on the verge of extinction (Oates 2011). In addition, the captive population is now so small that extinction in captivity is also a strong possibility (Lefaux and Montjardet 2016).

- Benefoh, D.T., Villamorvan Noordwijk, M., Borgemeister, C., Asante, W.A. and Asubonteng, K.O. (2018). Assessing land-use typologies and change intensities in a structurally complex Ghanaian cocoa landscape. *Appl. Geogr.* 99: 109–119.
- Bitty, E.A., Gonedelé Bi, S. and McGraw, W.S. (2013). Accelerating deforestation and hunting in protected reserves jeopardize primates in southern Côte d'Ivoire. *Am. J. Phys. Anthropol. Suppl.* 56: 81–82.
- Buzzard, P.J. and Parker, A.J.A. (2012). Surveys from the Subri River Forest Reserve, Ghana. *Afr. Primates*. 7: 175–183.
- Dempsey, A. (2014). Save Our Forest, Save Our Future: A Survey of the Tanoé-Ankasa Community-owned Forest for Primate Presence and Illegal Activity, Introducing SMART Technology. Master's thesis, Oxford Brookes University, Oxford, England.
- Gatti, S. (2010). Status of Primate Populations in Protected Areas Targeted Under the Community Forest Biodiversity Project. CFBP Report, West African Primate Conservation and Ghana Wildlife Division/Forestry Commission, Accra, Ghana. Available online <<http://www.primates-ug.org/ghana-unpublished-reports/>>.
- Gonedelé Bi, S., Koné, I., Béné, J.-C.K., Bitty, A.E., Akpatou, B.K., Goné Bi, Z., Ouattara, K. and Koffi, D.A. (2008). Tanoé forest, south-eastern Côte d'Ivoire identified as a high priority site for the conservation of Critically Endangered primates in West Africa. *Trop. Conserv. Sci.* 1: 265–278.
- Gonedelé Bi, S., Koné, I., Bitty, A.E., Béné, J.-C.K., Akpatou, B. and Zinner, D. (2012). Distribution and conservation status of catarrhine primates in Côte d'Ivoire (West Africa). *Folia Primatol.* 83: 11–23.
- Gonedelé Bi, S., Béné, J.-C.K., Bitty, A.E., N'Guessan, A., Koffi, A.D., Akpatou, B. and Koné, I. (2013). Roloway guenon (*Cercopithecus diana roloway*) and white-naped mangabey (*Cercocebus atys lunulatus*) prefer mangrove habitats in Tanoé Forest, southeastern Ivory Coast. *J. Ecosystem. Ecography*. 3: 126.
- Gonedelé Bi, S., Bitty, E.A. and McGraw, W.S. (2014). Conservation of threatened primates in Dassioko Sud and Port Gauthier forest reserves: use of field patrols to assess primate abundance and illegal human activities. *Am. J. Phys. Anthropol. Suppl.* 58: 127. (Abstract)
- Koné, I. (2015). Community empowerment for the conservation of Critically Endangered primates and their habitat in south-eastern Côte d'Ivoire. In: The IUCN Programme for African Protected Areas & Conservation (ed.), *Community Empowerment for the Conservation of Critically Endangered Primates and Their Habitat in South-eastern Côte d'Ivoire. Twenty-two Stories of Conservation in Africa: Key Elements for Effective and Well-Governed Protected Areas in Sub-Saharan Africa*, pp. 36–39. IUCN Programme for African Protected Areas & Conservation (PAPACO).
- Koné, I. and Akpatou, B.K. (2005). Recherche en Côte d'Ivoire de trois singes gravement menacés d'extinction. *CEPA Magazine* 12: 11–13.
- Koné, I., Oates, J.F., Dempsey, A., Gonedelé Bi, S., McGraw, S. and Wiafe, E. (2019). *Cercopithecus roloway*. The IUCN Red List of Threatened Species 2019: e.T4232A92384429.
- Koné, I., Koffi, D.A., and Bogui, E.B. (2021). The Tanoé-Ehy Forest Conservation Programme, Côte d'Ivoire: Research and Actions for the Community-based Conservation of Critically Endangered Primates and their habitat. 2018–2020 Activity report. Abidjan: Centre Suisse de Recherches Scientifiques (CSRS).
- Kyere-Boateng, R., Marek, M.V., Huba, M. and Kluvankova, T. (2021). Perceived injustices in forest policy interventions are causes of forest resources degradation and loss in Ghana: a review. *Open J. For.* 11: 171–191.
- Lefaux, B. and Montjardet, L. (2016). *7th European Roloway Monkey Studbook (Cercopithecus roloway)*. Edited by Mulhouse Zoological and Botanical Park, Mulhouse, France.
- Lezou, D.P.A. (2021). Inventaire des primates et des menaces dans la forêt classée de Dassioko sud, Côte d'Ivoire. Master's dissertation, Université Félix Houphouët Boigny, Abidjan, Côte d'Ivoire.
- McGraw, W.S. (1998). Surveys of endangered primates in the forest reserves of eastern Côte d'Ivoire. *Afr. Primates*. 3: 22–25.
- McGraw, W.S. (2005). Update on the search for Miss Waldron's red colobus monkey (*Procolobus badius waldroni*). *Int. J. Primatol.* 26: 605–619.
- Oates, J.F. (2006). *Primate Conservation in the Forests of Western Ghana: Field Survey Results, 2005–2006*. Ghana: Wildlife Division, Forestry Commission.
- Oates, J.F. (2011). *Primates of West Africa: A Field Guide and Natural History*. Arlington, VA: Conservation International.
- Osei, D., Horwich, R.H. and Pittman, J.M. (2015). First sightings of the roloway monkey (*Cercopithecus diana roloway*) in Ghana in ten years and the status of other endangered primates in southwestern Ghana. *Afr. Primates* 10: 25–40.
- O'Sullivan, R., Roth, M., Antwi, Y.A., Ramirez, P. and Sommerville, M. (2018). Land and Tree Tenure Innovations for Financing Smallholder Cocoa Rehabilitation in Ghana. Presentation at the 2018 World Bank Conference on Land and Poverty, Washington DC, 19–23 March 2018.
- Trench, P. (2000). The many faces of community wildlife management in Central and West Africa. In: J. Abbott, F.G. Ananze, N. Barning, P. Burnham, E. de Merode, A. Dunn, E. Fuchi, E. Hakizumwami, C. Hesse, R. Mwinyihali, M. Mahaman Sani, D. Thomas, P. Trench, and R. Tshombe (eds.), *Promoting Partnerships: Managing Wildlife Resources in Central and West Africa*, pp. 9–49. London, UK: International Institute for Environment and Development (IIED) Publications.
- WAPCA (2014). *Annual Report*. Accra, Ghana: West African Primate Conservation Action (WAPCA).
- Wiafe, E.D. (2013). Status of the Critically Endangered roloway monkey (*Cercopithecus diana roloway*) in the Dadieso Forest Reserve, Ghana. *Afr. Primates* 8: 9–15.
- Wiafe, E.D. (2021). Distribution and population density of endangered primate species in Ghana's forest reserves. *Forestist* 71(3): 238–247. doi.10.5152/forestist.2021.20040

AFRICA



NIGER DELTA RED COLOBUS

Piliocolobus epieni (Grubb and Powell, 1999)

Nigeria
(2008, 2010, 2016, 2018, 2022)

Rachel Ashegbofe Ikemeh, John F. Oates and Tukur Seibokuro

The Niger Delta Red Colobus (*Piliocolobus epieni*) is endemic to the marsh forests in the central part of the Niger Delta of Nigeria (Oates 2011). Its species name is derived from its name in the language of the Ijaw people who inhabit the limited area of about 1,500 km² in Bayelsa State where it occurs. *Piliocolobus epieni* only became known to science in 1993, in the course of a biodiversity survey co-ordinated by C. Bruce Powell (Blench 2007). Studies of vocalizations and mitochondrial DNA suggest that this population is not closely related to its closest relatives geographically, the Bioko Red Colobus (*Piliocolobus pennantii*) and Preuss's Red Colobus (*Piliocolobus preussi*) of eastern Nigeria and western Cameroon, leading Ting (2008) to treat this monkey not as a subspecies of *P. pennantii* (see Groves 2001, Grubb *et al.* 2003) but as a distinct species. Groves (2007) regarded almost all the different red colobus monkeys, including *epieni*, *pennantii* and *preussi*, as separate species in the genus *Piliocolobus* – a taxonomy that we follow here. The IUCN Red List of Threatened Species has regarded *P. epieni* as Critically Endangered since 2008 (Ikemeh *et al.* 2019).

The marsh forests where the Niger Delta Red Colobus is found have a high water table all year round but do not suffer deep flooding or tidal effects. The most intensive ecological study of this monkey, by Lodjewijk Werre in 1994–1996 suggested that the clumped distribution of food species in the marsh forest is a key factor restricting *P. epieni* to its limited range, which is demarcated by the Forcados River and Bomadi Creek in the northwest, the Sagbama, Osiana and Apoi creeks in the east, and the mangrove belt to the south (Werre 2000). At the time of its discovery

in the mid-1990s, this red colobus was locally common, especially in forests near the town of Gbanraun, but it was beginning to come under intense pressure from degradation of its habitat and commercial hunting. Important colobus food trees, especially *Fleroya ledermannii*, were being felled at a high rate by artisanal loggers, and the logs were floated out of the delta on rafts to processing centers in Lagos and elsewhere. In addition, large canals dug as part of oil extraction activities, as well as smaller canals dug by loggers into the interior swamps, were changing local hydrology (Werre and Powell 1997, Grubb and Powell 1999). The Ijaw people are traditionally fishermen, but outside influences introduced by the oil industry have encouraged commercial bushmeat hunting and logging throughout the Niger Delta.

The most recent range-wide assessment of *P. epieni*, conducted in 2013, suggests that as a result of habitat destruction and hunting the population has declined significantly since the 1990s, and that it may now be around 90% lower than estimated 25 years ago (Ikemeh 2015). In the 2013 survey, the presence of *P. epieni* was confirmed only in four forest areas, and it was considered extirpated from 11 other forests where it had been reported in the 1990s by Werre (2000). Cumulative survey data indicate that the current number of individuals surviving in the wild may be only a few hundred (Ikemeh 2015). Insecurity in the region and the consequences of poor governance, amongst other factors, have exacerbated the major threats of habitat degradation and commercial hunting. Because red colobus monkeys are known to be sensitive to habitat disturbance and hunting in other parts of Africa (Struhsaker 2005), it is feared that the



Niger Delta Red Colobus, with its very restricted range, is at high risk of extinction.

The red colobus monkeys are probably more threatened than any other taxonomic group of primates in Africa (Oates 1996, Struhsaker 2005). *Piliocolobus preussi* (western Cameroon and eastern Nigeria), *Piliocolobus pennantii* (Bioko Island, Equatorial Guinea) and *Piliocolobus rufomitratu*s (Tana River, Kenya) are all regarded as Critically Endangered from different combinations of habitat loss and hunting, while *Piliocolobus waldroni* (eastern Côte d'Ivoire and western Ghana) may already be extinct (Oates 2011).

The Niger Delta Red Colobus shares its marsh forest habitat with two other threatened primates; the Nigerian White-throated Guenon (*Cercopithecus erythrogaster pococki*) and the Red-capped Mangabey (*Cercocebus torquatus*) (Ikemeh 2015). Also found in these forests are the Putty-nosed Monkey (*Cercopithecus nictitans*), the Mona Monkey (*Cercopithecus mona*) and the Olive Colobus (*Procolobus verus*) (Efenakpo et al. 2018). However, political instability in the delta, related in the most part to disputes over the allocation of oil revenues, has hindered progress in biodiversity conservation during the last decade (Ikemeh 2015).

The two most important remaining areas for *P. epieni* conservation have been identified as the Apoi Creek Forests, flanked by the communities of Gbanraun, Apoi and Kokologbene, and forests near Kolotoro (Ikemeh 2015). However, in the absence of conservation intervention, the Otolokolotoro-Ongoloba area has been devastated by excessive logging, driving the population in that area to the edge of extinction. In 2021, a community-based conservation area was established covering 1,109 ha in Apoi Creek Forest. This area is under the customary authority of the Apoi community, and protects 150–300 Niger Delta Red Colobus Monkeys, possibly the most significant population anywhere. The effort to create a community conservancy has been coordinated by a local conservation group – the Southwest Niger Delta Forest Project. Further priority actions needed to secure the survival of this species include establishing appropriate laws at the state and national level to protect the species

and its habitat and conducting new surveys to identify sites where other viable populations still exist and where additional protected areas might be created. Finally, efforts need to continue to increase local level awareness on the ecological importance of the species and its habitat.

- Blench, R. (2007). *Mammals of the Niger Delta, Nigeria*. Port Harcourt, Nigeria: Kay Williamson Education Foundation.
- Efenakpo, O., Ijeomah, H. and Ayodele, A.I. (2018). *Threat and Conservation of Wildlife Resources in Niger Delta Region of Nigeria*. In: *Proceedings of 2nd Wildlife Society of Nigeria conference, Akure, Nigeria* (pp. 259–267). Akure, Nigeria.
- Groves, C.P. (2001). *Primate Taxonomy*. Washington, DC: Smithsonian Institution Press.
- Groves, C.P. (2007). The taxonomic diversity of the Colobinae of Africa. *J. Anthropol. Sci.* 85: 7–34.
- Grubb, P. and Powell, C.B. (1999). Discovery of red colobus monkeys (*Procolobus badius*) in the Niger delta with the description of a new and geographically isolated subspecies. *J. Zool., Lond.* 248: 67–73.
- Grubb, P., Butynski, T.M., Oates, J.F., Bearder, S.K., Disotell, T.R., Groves, C.P. and Struhsaker, T.T. (2003). Assessment of the diversity of African primates. *Int. J. Primatol.* 24(6): 1301–1357.
- Ikemeh, R.A. (2015). Assessing the population status of the Critically Endangered Niger Delta Red Colobus (*Piliocolobus epieni*). *Primate Conserv.* (29): 1–10.
- Ikemeh, R.A., Oates, J.F. and Inaoyom, I. (2019). *Piliocolobus epieni*. The IUCN Red List of Threatened Species 2019: e.T41024A92656391.
- Oates J.F. (1996). *African Primates: Status Survey and Conservation Action Plan*. Revised Edition. Washington, D.C.: IUCN/SSC Primate Specialist Group.
- Oates, J.F. (2011). *Primates of West Africa: A Field Guide and Natural History*. Arlington, VA: Conservation International.
- Struhsaker, T.T. Conservation of red colobus and their habitats. *Int. J. Primatol.* 26: 525–538.
- Ting, N. (2008). *Molecular Systematics of Red Colobus Monkeys (Procolobus [Piliocolobus]): Understanding the Evolution of an Endangered Primate*. Doctoral dissertation, City University of New York, New York, NY.
- Werre, J.L.R. (2000). *Ecology and Behavior of the Niger Delta Red Colobus Monkey (Procolobus badius epieni)*. Doctoral dissertation, City University of New York, New York, NY.
- Werre, J.L.R. and Powell, C.B. (1997). The Niger Delta colobus – discovered in 1993 and now in danger of extinction. *Oryx* 31: 7–9.

AFRICA

© Ekwoge Abwe



NIGERIA-CAMEROON CHIMPANZEE

Pan troglodytes ellioti (Matschie, 1914)

Cameroon, Nigeria
(2022)

Ekwoke Abwe, Osiris Doumbé, Paul Dutton, Chefor Fotang, Mary K. Gonder, Rachel Ashegbofe Ikemeh, Inaoyom Imong, Serge A. Kamgang, Bethan J. Morgan and Amadou Ngouh

The Nigeria-Cameroon Chimpanzee (*Pan troglodytes ellioti*), until recently known as *P. t. vellerosus*, ranges from Cameroon, west of the Sanaga River, to Nigeria (Gonder *et al.* 2006, Oates *et al.* 2009). *Pan t. ellioti* has two distinct genetic groups, one associated with lowland and mountainous rainforest in west Cameroon and east Nigeria, and the second with the forest-woodland-savannah mosaic in central Cameroon (Mitchell *et al.* 2015a). It inhabits primary and secondary moist lowland forest, montane and submontane forest, dry forest, gallery forest in savanna woodland, and farmland, and spans an altitudinal range from sea level to 2000 m (Oates 2011, Sesink Clee *et al.* 2015, Abwe *et al.* 2020).

Pan t. ellioti has the smallest geographic range and is the least numerous subspecies of chimpanzee with a total population that is almost certainly less than 9,000 individuals and probably less than 6,000 remaining in the wild (Morgan *et al.* 2011). One of the largest, and probably most secure, subpopulations of *P. t. ellioti* is in Gashaka-Gumti National Park in Nigeria, which has an estimated subpopulation of 900–1,000 individuals (Ogunjemite and Ashimi 2010, Adanu *et al.* 2011). Other major subpopulations are found in Cameroon in the Banyang-Mbo Wildlife Sanctuary (estimated at 500–900 or 800–1,450 individuals, depending on the nest-decay parameters used; Greengrass and Maisels 2007), in the Ebo forest (estimated at 626–1,480 individuals; M.S. Ndimbe and B.J. Morgan pers. comm. 2015), and in Mbam and

Djerem National Park (at least 500 individuals; Kamgang *et al.* 2020). Recent genetic studies especially in the mountainous region along the Nigeria-Cameroon border and south of the Adamawa Plateau in Central Cameroon estimate the current effective population size of *P. t. ellioti* in Cameroon at 3,000–4,500 individuals (Mitchell *et al.* 2015b).

The Nigeria-Cameroon Chimpanzee is classified as Endangered on the IUCN Red List of Threatened Species based on an inferred population size reduction of 50% over a three-generation period from the mid-1980s to 2060 (Oates *et al.* 2016). Within its larger range, *P. t. ellioti* is most seriously threatened in two subregions: southwestern Nigeria and northwestern Cameroon. In each of these subregions, total chimpanzee population numbers are very small (probably less than 250), suitable habitat is highly fragmented, and hunting pressure is intense, and population declines exceeding 80% are likely in the 1985–2060 period (Greengrass 2009, Ikemeh 2013, Fotang *et al.* 2021a). The reduction in *P. t. ellioti* populations is due to increasing anthropogenic pressure exacerbated by human population growth in Cameroon and Nigeria, and linked with poaching (for bushmeat, traditional medicine, and the pet trade) and habitat loss from farming, logging, fire, and commercial plantations (Morgan *et al.* 2011). Analysis of the viability of this subspecies in Cameroon and Nigeria through extinction-risk modeling has shown that the species could become extinct in 2035 if appropriate conservation



measures are not initiated and implemented (Hughes *et al.* 2011). Climate change is expected to further shrink *P. t. ellioti* habitat in the forest-woodland-savannah mosaic over the coming century (Sesink Clee *et al.* 2015). Since 2018, political instability, especially in Cameroon's Northwest and Southwest Regions and along the entire boundary with Nigeria, has stalled research and conservation efforts in the central area of the *P. t. ellioti* range. The proliferation of arms and ammunition and local communities taking refuge in the forest could jeopardize not only fragile chimpanzee communities (Mbembe forest, Kom-Wum Forest Reserve) but also well-established populations, including in Korup National Park and Banyang-Mbo Wildlife Sanctuary. The species has already disappeared from some sites such as the Bafut-Ngamba Forest Reserve, Nkwende Hills (Bobo *et al.* 2013), South Bakundu Forest Reserve (Eno-Nku 2004) in Cameroon and the Ala, Oba Hills and Ogbesse Forest Reserves in Nigeria (Greengrass 2006).

Pan t. ellioti occurs in several important protected areas, including the Gashaka-Gumti National Park, Cross River National Park and Afi Mountain Wildlife Sanctuary in Nigeria, and Mbam and Djerem National Park, Korup National Park, Takamanda National Park, Mount Cameroon National Park, and Banyang-Mbo Wildlife Sanctuary in Cameroon (Morgan *et al.* 2011). More recently, the presence of a viable population of Nigeria-Cameroon chimpanzee was confirmed in Mpem and Djim National Park, in the forest-woodland-savannah mosaic of central Cameroon (O. Doumbé and A. Ngouh unpubl. data 2021). Management effectiveness varies across protected areas; poaching for bushmeat occurs, in most of them, sometimes at high levels. Biological surveys, including non-invasive sample collection efforts for genetic studies throughout much of the subspecies' range in Cameroon, have shown that many chimpanzees still survive outside protected areas (Mitchell *et al.* 2015b). One is the Yabassi Key Biodiversity Area which encompasses the Ebo forest, where chimpanzee and gorilla conservation efforts have been underway since 2005 (Abwe and Morgan 2008). *Pan t. ellioti* also survives in community-managed forests such as the Mbe Mountains in Nigeria.

Like other chimpanzees, *P. t. ellioti* is omnivorous. Fruits (including figs) make up a large proportion of the diet, but leaves, bark, stems and animals are also eaten, especially when fruits are scarce (Dutton and Chapman 2015, Abwe et al. 2020). Tools made from plant parts are used to extract honey and also ants and termites from their nests (Fowler and Sommer 2007, Abwe and Morgan 2008), stone and wooden hammers are used to crack nuts (Morgan and Abwe 2006), and monkeys and other mammals are probably captured for food (Morgan et al. 2012, Abwe et al. 2020). *Pan. t. ellioti* nesting is linked to ecological and environmental factors. They build nests mainly in trees, but ground-nesting is common in several populations (Last and Muh 2013, Abwe and Morgan 2008, Fotang et al. 2021b).

Long-term research and conservation outreach for *P. t. ellioti* are ongoing in Gashaka-Gumti National Park in Nigeria, and Ebo forest and Mbam & Djerem National Park in Cameroon (Sommer et al. 2004, Abwe and Morgan 2008, Morgan et al. 2011). Chimpanzee ecological research with a focus on habitat characterization, feeding and nesting behavior, and population structure and dynamics is key in informing conservation action for populations in and outside protected areas (Morgan et al. 2011). Conservation outreach programs in Cross River National Park, Mbe Mountains, Afi Mountain Wildlife Sanctuary, and Ise forest in Nigeria, and Ebo forest and Mbam & Djerem National Park in Cameroon are designed to ignite community interest in chimpanzee monitoring and conservation through protected area management, chimpanzee guardian clubs in Ebo, and a wildlife center at the three sites, respectively. In addition, inclusive land use planning efforts in Ebo preceded by community participatory mapping envisage conservation units including the nut-cracking chimpanzee population west of the forest, and gorilla-chimpanzee habitat north of the forest.

Abwe, E.E. and Morgan, B.J. (2008). The Ebo forest: four years of preliminary research and conservation of the Nigeria-Cameroon chimpanzee (*Pan troglodytes*). *PanAfrica News* 15(2): 26.

Abwe, E.E., Morgan, B.J., Doudja, R., Kentatchime, F., Mba, F., Dadjo, A., Venditti, D.M., Mitchell, M.W., Fosso, B., Mouna, A. and Fotso, R.C. (2020). Dietary ecology of the

Nigeria-Cameroon chimpanzee (*Pan troglodytes ellioti*). *Int. J. Primatol.* 41(1): 81–104.

Adanu, J., Sommer, V. and Fowler, A. (2011). Hunters, fire, cattle. Conservation challenges in eastern Nigeria, with special reference to chimpanzees. In: V. Sommer and C. Ross (eds.), *Primates of Gashaka: Socioecology and Conservation in Nigeria's Biodiversity Hotspot*, pp. 55–100. New York: Springer.

Bobo, K., Ntumwel, B.C. and Aghomo, F.F.M. (2013). Local perception on wildlife uses and related loss of cultural values around the Nkwende Hills Forest Reserve, south-west Cameroon. *Life Sciences Leaflets*. 5: 1–8.

Dutton, P. and Chapman, H. (2015). Dietary preferences of a submontane population of the rare Nigeria-Cameroon chimpanzee (*Pan troglodytes ellioti*) in Ngel Nyaki Forest Reserve, Nigeria. *Am. J. Primatol.* 77: 86–97.

Fotang, C., Bröring, U., Roos, C., Enoguanbhor, E.C., Abwe, E.E., Dutton, P., Schierack, P., Evaristus Angwafo, T. and Birkhofer, K. (2021a). Human activity and forest degradation threaten populations of the Nigeria-Cameroon chimpanzee (*Pan troglodytes ellioti*) in western Cameroon. *Int. J. Primatol.* 42(1): 105–129.

Fotang, C., Bröring, U., Roos, C., Enoguanbhor, E.C., Dutton, P., Tédonzong, L.R., Yuh, Y.G. and Birkhofer, K. (2021b). Environmental and anthropogenic effects on the nesting patterns of Nigeria-Cameroon chimpanzees in north-west Cameroon. *Am. J. Primatol.* 83(9): e23312.

Eno Nku, M. (2004). Large Mammal Reconnaissance Surveys of Lake Barombi Mbo and Southern Bakundu Forest Reserves, SW Province Cameroon. Limbe, Cameroon: Wildlife Conservation Society.

Gonder, M.K., Disotell, T.R. and Oates, J.F. (2006). New genetic evidence on the evolution of chimpanzee populations, and implications for taxonomy. *Int. J. Primatol.* 27(4): 1103–1127.

Greengrass, E.J. (2006). A Survey of Chimpanzees in South-west Nigeria. Lekki, Nigeria: Nigerian Conservation Foundation and Wildlife Conservation Society.

Greengrass, E.J. (2009). Chimpanzees are close to extinction in southwest Nigeria. *Primate Conserv.* (24): 77–83.

Greengrass, E.J. and Maisels, F. (2007). *Conservation of the Nigerian-Cameroon chimpanzee P. t. vellerosus (and other mammals) in and around the Banyang-Mbo Wildlife Sanctuary, South-west Province, Cameroon*. Yaoundé, Cameroon: Wildlife Conservation Society.

Hughes, N., Rosen, N., Grestky, N. and Sommer, V. (2011). Will the Nigeria-Cameroon chimpanzee go extinct? In: V. Sommer and C. Ross (eds.), *Models Derived from Intake Rates of Ape Sanctuaries*, pp. 545–575. London: Springer.

Ikemeh, R.A. (2013). Population survey of Nigerian-Cameroon chimpanzees (*Pan troglodytes ellioti*) in southwestern Nigerian priority sites: Idanre Forest Cluster and Ise Forest Reserve. *Afr. Primates* 8: 39–50.

Kamgang, S.A., Carne, T.C., Bobo, K.S., Abwe, E.E., Gonder, M.K. and Sinsin, B. (2020). Assessment of *in situ* nest decay rate for chimpanzees (*Pan troglodytes ellioti* Matschie, 1914) in Mbam-Djerem National Park, Cameroon: implications for long-term monitoring. *Primates* 61(2): 189–200.

Last, C. and Muh, B. (2013). Effects of human presence on chimpanzee nest location in the Lebialem-Moné Forest

- landscape, southwest region, Cameroon. *Folia Primatol.* 84(1): 51–63.
- Mitchell, M.W., Locatelli, S., Sesink Clee, P.R., Thomassen, H.A. and Gonder, M.K. (2015a). Environmental variation and rivers govern the structure of chimpanzee genetic diversity in a biodiversity hotspot. *BMC Ecol. Evol.* 15(1): 1. doi 10.1186/s12862-014-0274-0
- Mitchell, M.W., Locatelli, S., Ghobrial, L., Pkempner, A.A., Sesink, P.R., Clee, Abwe, E.E., Nicholas, A., Nkempi, L., Anthony, N.M., Morgan, B.J., Fotso, R., Peeters, M., Hahn, B.H. and Gonder, M.K. (2015b). The population genetics of wild chimpanzees in Cameroon and Nigeria suggests a positive role for selection in the evolution of chimpanzee subspecies. *BMC Ecol. Evol.* 15(1): 3. doi 10.1186/s12862-014-0276-y
- Morgan, B.J. and Abwe, E.E. (2006). Chimpanzees use stone hammers in Cameroon. *Curr. Bio.* 16(16): R632–633.
- Morgan, B., Adeleke, A., Bassey, T., Bergl, R., Dunn, A., Fotso, R., Gadsby, E., Gonder, K., Greengrass, E., Koutou Koulagna, D., Mbah, G., Nicholas, A., Oates, J., Omeni, F., Saidu, Y., Sommer, V., Sunderland-Groves, J., Tiebou, J. and Williamson, E. (2011). *Regional Action Plan for the Conservation of the Nigeria-Cameroon Chimpanzee (Pan troglodytes ellioti)*. IUCN SSC Primate Specialist Group, Gland, Switzerland, and Zoological Society of San Diego, San Diego, CA. 48pp. <www.primates-g.org/NCCAP.pdf>.
- Morgan B.J., Suh, J.N. and Abwe, E.E. (2012) Attempted Predation by Nigeria-Cameroon Chimpanzees (*Pan troglodytes ellioti*) on Preuss's Red Colobus (*Procolobus preussi*) in the Ebo Forest, Cameroon. *Folia Primatol.* 83: 329–331.
- Oates, J.F., Groves, C.P. and Jenkins, P.D. (2009). The type locality of *Pan troglodytes vellerosus* (Gray, 1862), and implications for the nomenclature of West African chimpanzees. *Primates* 50(1): 78–80.
- Oates, J.F. (2011). *Primates of West Africa: A Field Guide and Natural History*. Conservation International, Arlington, Virginia, USA.
- Oates, J.F., Doumbé, O., Dunn, A., Gonder, M.K., Ikemeh, R., Imong, I., Morgan, B.J., Ogunjemite, B. and Sommer, V. (2016). *Pan troglodytes* ssp. *ellioti*. The IUCN Red List of Threatened Species 2016: e.T40014A17990330.
- Ogunjemite, B.G. and Ashimi, T.A. (2010), Hunting and trading in the Nigerian Chimpanzee (*Pan troglodytes vellerosus*) in Gashaka-Mambilla Region, Nigeri., *Ethiopian J. Environ. Stud. Manag.* 3(1): 62–69.
- Sesink Clee, P.R., Abwe, E.E., Ambahe, R.D. Anthony, N.M., Fotso, R., Locatelli, S., Maisels, F. Mitchell, M.W., Morgan, B.J., Pokempner A.A. and Gonder, M.K. (2015). Chimpanzee population structure in Cameroon and Nigeria is associated with habitat variation that may be lost under climate change. *BMC Ecol. Evol.* 15: 2. doi 10.1186/s12862014-0275-z
- Sommer, V., Adanu, J., Faucher, I. and Fowler, A. (2004). Nigerian chimpanzees (*Pan troglodytes vellerosus*) at Gashaka: two years of habituation efforts. *Folia Primatol.* 75(5): 295–316.



Sangihe Tarsier
Tarsius sangirensis

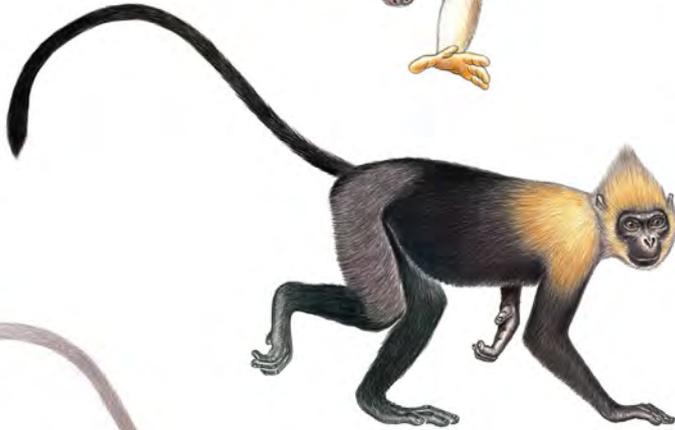
Javan Slow Loris
Nycticebus javanicus



Guizhou Snub-nosed Monkey
Rhinopithecus brelichi

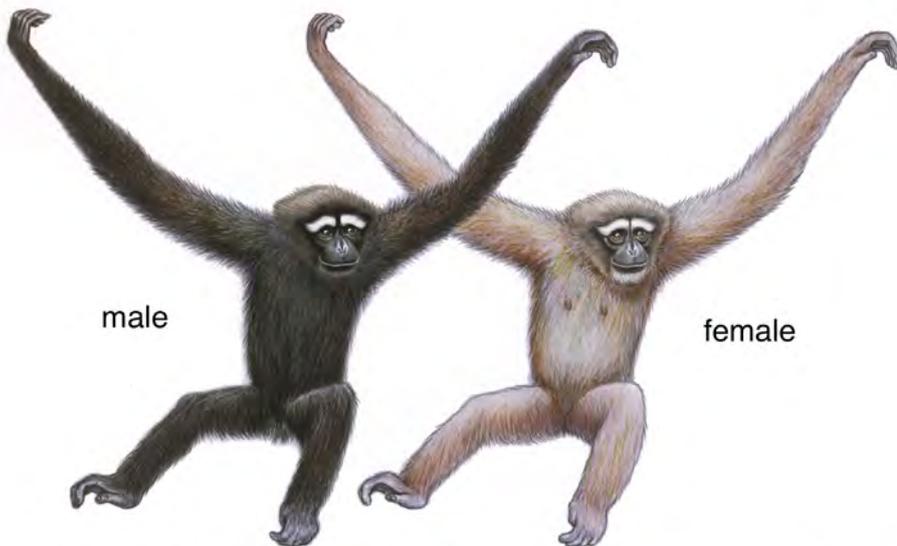


Golden-headed Langur
Trachypithecus poliocephalus



Purple-faced Langur
Semnopithecus vetulus

Raffles' Banded Langur
Presbytis femoralis



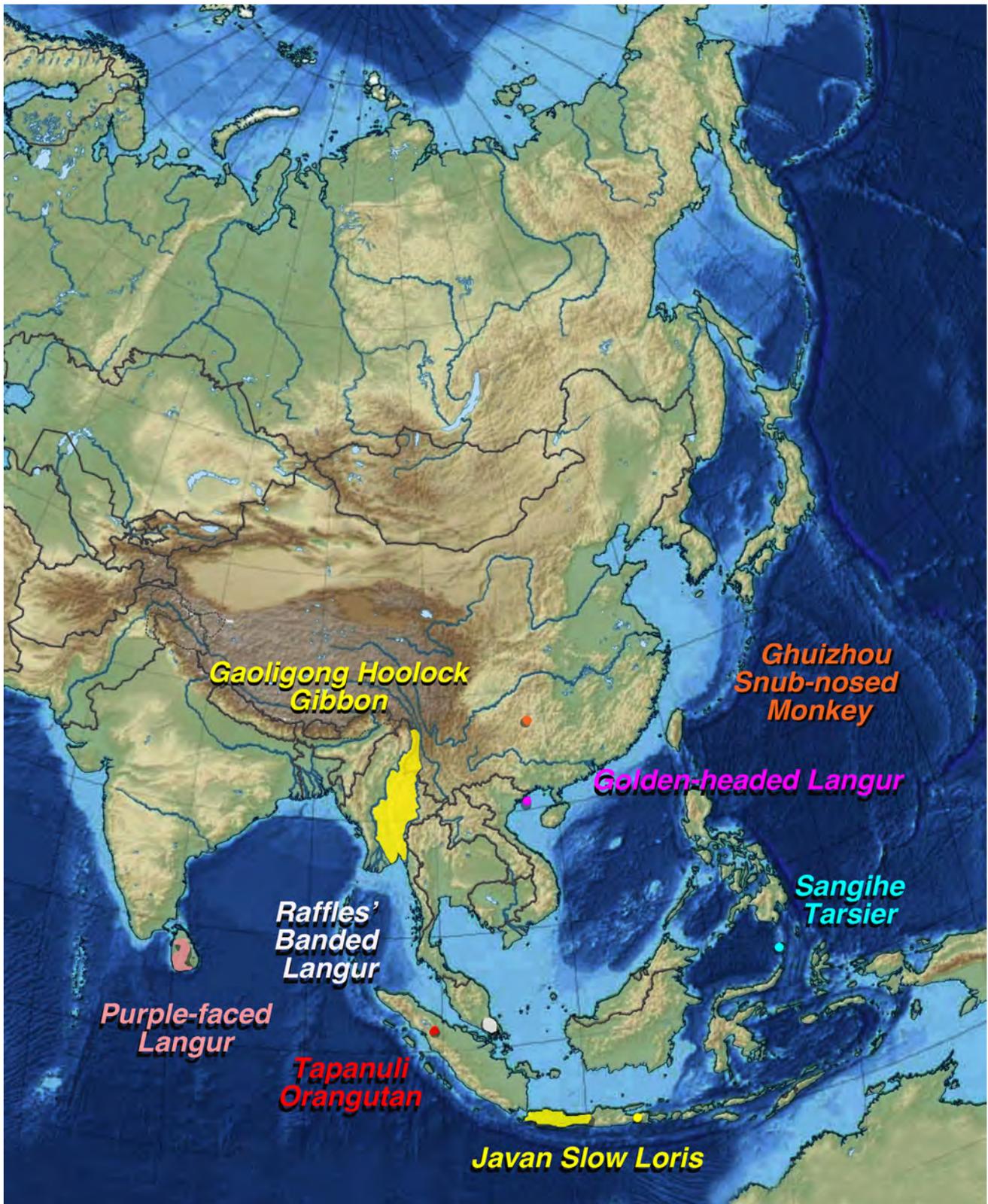
male

female

Gaoligong Hoolock Gibbon
Hoolock tianxing

Tapanuli Orangutan
Pongo tapanuliensis

ASIA



ASIA



JAVAN SLOW LORIS

Nycticebus javanicus É. Geoffroy Saint-Hilaire, 1812

Indonesia
(2008–2018, 2022)

K. Anna I. Nekaris and Vincent Nijman

Habitat loss and habitat degradation throughout Southeast Asia threaten all nine species of slow and pygmy loris with extinction – Pygmy *Xanthonycticebus pygmaeus*, Greater *Nycticebus coucang*, Bengal *N. bengalensis*, Philippine *N. menagensis*, Bornean *N. borneanus*, Kayan *N. kayan*, Sody's *N. bancanus*, Sumatran *N. hilleri*, and Javan *N. javanicus* (Munds *et al.* 2013, Pozzi *et al.* 2014, Rowe and Myers 2016, Nekaris and Nijman 2022). Slow and pygmy lorises exhibit numerous unique traits including slow life history, locomotion and digestion, and the ability to enter torpor and hibernate, and they are the only venomous primates (Nekaris 2014). Still, wild slow lorises have seldom been studied for more than a year (Cambodia *X. pygmaeus*, Starr *et al.* 2011; Malaysia *N. coucang*, Wiens *et al.* 2006; India, *N. bengalensis*, Das *et al.* 2014), with only *N. javanicus* being the focus of a long-term study (Nekaris 2016). Many researchers and conservationists have only ever seen a slow or pygmy loris in the illegal wildlife trade, either dried on bamboo sticks in preparation for traditional medicine, paraded as a photo prop on a tourist beach, or sold as a pet (Schulze and Groves 2004, Das *et al.* 2009, Nijman *et al.* 2015, Osterberg and Nekaris 2015). The extreme popularity of viral slow loris internet videos is a double-edged sword, to some extent making the public aware of their decline, but also causing the public to think that they are not threatened (Nekaris *et al.* 2013a). The level of international trade was sufficiently large for the genus *Nycticebus* (now *Nycticebus* and *Xanthonycticebus*) to be transferred to CITES Appendix I in 2007 (Nekaris and Nijman 2007, 2022), meaning that all commercial international trade is prohibited.

Javan Slow Lorises are listed as Critically Endangered on the IUCN Red List of Threatened Species, thus here we use this species as the flagship for slow and pygmy loris conservation (Nekaris *et al.* 2013b). Since being re-recognized as a species by IUCN in 2006, work on the Javan Slow Loris has increased and provides a sound example of understanding and mitigating the threats to a highly threatened species.

Capture to meet the demand for pets is the most severe threat to the survival of Javan Slow Lorises. Despite being legally protected in Indonesia since 1973, with their striking coloration and their presence on Java, Indonesia's commercial center, it is no wonder that Indonesian pet traders in the 1990s targeted Javan Slow Lorises above other endemic slow loris species. Analysis of slow lorises in the wildlife markets of Java and Bali shows that the overall number openly offered for sale remains fairly constant, but the species composition changed, with fewer Javan Slow Lorises counted (Nijman *et al.* 2017). Traders claim that Javan Slow Lorises are increasingly difficult to obtain and, as with other wildlife, trade has moved from animal markets only, to both animal markets as well as online trade. COVID-19 thus far has had limited effect on the wildlife markets and trade in Javan Slow Lorises; during lockdowns and times of regional travel restrictions the number of visitors and vendors may have dropped temporarily, but in general wildlife markets have remained open.

Successful prosecution of lawbreakers buying or selling slow lorises in Indonesia is a very rare occurrence and despite hundreds of slow lorises having been confiscated from traders over the last decade, we are only aware of a



handful of successful prosecutions (Nekaris and Nijman 2018). Wildlife traders in Indonesia have increasingly turned to social media to advertise their illegal stock, including Javan Slow Lorises. The huge rise in Facebook, Instagram, and WhatsApp means that many are sold via social media without ever being seen in a wildlife market. An ongoing online monitoring program by the Little Fireface Project suggests that dozens of live Javan Slow Lorises are offered for sale in online forums. This monitoring revealed that slow lorises in Indonesia are also traded for medicinal purposes, mainly in the form of slow loris oil, and Javan Slow Lorises are one of three species most affected by this trade (Nekaris *et al.* 2020).

Slow lorises are the only venomous primates and, amongst other functions, use their venom for interspecific competition (Nekaris *et al.* 2020). To avoid being bitten by the venomous slow lorises, traders habitually cut or pull out an animal's lower front teeth prior to selling them (Nekaris *et al.* 2013c). Traders may also cut teeth prior to packing slow lorises tightly into crates, as they often damage each other with their venomous bites during transport. Fuller *et al.* (2018) showed that following confiscations and during rehabilitation, nearly 30% die in the first 6 months, with morbidity from wounds (mainly bites) being the main cause. Other causes of death due to dental removal include dental abscess or pneumonia (Nekaris and Starr 2015). Those that do survive are no longer able to eat their preferred food (gum) (Das *et al.* 2014) or engage in the important behavior of social grooming with the toothcomb, meaning that any confiscated animals are unlikely to survive if released to the wild.

Reintroduction itself is a threat to the Javan Slow Loris. In the major markets in Java, at least four other slow loris species from Borneo and Sumatra are traded alongside the Javan Slow Loris, and in the markets in Sumatra at least three species are regularly traded, including Javan Slow Lorises. Likewise, traders based in Java and Sumatra offer several species for sale, including ones that do not occur naturally on the island where the traders reside. The similar appearance of slow lorises, to the untrained eye, results in release of slow loris species from Sumatra and Borneo into Java, and Javan Slow Lorises in Sumatra and Borneo, causing potential for hybridization

or even displacement of native species by introduced ones (Nekaris and Starr 2015). The ability of slow lorises to persist in human habitat if left undisturbed means that well-meaning people may translocate animals to habitat that is unknown to the animals, exacerbating these problems (Kumar *et al.* 2014).

Moore *et al.* (2014) assessed the success of Javan Slow Loris reintroductions, finding a death rate of up to 90%. Illness, hypothermia and exhaustion were all implicated in the death of slow lorises. Reintroductions were started before the basics were known about the Javan Slow Loris' behavior, ecology, or distribution. No habitat suitability assessment could be made, since details were lacking on the type of habitat the species preferred and what it avoided. It has recently been reported by rescue centers that the success rates of Javan Slow Loris reintroductions are improving, but unfortunately no published data are available to verify these claims. Newspaper reports show that up to 30 slow lorises are released in one site at one time, but the highly territorial and venomous nature of slow lorises means that such releases are destined to have a high failure rate. A related study of pygmy lorises in Vietnam found that the season of release and age should be considered to increase the likelihood of survival (Kenyon *et al.* 2014).

To obtain vital information on the Javan Slow Lorises, in 2011 the Little Fireface Project instigated a study of the species' behavioral ecology in Garut District of West Java, Indonesia (Nekaris 2016). This multi-disciplinary project has obtained data on home range size, social organization, infant dispersal, and feeding ecology. It was found that both sexes disperse from their natal range at about 20 months old, dispersal distances are 1–3 km from the natal range, home range sizes are large relative to the size of the animal (5–10 ha), the species goes into torpor, and the diet comprises mainly gum, supplemented with nectar and insects (Cabana *et al.* 2017, 2019). Several initiatives have been put into place to conserve slow lorises in the area and in other parts of Java. National workshops have been held for law enforcement officers and rescue center employees to provide essential data for a national slow loris action plan. At the local level, slow lorises are often totally

dependent on local people for their protection, feeding on human-planted tree species and residing in farmland. Thus, a major conservation program combining empowerment activities, conservation education, and village events has been launched, and it is hoped that it can be used as a model for other key slow loris sites in Indonesia (Nekaris and Starr 2015). One such program involved building bridges for slow lorises to connect habitat. Most of these bridges are made of water hose pipes that also help to irrigate the land of farmers. This program was accompanied by an intensive education program for children and their parents, making people aware of the lorises who live on their land (Biro *et al.* 2020, Nekaris *et al.* 2021). This program has been reproduced by other loris conservation projects in Bangladesh and in Thailand, where artificial bridges have also been used successfully by *N. bengalensis*. Because many slow loris species rely on non-protected farmland, helping local people to understand their important role in pollination and pest control can be vital for populations to persist. With this in mind, extending on the building bridges program, the Little Fireface Project also developed an eco-friendly coffee program, with cooperatives of farmers achieving Wildlife Friendly Certification. The certification involved a total hunting ban in the area, as well as significant reforestation of endemic tree species (Campera *et al.* 2021).

For a long time, slow lorises were thought to be common throughout Indonesia, and the presence of animals in trade was believed to be an indicator of their abundance. We are only beginning to unravel the complexity of their taxonomy and distribution, leading to a bleak overall picture. While Java has an impressive and comprehensive protected area network, encompassing over 120 terrestrial conservation areas and covering 5,000 km², enforcement of environmental laws and active protection in most of these parks is lacking and, as indicated above, many of the Javan Slow Lorises are found outside the protected area network. Besides curbing the illegal trade, it is paramount that these conservation areas, and indeed all other remaining forest areas on the island, are effectively protected.

- Biro, H., Campera, M., Imron, M.A. and Nekaris, K.A.I. (2020). Artificial canopy bridges improve connectivity in fragmented landscapes: the case of Javan slow lorises in an agroforest environment. *Am. J. Primatol.* 82(4): 23076.
- Cabana, F., Dierenfeld, E., Wirdateti, W., Donati, G. and Nekaris, K.A.I. (2017). The seasonal feeding ecology of the Javan slow loris (*Nycticebus javanicus*). *Am. J. Phys. Anthropol.* 162: 768–781.
- Cabana, F., Clayton, J.B., Nekaris, K.A.I., Wirdateti, W., Knights, D. and Seedorf, H. (2019). Nutrient-based diet modifications impact on the gut microbiome of the Javan slow loris (*Nycticebus javanicus*). *Sci. Rep.* 9(1): 1–11.
- Campera, M., Budiadi, B., Adinda, E., Ahmad, N., Balestri, M., Hedger, K., Imron, M.A., Manson, S., Nijman, V. and Nekaris, K.A.I. (2021). Fostering a wildlife-friendly program for sustainable coffee farming: the case of small-holder farmers in Indonesia. *Land* 10(2): 121.
- Das, N., Biswas, J., Das, J., Ray, P.C., Sangma, A. and Bhattacharjee, P.C. (2009). Status of Bengal slow loris *Nycticebus bengalensis* (Primates: Lorisidae) in Gibbon Wildlife Sanctuary, Assam, India. *J. Threat. Taxa.* 1: 558–561.
- Das, N., Nekaris, K.A.I. and Bhattacharjee, P.C. (2014). Medicinal plant exudativory by the Bengal slow loris *Nycticebus bengalensis*. *Endang. Species Res.* 23: 149–157.
- Fuller, G., Eggen, W.F., Wirdateti, W. and Nekaris, K.A.I. (2018). Welfare impacts of the illegal wildlife trade in a cohort of confiscated greater slow lorises, *Nycticebus coucang*. *J. Appl. Anim. Welf. Sci.* 21(3): 224–238.
- Kenyon, M., Streicher, U., Loung, H., Tran, T., Tran, M., Vo, B. and Cronin, A. (2014). Survival of reintroduced pygmy slow loris *Nycticebus pygmaeus* in South Vietnam. *Endang. Species Res.* 25: 185–195.
- Kumar, A., Sarma, K., Panvor, J., Mazumdar, K., Devi, A., Krishna, M. and Ray, P.C. (2014). Threats to the Bengal slow loris *Nycticebus bengalensis* in and around Itanagar Wildlife Sanctuary, Arunachal Pradesh, India: impediments to conservation. *Endang. Species Res.* 23: 99–106.
- Moore, R., Wihermanto, S. and Nekaris, K.A.I. (2014). Compassionate conservation, rehabilitation and translocation of Indonesian slow lorises. *Endang. Species Res.* 26: 93–102.
- Munds, R.A., Nekaris, K.A.I. and Ford, S.M. (2013). Taxonomy of the Bornean slow loris, with new species *Nycticebus kayan* (Primates, Lorisidae). *Am. J. Primatol.* 75: 46–56.
- Nekaris, K.A.I. (2014). Extreme primates: ecology and evolution of Asian lorises. *Evol. Anthropol.* 23: 177–187.
- Nekaris, K.A.I. (2016). The Little Fireface Project: community conservation of Asia's slow lorises via ecology, education, and empowerment. In: M.T. Waller (ed.), *Ethnoprimatology*, pp. 259–272. New York: Springer.
- Nekaris, K.A.I., Campbell, N., Coggins, T.G., Rode, E.J. and Nijman, V. (2013a). Tickled to death: analysing public perceptions of 'cute' videos of threatened species (slow lorises – *Nycticebus* spp.) on web 2.0 sites. *PLoS One* 8: e69215.
- Nekaris, K.A.I., Campera, M., Nijman, V., Biro, H., Rode-Margono, E.J., Fry, B.G., Weldon, A., Wirdateti, W. and Imron, M.A. (2020). Slow lorises use venom as a weapon in intraspecific competition. *Curr. Biol.* 30(20): 1252–1253.
- Nekaris, K.A.I., Handby, V. and Campera, M. (2021). Impact of weather conditions, seasonality and moonlight on the use of artificial canopy bridges by nocturnal arboreal mammals. *Biodiv. Conserv.* 30(12): 3633–3645.
- Nekaris, K.A.I., Moore, R.S., Rode, E.J. and Fry, B.G. (2013c). Mad, bad, and dangerous to know: the only venomous primates, slow lorises. *J. Venom. Anim. Toxins Incl. Trop. Dis.* 19: 21.
- Nekaris, K.A.I. and Nijman, V. (2007). CITES proposal highlights rarity of Asian nocturnal primates (Lorisidae: *Nycticebus*). *Folia Primatol.* 78: 211–214.
- Nekaris, K.A.I. and Nijman, V. (2018). Successful prosecution of slow loris traders in Indonesia. *Oryx* 52(3): 411–411.
- Nekaris, K.A.I. and Nijman, V. (2022). A new genus name for pygmy lorises, *Xanthonycticebus* gen. nov. (Mammalia, Primates). *Zoosyst. Evol.* 98: 87–92.
- Nekaris, K.A.I., Shekelle, M., Wirdateti, W., Rode, E.J. and Nijman, V. (2013b). *Nycticebus javanicus*. The IUCN Red List of Threatened Species 2013. doi.org/10.2305/IUCN.UK.2013-2.RLTS.T39761A17971158.en
- Nekaris, K.A.I. and Starr, C.R. (2015). Conservation and ecology of the neglected slow loris: priorities and prospects. *Endang. Species Res.* 28: 87–95.
- Nijman, V., Shepherd, C.R. and Nekaris, K.A.I. (2015). Trade in Bengal slow lorises in Mong La, Myanmar, on the China border. *Primate Conserv.* (28): 139–142.
- Nijman, V., Spaan, D., Rode-Margono, E.J. and Nekaris, K.A.I. (2017). Changes in the primate trade in Indonesian wildlife markets over a 25-year period: Fewer apes and langurs, more macaques and slow lorises. *Am. J. Primatol.* 79(11): 22517.
- Osterberg, P. and Nekaris, K.A.I. (2015). The conservation implications of the use of photo prop animals for tourists in Thailand: a slow loris case study (*Nycticebus* spp.). *TRAFFIC Bulletin* 27: 13–18.
- Pozzi, L., Hodgson, J.A., Burrell, A.S., Sterner, K.N., Raaum, R.L. and Disotell, T.R. (2014). Primate phylogenetic relationships and divergence dates inferred from complete mitochondrial genomes. *Mol. Phylogenet. Evol.* 75: 165–183.
- Rowe, N. and Myers, M. (2016). *All the World's Primates*. Charlestown, RI: Pogonias Press.
- Schulze, H. and Groves, C.P. (2004). Asian lorises: taxonomic problems caused by illegal trade. In: T. Nadler, U. Streicher and Ha Thang Long (eds.), *Conservation of Primates in Vietnam*, pp. 33–36. Frankfurt, Germany: Frankfurt Zoological Society.
- Starr, C., Nekaris, K.A.I., Streicher, U. and Leung, L.K.P. (2011). Field surveys of the vulnerable pygmy slow loris *Nycticebus pygmaeus* using local knowledge in Mondulkiri Province, Cambodia. *Oryx* 45: 135–142.
- Wiens, F., Zitzmann, A. and Hussein, N.A. (2006). Fast food for slow lorises: is low metabolism related to secondary compounds in high-energy plant diet? *J. Mammal.* 87: 790–798.

ASIA



SANGIHE TARSIER

Tarsius sangirensis Meyer, 1897

Indonesia
(2022)

Myron Shekelle

Sometime ago in the distant past, a small family of tarsiers found itself trapped on a floating island of vegetation, tossed about on the Pacific Ocean (Shekelle *et al.* 2013). Drifting northward from their home on Sulawesi, they travelled for days, up to 200 km from where their journey began, their life raft touched on the tiny island of Sangihe. Sangihe Island is an active volcano that pushed upward from the ocean floor several thousands of meters below the surface. Thus, like the more famous island chains of Hawaii and Galapagos, all life found on Sangihe Island arrived as wandering vagabonds, just as these tarsiers did. For a million years or more, these tarsiers lived in isolation, evolving into the species *Tarsius sangirensis*.

Isolated no more, Sangihe Island has the bustling port city of Tahuna, home to 33,000 people, an airport, and many of the conveniences of industrialized life. The island, of 547 km² (Shekelle and Salim 2009), is about one-fifth the size of Luxembourg. With a human population of 140,000 (Badan Pusat Statistik, 2022) crowded into 255 people per km², the island would rank tenth highest in terms of population density – just ahead of Luxembourg – were it a European nation. Looked at another way, Sangihe Island is slightly smaller than the Isle of Man, but its population is about 175% larger.

The northern half of Sangihe Island is dominated by the volcano, Mt. Awu, ranked as the fourth most deadly volcano in Indonesia's "Ring of Fire" (Bani *et al.* 2020). In 2021, a concession for a gold mine was ceded on the southern half of the island. The BBC named Sangihe Island, "Indonesia's Gold Island", an island made of gold (BBC, 2021). Unfortunately, as far as is known, the

highest value conservation habitats are on the southern end of Sangihe (Whitten, 2006), in the gold mine concession.

Sangihe Island is famous to bird conservationists for its highly threatened avifauna. The Cerulean Flycatcher (*Eutrichomyias rowleyi*) graced the first cover of the journal, *Conservation Biology*, accompanying an article concerned that it had gone extinct (see Whitten 2006). When its rediscovery in the wild was announced in 2006, its conservation hinged on a 940-ha patch of mixed primary and secondary forest that had been zoned by the community as a water catchment, a level of protection so limited that it did not even prohibit hunting (Whitten 2006). In an amazing contrast to the near disregard of this forest by anyone other than the local community, it was known to shelter three species of Critically Endangered birds – no other place in Indonesia has more than one Critically Endangered bird species (Whitten 2006). In addition to the Cerulean Flycatcher, the Sangihe Shrike-Thrush (*Coracornis sanghirensis*) and the Sangihe White-eye (*Zosterops nehrkorni*) are also Sangihe Island endemics (Whitten 2006). All rely on that 940-ha patch of forest, a little less than three times the size of New York's Central Park, now within the gold mine concession.

We can add to this list a small primate, *Tarsius sangirensis*. It is listed as Endangered on the IUCN Red List of Threatened Species (Shekelle 2020). The presence of the gold mine across the southern half of the island, and the loss of the local community's ability to manage their own forests, has greatly changed the threat status to the Sangihe Island Tarsier, and to all of the endemic biodiversity of the Island. Shekelle and Salim (2009) found that the Sangihe Island Tarsier



was at risk from a small extent of occurrence and area of occupancy, small population size, high risk of volcanism, high human population density, fragmented populations (many of which are in marginal habitat), and lack of conservation areas. There are no *ex situ* conservation options for any tarsier species, should their extinction in the wild become imminent.

Local people have protested the gold mine, and one anti-mine government official died under conditions that some find suspicious. They have created a petition on Change.Org that has nearly 150,000 signatures. If it is determined that the gold mining company, PT. Tambang Mas Sangihe (TMS), the Indonesian company registered by BARU Gold Corporation, has a legal right to mine gold on Sangihe Island, then that must be respected. Listing *Tarsius sangirensis* among the World's 25 Most Endangered Primates tells the gold mine that the eyes of the world are focused on its management of the biodiversity that it has been entrusted by Indonesian mining laws to preserve.

- BBC. (2021). The Battle for Indonesia's Gold Island. BBC News Video. Available online: <<https://www.bbc.co.uk/news/av/world-asia-57902815>>.
- Badan Pusat Statistik. (2022). Available online: <<https://www.bps.go.id/>>.
- Bani, P., Kristianto, Kunrat, S. and Syahbana D.K. (2020). Insights into the recurrent energetic eruptions that drive Awu, among the deadliest volcanoes on Earth. *Nat. Hazards Earth Syst. Sci.* 20: 2119–2312.
- Shekelle, M. (2020). *Tarsius sangirensis*. The IUCN Red List of Threatened Species 2020: e.T21493A17977351.
- Shekelle, M. and Salim, A. (2009). An acute conservation threat to two tarsier species in the Sangihe Island chain, North Sulawesi, Indonesia. *Oryx* 43: 419–426.
- Shekelle, M., Gursky-Doyen, S. and Richardson, M.C. (2013). Family: Tarsiidae (Tarsiers). In: R.A. Mittermeier, A.B. Rylands and D.E. Wilson (eds.), *Handbook of the Mammals of the World. Volume 3. Primates*, pp. 236–261. Barcelona: Lynx Edicions.
- Whitten, T. (2006). Cerulean paradise-flycatcher not extinct: subject of first cover lives. *Conserv. Biol.* 20: 918–920.

ASIA



PURPLE-FACED LANGUR

Semnopithecus vetulus (Erxleben, 1777)

Sri Lanka

S. v. nestor (2004–2022)

S. v. vetulus, *S. v. monticola*, *S. v. philbricki* (2018–2022)

Rasanayagam Rudran

Extensive deforestation occurred following the cessation of Sri Lanka's 26-year civil war in 2009, escalating human-primate conflicts and undermining the long-term survival of three Sri Lankan primates, *Semnopithecus vetulus*, *S. priam thersites* and *Macaca sinica* that are not only endemic, but also threatened with extinction. As public outcry and political pressure mounted to resolve these conflicts, several government institutions and non-governmental organizations, led by SPEARS Foundation, helped the country's Department of Wildlife Conservation (DWC) to develop an action plan for people to conserve and coexist with all species of monkeys. The plan was submitted to the country's government in March 2016 for cabinet approval.

While awaiting approval, SPEARS Foundation used funds from foreign donors to implement some key elements of the plan. One was to develop Community Conservation Areas (CCAs), which, when established, would be administered and managed sustainably by local communities under DWC supervision. To find suitable sites for CCAs, the SPEARS team analyzed complaints of human-monkey conflicts received by the DWC between 2007 and 2015. The analysis indicated that conflicts occurred throughout the country, but their frequency varied between localities (Cabral *et al.* 2018). Thirteen field surveys were conducted, therefore, from 2016 to 2018, to locate sites best suited for the establishment of CCAs. Information from these surveys and other relevant data on all four Purple-faced Langur subspecies are presented below.

Three of the four subspecies of *Semnopithecus vetulus* are Endangered. The fourth, the western

subspecies, *S. v. nestor*, is Critically Endangered (Rudran *et al.* 2020a). The range of the Western Purple-faced Langur (*Semnopithecus vetulus nestor*) includes the most densely populated region around Colombo, the country's capital. Urbanization poses a serious threat, therefore, to the long-term survival of this Critically Endangered and endemic subspecies (Rudran *et al.* 2009, 2020a). A survey conducted in 2007 (Rudran 2007) indicated that 81% of *S. v. nestor*'s historical range (Hill 1934, Phillips 1981) had been deforested and converted to human altered landscapes. Due to this habitat reduction, much of *S. v. nestor*'s current population subsists mainly on fruit from home gardens (Dela 2007, Rudran 2007). Nutritional consequences of feeding on a low diversity diet of cultivated fruits are unclear but considered detrimental to the folivorous *S. v. nestor* (Rudran 2015).

Besides depleting natural food sources, deforestation causes habitat fragmentation, forcing animals to travel on the ground and along power lines to move between fragments. These movements increase mortality by exposing them to attacks by dogs, speeding vehicles, and electrocution (Parker *et al.* 2008). In some parts of its range, *S. v. nestor* is occasionally shot and killed as a pest while feeding in home gardens (Dela 2004). Such human-induced fatalities reduce group sizes and appear to lead to local extinctions in *S. v. nestor*'s range (Rudran 2007).

The Highland Purple-faced Langur (*S. v. monticola*), also known as the Bear Monkey, was studied for two years at Horton Plains by Rudran (1973a, 1973b) nearly fifty years ago. When the area was surveyed again in 2016, Rudran noted



appreciable changes to the vegetation. Many species previously recorded as important food plants of the Bear Monkey were dead or dying. This appeared to be primarily due to debarking of the adult trees and consumption of saplings by the sambar (*Cervus unicolor*) population, which had increased in numbers because of the invasive soft grass introduced to Horton Plains with the fertilizer used by a now defunct potato farm (Adikaram *et al.* 1999). The death and lack of regeneration of food plants appear to have undermined Bear Monkey survival. A census was not conducted in 2016, but early morning loud calls of harem males were considerably less frequent than before, indicating a population decline. The area was surveyed again in 2017 to collect data on crop damage and human attitudes towards monkeys.

Three surveys were conducted in the range of the Southern Purple-faced Langur (*S. v. vetulus*) in 2017. In addition, a long-term study of *S. v. vetulus* (Roscoe *et al.* 2013) reported several threats to the future survival of this subspecies. These threats were the same as those experienced by *S. v. nestor*. Additionally, a major highway constructed through *S. v. vetulus*' range is expected to create a permanent barrier to gene flow between the populations found along the coast and the interior of the country.

The Northern Purple-faced Langur (*S. v. philbricki*) was investigated for two years in the late 1960s (Rudran 1973a, 1973b) when conflicts with humans were not a serious issue. In the late 1970s, however, the impact of the Accelerated Mahaweli Development Program (AMDP) on wildlife in *S. v. philbricki*'s range became a serious concern. To mitigate this concern, an Environmental Impact Assessment (EIA) of the AMDP recommended the establishment of four new national parks around the development area (Tippetts-Abbott-McCarthy-Stratton 1980). While these areas provided protection to *S. v. philbricki*, serious threats such as habitat fragmentation and hunting for food, medicinal purposes and rituals still remained in other areas (Wickremasinghe *et al.* 2016). Similar findings have also been reported by other investigators (Nahallage and Huffman 2013). Two surveys conducted in 2018 by SPEARS Foundation staff found that populations of the highly arboreal *S. v. philbricki* were fewer than that of the other two subspecies in the area due to the fragmentation of their habitat.

In the last couple of years, the COVID-19 pandemic has hampered the SPEARS team's field activities, though the pandemic did provide the team with opportunities to publish data that it had on file, to produce video documentaries about their efforts, and to develop a device

designed to reduce financial losses due to crop damage by monkeys.

In regards to publications published during COVID-19, these were based on data that had been collected prior to the onset of pandemic. One of the articles discussed an ethno-primatological approach to conserving the Critically Endangered Western Purple-faced Langur (Rudran et al. 2020). This paper was the outcome of a 14-year effort during which time the SPEARS team implemented annual outreach activities with the aim of building support in rural communities, so that they would become staunch allies in promoting the conservation of the species. These efforts were managed by a non-governmental organization, because the Sri Lankan government's wildlife agency did not have adequate staff and financial resources to deal with critically important wildlife conservation issues. Donor agencies are urged, therefore, to provide long-term financial support to the country's non-governmental organizations that have demonstrated their unwavering commitment to promote wildlife conservation. Such support may also be useful in other countries that have rural communities and wildlife protection agencies with characteristics similar to those in Sri Lanka.

As another example, the SPEARS team published research about the use of an ethnoprimatological approach to mitigate Sri Lanka's human-monkey conflicts (Rudran et al. 2021). This problem had skyrocketed after 2009, when the end of Sri Lanka's 26-year ethnic war precipitated extensive deforestation to expand the country's agricultural base and economy. To assess the intensity of this country-wide problem, the SPEARS team conducted field surveys, for five days each month from January 2016 to June 2018, in 11 of Sri Lanka's 25 administrative districts. During these 30 months, the survey team held semi-structured interviews with more than 1,600 adults, which were used to craft recommendations, including a recommendation to establish a private insurance scheme or a government-sponsored compensation program to deal with human-monkey conflicts (Rudran et al. 2021). In addition, and since human-monkey conflicts occurred throughout the country, officers of the understaffed and underfunded wildlife agency could not be

expected to travel extensively to assess the damage before providing compensation. The SPEARS Team, therefore, recommended that local community organizations be tasked with assessing the damage (Rudran et al. 2021). The recommendation also stressed that requests for compensation payments should be submitted to wildlife authorities only with convincing and verifiable supporting evidence. This arrangement was recommended to help prevent bogus claims for crop damage by monkeys.

The SPEARS team's articles were published in scientific journals not easily accessible to people living in Sri Lanka. To stimulate local interest about Sri Lanka's monkeys and its natural habitats, the SPEARS team used video footage taken before the pandemic to produce nine presentations in English and the two local languages. Each presentation lasted anywhere from two to nearly 30 minutes, and introduced local people to the objectives of the SPEARS team, the diversity of Sri Lankan monkeys, and causes of human-monkey conflicts. Some presentations also provided information on interesting local species and important natural habitats, such as the Malabar Pied Hornbill and the country's vanishing wetlands. These popular video presentations were shown at several public meetings held by the SPEARS team before the pandemic took hold in Sri Lanka.

Another pre-pandemic project launched by the SPEARS Team involved the development of a motion sensing device designed to emit loud alarm signals when monkeys enter home gardens and croplands. When the alarm is activated, the homeowner was expected to use his/her cell phone to alert the crop protection brigade (Rudran et al. 2021) composed of unemployed and underemployed youngsters, who have their own modes of conveyance and expertise in using catapults and other non-lethal devices to chase away monkeys. When the monkeys are evicted, homeowners whose crops were saved would compensate the crop protection brigade. In this manner the crop protection program will not only help minimize financial losses incurred by homeowners but also provide gainful employment to local youngsters. This program is expected to become functional after

the pandemic dies out and does not pose any further threats to human health.

In conclusion, although Sri Lanka's monkeys face a perilous future (Rudran 2013), there is hope that they can be conserved. One reason for hope is that most Sri Lankans follow the Buddhist doctrine of compassion towards all living things. Promoting this doctrine and Buddha's own reverence of the forest presents, therefore, opportunities to deter deforestation in a country steeped in cultural traditions but ignorant of the detrimental effects of habitat destruction. Another reason for optimism stems from a decision by successive governments to increase Sri Lanka's forest cover from 27% to 36% using native plants, to achieve the country's economic development goals (Yatawara 2011). The political will to increase forest cover augurs well for the future protection of wildlife. It is important that the Sri Lankan government approves the 2016 action plan in order to ensure a steady flow of financial support to conserve Sri Lanka's monkeys.

- Adikaram, N.K.B., Ranawana, K.B., Dissanayake, C.B. and Ranasinghe, P.N. (1999). *Forest dieback in Horton Plains National Park*. Project Terminal Report. Global Environmental Facility Project of the Department of Wildlife Conservation.
- Cabral, S.J., Sumanapala, A.P., Weerakoon, D.K., Kotagama, S.W. and Rudran, R. (2018). Have habitat loss and fragmentation affected the social organization of the western purple-faced langur (*Semnopithecus vetulus nestor*)? *Primate Conserv.* (32): 159–166.
- Dela, J.D.S. (2004). Protecting the endemic purple-faced langur. *Loris* 23: 14–22.
- Dela, J.D.S. (2007). Seasonal food use strategies of *Semnopithecus vetulus nestor* at Panadura and Piliyandala, Sri Lanka. *Int. J. Primatol.* 28: 607–626.
- Hill, W.C.O. (1934). A monograph on the purple-faced leaf monkeys (*Pithecus vetulus*). *Ceylon J. Sci.* 29(1): 23–88.
- Nahallage, C.A.D. and Huffman, M.A. (2013). Macaque-human interactions in the past and present day Sri Lanka. In: S. Radhakrishna, M.A. Huffman and A. Sinha (eds.), *The Macaque Connection: Cooperation and Conflict between Humans and Macaques*, pp. 135–147. New York, NY: Springer.
- Parker, L., Nijman, V. and Nekaris, K.A.I. (2008). When there is no forest left: fragmentation, local extinction, and small population sizes in the Sri Lankan western purple-faced langur. *Endang. Species. Res.* 5: 29–36.
- Phillips, W.W.A. (1981). *Manual of the Mammals of Sri Lanka. Part II*. 2nd edition. Colombo, Sri Lanka: Wildlife and Nature Protection Society.
- Roscoe, C.J., De Silva, M.A., Hapuarachchi, N.C. and Rohan Krishantha, P.A. (2013). A new color morph of the southern purple-faced langur (*Semnopithecus vetulus vetulus*) from the rainforests of southwestern Sri Lanka. *Primate Conserv.* (26): 115–124.
- Rudran, R. (1973a). The reproductive cycles of two subspecies of purple-faced langurs (*Presbytis senex*) with relation to environmental factors. *Folia Primatol.* 19: 41–60.
- Rudran, R. (1973b). Adult male replacement in one-male troops of purple-faced langurs (*Presbytis senex*) and its effect on population structure. *Folia Primatol.* 19: 166–192.
- Rudran, R. (2007). A survey of Sri Lanka's endangered and endemic western purple-faced langur (*Trachypithecus vetulus nestor*). *Primate Conserv.* (22): 139–144.
- Rudran, R. (2013). Purple-faced langur, *Trachypithecus vetulus*. In: J.C. Daniel and N. Manjrekar (eds.), *Mammals of South Asia*, pp. 317–331. Hyderabad, India: Universities Press.
- Rudran, R. (2015). Western purple-faced langur *Semnopithecus vetulus nestor* (Bennett, 1833). In: C. Schwitzer et al. (eds.), *Primates in Peril: The World's 25 Most Endangered Primates 2014–2016*, pp. 63–66. Arlington, USA: IUCN SSC Primate Specialist Group (PSG), International Primatological Society (IPS), Conservation International (CI) and Bristol Zoological Society.
- Rudran, R., Weerakoon, K. and Wanasinghe, A. 2009. Western purple-faced langur *Trachypithecus (Semnopithecus) vetulus nestor* (Bennett, 1833). In: R.A. Mittermeier et al. (eds.), *The World's 25 Most Endangered Primates 2008–2010*, pp. 24–25. Arlington, USA: IUCN SSC Primate Specialist Group (PSG), International Primatological Society (IPS), Conservation International (CI) and Bristol Zoological Society.
- Rudran, R., Dittus, W., Gamage, S.N. and Nekaris, K.A.I. (2020a). *Semnopithecus vetulus*. The IUCN Red List of Threatened Species 2020: e.T22042A17959452.
- Rudran, R., Cabral de Mel, S.J., Salindra, H.G., Dayananda, K., Ratnayake, R.M.R.R., Weerakkody, S. and de Mel, R.K. (2020b). An ethnoprimateological approach to conserving Sri Lanka's critically endangered western purple-faced langur. *Primate Conserv.* (34): 227–233.
- Rudran, R., Cabral de Mel, S.J., Sumanapala, A., de Mel, R.K. and Mahindaratna K.K.T.I. (2021). An ethnoprimateological approach to mitigating Sri Lanka's human-monkey conflicts. *Primate Conserv.* (35): 189–198.
- Tippetts-Abbott-McCarthy-Stratton (TAMS). (1980). *Environmental Impact Assessment, Accelerated Mahaweli Development Program. Volume II - Terrestrial Environment*. Ministry of Mahaweli Development, Democratic Socialist Republic of Sri Lanka.
- Wickremasinghe, S., Unantenna, J.R.K.W. and Dissanayake, D.S.B. (2016). Distribution of *Trachypithecus vetulus philbricki* in selected forest patches in the Anuradhapura District, Sri Lanka. 5th Asian Primate Symposium 18–22 October 2016. Sri Jayawardepura University, Sri Lanka.
- Yatawara, S.B. (2011). Let's preserve trees, before the last tree vanishes. Available online: <www.sundayobserver.lk/2011/11/06/fea05.asp>. Accessed 27 February 2014.

ASIA



GOLDEN-HEADED LANGUR

or Cat Ba Langur

Trachypithecus poliocephalus (Pousargues, 1898)

Vietnam
(2000–2022)

Neahga Leonard, Richard J. Passaro, Daniela Schrudde, Roswitha Stenke,
Phan Duy Thuc and Martina Raffel

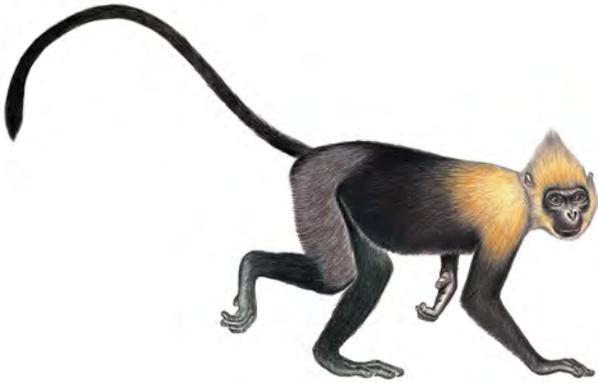
The Cat Ba Langur (also known as the Golden-headed Langur), *Trachypithecus poliocephalus*, is assessed as Critically Endangered on the IUCN Red List of Threatened Species and is probably the most endangered of the Asian colobines (Rawson *et al.* 2020). It occurs only on Cat Ba Island in the Gulf of Tonkin, off the north-eastern Vietnamese shore (Stenke and Chu 2004). The Cat Ba Archipelago is adjacent to the world-famous Ha Long Bay, a spectacular karst formation that was invaded by the sea following the last major glaciation. The favored habitat of the Cat Ba Langur is tropical moist forest on limestone karst hills, a habitat preference it shares with the other six to seven taxa of the *T. francoisi* group.

While there are no systematic and reliable data available on the historic density of the langur population on Cat Ba Island, reports by indigenous people suggest the entire island of Cat Ba (140 km²) and some smaller offshore islands were previously densely populated by langurs. Hunting has been identified as the sole cause for the dramatic and rapid population decline from an estimated 2,400–2,700 in the 1960s to approximately 50 individuals by 2000 (Nadler and Ha 2000). The langurs were poached mainly for trade in traditional medicines and for sport. Following the implementation of strict protection measures in 2000, the langur population on Cat Ba Island stabilized (Nadler *et al.* 2003) and since 2003 has been on the increase (Leonard *et al.* 2016). In the latter half of 2015, however, numbers fell from the mid-to high 60s to the low 50s and have since been slowly recovering. This has raised concerns that

as langur numbers recover interest in poaching by people from adjacent regions may also revive (Leonard *et al.* 2016).

Although the growth of the population is encouraging, the overall status of the species remains critical, and the total population is worryingly small. Habitat fragmentation and hunting has divided the remaining population into several isolated sub-populations, some of which are non-reproducing social units. A surplus of young males is a cause for concern as take-over attempts can lead to infanticide, inadvertent infant deaths, and group fragmentation, all of which have been recorded since 2018 (N. Leonard unpubl. data). Reproduction appears to only take place in groups above a threshold size, making group fragmentation a cause of concern for population growth.

The total reproductive output of *Trachypithecus poliocephalus* has been low due to the small population and the long inter-birth cycle but records indicate that the birth rate is increasing, with 55% of the total births recorded between 2000 and 2022 having taken place from 2017 to 2022. Births occur throughout the year, with a peak in February–April, just prior to the rainy season (Leonard *et al.* 2016), with a corresponding peak in conception in August–October at the conclusion of the rainy season. The portion of reproductively active females giving birth each year varies, but on average approximately 30% of the active females do so (N. Leonard unpubl. data).



In 2012, after many years of planning and preparation, two females were successfully translocated from a small offshore islet, where they had become stranded, to the relative safety of the strictly protected core zone of Cat Ba National Park. There they assimilated into existing groups containing males, thus giving them the opportunity to reproduce for the first time. It is hoped that continued protection efforts and additional population management interventions such as these will enhance the rebound of this species.

The Cat Ba Archipelago and adjacent Ha Long Bay are nationally and internationally recognized for their importance to biodiversity conservation. Cat Ba National Park was established in 1986. It presently covers more than half of the main island. Ha Long Bay was established as a World Heritage site in 1994, and the combined archipelago includes about 1,500–2,000 large and small islands, cliffs and rocks. In 2004, the Cat Ba Archipelago was designated a UNESCO Man and the Biosphere Reserve. Despite the conservation designations and laws to protect the region, nature and wildlife protection on Cat Ba Island is deficient. Environmental awareness and commitment among the local communities is slowly increasing, and hunting/trapping of all animals on the island illegal. Unfortunately, efforts to effectively conserve the langurs and their habitat continue to face major obstacles from increasing tourism development, increasing human population and severe deficiencies in law enforcement (Stenke 2005, Leonard 2018). As is common elsewhere in the region, poaching by local people is driven by livelihood issues, brought about by low incomes and lack of employment opportunities. Immense local and regional demand for wildlife and animal parts for food and dubious traditional medicines provide a market for poached animals and plants. Although langur hunting ostensibly stopped years ago, the 2015 decline in numbers raises doubts as to the permanence of the hunting cessation. Regardless, hunters continue to poach other animals and plants in langur areas, thus jeopardizing langur habitat. Strict enforcement of the established protections is therefore necessary for the survival of all species on Cat Ba Island that are targeted by the illegal Asian wildlife trade.

A conservation program for the Cat Ba Langur is supported by Zoo Leipzig, Zoological Society for the Conservation of Species and Populations (ZGAP), and the Allwetterzoo Münster in Germany. The project was initiated on Cat Ba Island in November 2000 by Allwetterzoo Münster and ZGAP. The aim of the Cat Ba Langur Conservation Program is to provide protection for the langurs and their habitat, to conduct research that will help inform future population management decisions, and to help contribute to the conservation of the overall biodiversity of the Cat Ba Archipelago, all in collaboration with Vietnamese authorities.

- Leonard, N. (2018). Is Primate tourism a Practical Protection Tool? The Case of Cat Ba Island, Vietnam. Presentation, XXVIIth Congress of the International Primatological Society, Nairobi, Kenya, 19–25 August 2018.
- Leonard, N., Mai, L.S., Raffel, M., Adler, J., Passaro, R., Schrudde, D. and Stenke, R. (2016). Current status of the Cat Ba langur population: numbers, population trend, and birth rates. Presentation, Joint Meeting of XXVIth Congress of the International Primatological Society and the American Society of Primatologists, Chicago, 21–27 August 2016.
- Nadler, T. and Ha, T.L. (2000). *The Cat Ba Langur: Past, Present and Future. The Definitive Report on Trachypithecus poliocephalus – the World's Rarest Primate*. Hanoi, Vietnam: Frankfurt Zoological Society.
- Nadler, T., Momberg, F., Nguyen, X.D. and Lormee, N. (2003). *Vietnam Primate Conservation Status Review 2002. Part 2: Leaf Monkeys*. Hanoi, Vietnam: Fauna and Flora International and Frankfurt Zoological Society.
- Rawson, B.M., Leonard, N., Covert, H. and Nadler, T. (2020). *Trachypithecus poliocephalus*. The IUCN Red List of Threatened Species 2020: e.T39871A17959804.
- Stenke, R. (2005). Conservation of the Golden-headed Langur (*Trachypithecus poliocephalus poliocephalus*) on Cat Ba Island, Vietnam: Status of the Golden-headed Langur and of Human Impact in Langur Areas. Report, People's Committee of Hai Phong (Provincial Government), Cat Ba, Hai Phong, Vietnam.
- Stenke, R. and Chu, C.X. (2004). The golden-headed langur (*Trachypithecus poliocephalus poliocephalus*) on Cat Ba Island – status, threat factors, and recovery options. In: T. Nadler, U. Streicher and T.L. Ha (eds.), *Conservation of Primates in Vietnam*, pp. 72–77. Hanoi, Vietnam: Frankfurt Zoological Society.

ASIA



RAFFLES' BANDED LANGUR

Presbytis femoralis (Martin, 1838)

Malaysia, Singapore
(2022)

Andie Ang, Sabrina Jabbar, Zan Hui Lee and Nadine Ruppert

Presbytis femoralis was formerly regarded as a species with three subspecies: *P. f. femoralis*, *P. f. percura* and *P. f. robinsoni* (Groves 2001, Roos et al. 2014). Based on multiple species delimitation algorithms applied to a dataset covering 40 species and 43 subspecies of Asian colobines, including the complete mitochondrial genomes of the three subspecies of *P. femoralis*, all three were resurrected to species (Ang et al. 2020).

The Raffles' Banded Langur (*P. femoralis*) is found only in Singapore and southern Peninsular Malaysia (in Johor state and a small part of Pahang state). The populations in Singapore and Malaysia are isolated from one another by the Strait of Johor. In Singapore, this primate is found mainly in the Central Catchment Nature Reserve (CCNR), the largest in the country. The CCNR comprises 2,880 hectares of lowland primary and secondary forest, and freshwater swamp forest. In Malaysia, most populations occur in the state of Johor, i.e., in Endau Rompin National Park, Gunung Arong, Gunung Belumut, Gunung Lambak, Gunung Pantii, Gunung Pulai, Kampung Johor Lama, which are isolated from each other, with just one known population in the state of Pahang (Rompin State Park).

As of 2021/22, there are 70 individuals in the Singapore population with a sex ratio (male:female:unknown) of 26:24:20 (Ang and Jabbar 2022). There are no reliable population estimates available for the conspecifics in Malaysia, but it is believed that only a few hundred individuals remain (Abdul-Latiff et al. 2019, Ang and Jabbar 2022). The overall population of *P. femoralis*, therefore, could be less than 250 mature individuals in the wild.

Presbytis femoralis eats young leaves, fruits, seeds, and flowers. A total of 61 plant species from 34 families were identified in the diet of *P. femoralis* in Singapore (Srivathsan et al. 2016, Ang and Jabbar 2022). In Malaysia, 27 plant species from 17 families in Kampung Johor Lama (Najmuddin et al. 2019a) and no less than 38 species from 20 families in Gunung Lambak (Z. H. Lee unpubl. report) were documented as food for the langurs.

The species is classified as Critically Endangered on the IUCN Red List of Threatened Species (Ang et al. 2021a) and is listed in Appendix II of CITES. It is protected in Peninsular Malaysia under Schedule 2 of the Wildlife Conservation (Amendment of Schedule) Order 2012 under the *Presbytis* spp. group. In Singapore, it is protected under the Protected Wildlife Species Rules 2020 of the Wildlife Act (Chapter 351) as *Presbytis femoralis femoralis*.

Deforestation and habitat conversion continue to be the major threats to this species. It is particularly affected by forest clearance and disturbance from urban development in Singapore and from oil palm plantations in Malaysia. As a result, known populations are distributed in fragmented habitats, and fragmentation is thus recognized as an additional stressor. *Presbytis femoralis* shows low genetic variability (Ang et al. 2012, Srivathsan et al. 2016) in Singapore, and there is still a lack of data on this species from Malaysia, where population numbers and the distribution are not up to date.

Casualties in both countries have been recorded as individuals attempt to travel between fragmented habitats using roads and electric



cables (Ang and Jabbar 2020; N. Ruppert, pers. obs.). Predation events are rare, although the langurs have been seen to be killed by eagles (Fam and Nijman 2011) and dogs (Yang and Lua 1988, Najmuddin *et al.* 2019b). In Malaysia, additional threats come from human-wildlife interactions when the langurs enter suburban and residential areas to eat garden fruits (Z.H. Lee pers. obs.).

In 2016, an IUCN Species Action Plan for the conservation of *P. femoralis* was developed, and the Raffles' Banded Langur Working Group was formed with representatives from government agencies, non-governmental organizations, universities, and experts from both countries. The goals of the action plan are threefold: (i) to recover and protect *P. femoralis* in the wild; (ii) to gather key data through ongoing studies; and (iii) to secure the necessary resources and commitments for the long-term conservation of the species (Ang *et al.* 2016).

In Singapore, two experimental rope bridges were installed by the National Parks Board to facilitate safe crossing of the langurs over roads (Ow *et al.* 2022). In Malaysia, a rope structure was installed by the Malaysian Nature Society (Johor) in Gunung Panti for primates, including *P. femoralis* (Chong 2020). In 2016, a citizen science program was set up in Singapore where volunteers are trained to collect data on the langurs in the CCNR (Ang *et al.* 2021b). In Malaysia, the Universiti Sains Malaysia, in collaboration with Malaysian Primatological Society, WWF (Malaysia, and Singapore) and Malaysian Nature Society (Johor), is conducting research on the behavior and ecology of the species and planning for public outreach and stakeholder engagement programs. Studies on the behavior and potential for nature-based tourism activities of this species have also been conducted by the Universiti Tun Hussein Onn Malaysia in Johor in recent years.

In the long term, conservation translocation of individuals of *P. femoralis* between Singapore and Malaysia might need to be considered to restore and maintain the genetic diversity of the populations and increase their genetic adaptive potential. The recognition of *P. femoralis* as

one of the Top 25 Most Endangered Primates can expedite urgent communication and collaboration between stakeholders in Singapore and Malaysia to foster more effective research on and conservation actions to protect this species, its habitat, and the shared natural heritage of the two countries.

- Abdul-Latiff, M.A.B., Baharuddin, H., Abdul-Patah, P. and Md-Zain, B.M. (2019). Is Malaysia's banded langur, *Presbytis femoralis femoralis*, actually *Presbytis neglectus neglectus*? Taxonomic revision with new insights on the radiation history of the *Presbytis* species group in Southeast Asia. *60*(1): 63–79.
- Ang, A. and Jabbar, S. (2020). Use of forest in state land along Upper Thomson Road by Raffles' banded langurs *Presbytis femoralis* (Martin, 1838) in Singapore. *Nat. Singap.* 13: 7–10.
- Ang, A. and Jabbar, S. (2022). *Raffles' Banded Langur: The Elusive Primate of Singapore and Malaysia*. Singapore: World Scientific.
- Ang, A., Srivathsan, A., Md-Zain, B.D., Ismail, M.R.B. and Meier, R. (2012). Low genetic variability in the recovering urban banded leaf monkey population of Singapore. *Raffles Bull. Zool.* 60(2): 589–594.
- Ang, A., D'Rozario, V., Jayasri, S.L., Lees, C.M., Li, T.J. and Luz, S. (2016). Species Action Plan for the Conservation of Raffles' Banded Langur (*Presbytis femoralis femoralis*) in Malaysia and Singapore. Report to IUCN SSC Conservation Breeding Specialist Group, Minnesota, USA.
- Ang, A., Roesma, D.I., Nijman, V., Meier, R., Srivathsan, A. and Rizaldi. (2020). Faecal DNA to the rescue: shotgun sequencing of non-invasive samples reveals two subspecies of Southeast Asian primates to be Critically Endangered species. *Sci. Rep.* 10: 9396.
- Ang, A., Boonratana, R. and Nijman, V. (2021a). *Presbytis femoralis*. The IUCN Red List of Threatened Species 2021: e.T39801A205832720.
- Ang, A., Jabbar, S., D'Rozario, V. and Lakshminarayanan, J. (2021b). Citizen science program for critically endangered primates: a case study from Singapore. *Primate Conserv.* (35): 179–188.
- Chong, C.H.A. (2020). Aerial bridges for primates at Panti Bird Sanctuary. Panti Scientific Expedition (Part 1). *Malaysian Naturalist* 74(1): 83–85.
- Fam, S.D. and Nijman, V. (2011). *Spizaetus* hawk-eagles as predators of arboreal colobines. *Primates* 52(2): 105–110.
- Groves, C.P. (2001). *Primate Taxonomy*. Smithsonian Institution Press, Washington, DC.
- Najmuddin, M.F., Haris, H., Shahrool-Anuar, R., Md-Zain, B.M. and Abdul-Latiff, M.A.B. (2019a). Primate tourism: plant selection by Schlegel's banded langur *Presbytis neglectus* in Johor. *IOP Conference Series: Earth and Environmental Science*. 269: 012036.
- Najmuddin, M.F., Haris, H., Norazlimi, N., Md-Zain, B.M., Mohd-Ridwan, A., Shahrool-Anuar, R., Husna, H.A. and Abdul-Latiff, M.A.B. (2019b). Predation of domestic dogs (*Canis lupus familiaris*) on Schlegel's banded langur (*Presbytis neglectus*) and crested hawk-eagle (*Nisaetus cirrhatu*) on dusky leaf monkey (*Trachypithecus obscurus*) in Malaysia. *J. Sustain. Sci. Manag.* 14(6): 39–50.
- Ow, S., Chan, S., Toh, Y.H., Chan, S.H., Lakshminarayanan, J., Jabbar, S., Ang, A. and Loo, A. (2022). *Bridging the gap: assessing the effectiveness of rope bridges for wildlife in Singapore*. *Folia Primatol.* doi.org/10.1163/14219980-20211110
- Roos, C., Boonratana, R., Supriatna, J., Fellowes, J.R., Groves, C.P., Nash, S.D., Rylands, A.B. and Mittermeier, R.A. (2014). An updated taxonomy and conservation status review of Asian primates. *Asian Primate J.* 4(1): 2–38.
- Srivathsan, A., Ang, A., Vogler, A.P. and Meier, R. (2016). Fecal metagenomics for the simultaneous assessment of diet, parasites, and population genetics of an understudied primate. *Front. Zool.* 13: 17.
- Yang, C.M. and Lua, H.K. (1988). A report of a banded leaf monkey found dying near the Bukit Timah Nature Reserve. *Pangolin* 1: 23.

ASIA



GUIZHOU SNUB-NOSED MONKEY

or Gray Snub-nosed Monkey

Rhinopithecus brelichi Thomas, 1903

China
(2002, 2022)

Jiang Zhou, Baoping Ren and Paul A. Garber

The Guizhou or Gray Snub-nosed Monkey (*Rhinopithecus brelichi*) is endemic to southwestern China. The last remaining wild population of this species inhabits evergreen and deciduous broadleaf mixed forest at an altitude of 1400–2100 m in the Fanjingshan National Nature Reserve, Guizhou Province (108°45'55"–108°48'30"E, 27°49'50"–28°1'30"N) (Guo *et al.* 2020). The reserve was established in 1986 and encompasses an area of 419 km². It is surrounded by local villages and small forest fragments (Xiang *et al.* 2009) and is separated from nearby lowland forested areas by a road built in 2010. Outside Guizhou province, there are also five Guizhou Snub-nosed monkeys housed at the Beijing Zoo.

The Guizhou Snub-nosed Monkey is listed as Endangered on the IUCN Red List of Threatened Species (Long *et al.* 2020), a Class I key protected species under the Chinese Wild Animal Protection Law, and as Critically Endangered on the Red List of China's Vertebrates (Xiang *et al.* 2009, Jiang *et al.* 2016). It was initially regarded as a subspecies of the Golden Snub-nosed Monkey (*Rhinopithecus roxellana*, Quan and Xie 1981). Based on genomic data, however, these two lineages appear to have diverged some 1.6 mya (Zhou *et al.* 2014). Both *R. brelichi* and *R. roxellana* are considered 'northern' species of snub-nosed monkeys (Zhou *et al.* 2014). A recent study of the mitochondrial DNA D-loop based on over 300 *R. brelichi* fecal samples identified 11 haplotypes (Wang and Zhou 2021). Haplotype diversity in *R. brelichi* was lower than that reported in *R. roxellana* and *R. bieti*. These latter two snub-nosed monkey species have larger populations (Li *et al.* 2018).

As is the case for all five species of extant snub-nosed monkeys, the social organization of *Rhinopithecus brelichi* is best described as a large multilevel or modular society composed of several adult males, multi-adult females plus offspring units (OMUs) that feed, forage, rest, and travel together throughout the year. These OMUs collectively form a breeding band that is followed by an all-male unit (AMU) composed of juvenile, subadult, and adult males (Qi *et al.* 2014, Tan and Bleisch 2016).

Over the past several decades, deforestation and habitat conversion for agriculture, mining, the collection of firewood and medicinal plants, and infrastructure development have significantly altered and severely fragmented the remaining habitat available to the Guizhou Snub-nosed Monkey (Xiang *et al.* 2009, Guo *et al.* 2020). Observations of this species in the 1960s and 1980s often reported individuals exploiting forests at an elevation of 500–800 m (Zhou and Deng 2019). Today, individuals are principally found in a narrow forest band between 1400 and 2100 m. Across their range, trees of the genera *Cyclobalanopsis*, *Betula*, *Acer*, *Fagus*, and *Lithocarpus* are the most common (Guo *et al.* 2018). Guizhou Snub-nosed Monkeys have been reported to feed on 104 plant species (Guo *et al.* 2018).

A recent study found that only 16.6% (69.6 km²) of the Fanjingshan National Nature Reserve contains habitat suitable for the monkeys (Guo *et al.* 2020). And, although the hunting of Guizhou Snub-nosed Monkeys has been largely eliminated, the construction of roads, shops, accommodation,



and facilities for the more than 1.4 million tourists that have visited the reserve since 2018 (Guizhou Provincial Government 2021), has impacted Snub-nosed Monkey patterns of ranging and distribution. For example, the construction of an aerial tram in the reserve in 2009, divided the remaining area of suitable habitat into two isolated regions: a northern region of 41.1 km² and a southern region of 28.5 km² (Guo *et al.* 2020). Extensive field surveys indicate there are no Snub-nosed Monkeys present in the southern region, and a fine-grained analysis of habitat disturbance and forest fragmentation in the northern region found that the area of remaining suitable habitat totals only 27.8 km² (Guo *et al.* 2020).

Population estimates for the Guizhou Snub-nosed Monkey have varied over the past 35 years, from a low of 90 individuals (Quan and Xie 1981) to a high of 750 (Xiang *et al.* 2009). A recent study based on direct field observations to calculate the population density of Guizhou Snub-nosed Monkeys in the reserve found that the remaining population totals only between 125 and 336 individuals and appears to represent a single multilevel society.

Guo *et al.* (2020) outline a set of conservation recommendations designed to expand existing areas of suitable habitat for this last remaining wild population of Guizhou Snub-nosed Monkeys. These include: 1) implementing an aggressive program of the targeted reforestation of fragmented habitat in the northern part of the reserve in order to expand the ability of these monkeys to reach small disconnected patches of forest that contain feeding trees; 2) hiring local villagers to plant deciduous and evergreen broadleaf mixed forest trees throughout the reserve; and 3) given the small size of the Guizhou Snub-nosed Monkey population, moving its conservation status to Critically Endangered on the IUCN Red List. We also suggest a moratorium on expanding tourist infrastructure in the Fanjingshan National Nature Reserve and limiting the number of tourists visiting the reserve each year. In addition, nearby the Fanjingshan National Nature Reserve there is another nature reserve, the Yangxi Provincial Nature Reserve (218 km²), which is largely unexplored. It remains

uncertain whether there are any Guizhou Snub-nosed Monkeys present there.

- Guizhou Provincial Government (2021). Available online: <https://www.sohu.com/a/392098644_114988>.
- Guo, Y., Zhou, J., Xie, J.H., Garber, P.A., Michael, B., Ren, B.P., Ni, D.Y. and Zhou, J. (2018). Altitudinal ranging of the Guizhou golden monkey (*Rhinopithecus brelichii*): patterns of habitat selection and habitat use. *Glob. Ecol. Conserv.* 16. doi.10.1016/j.gecco.2018.e00473
- Guo, Y. et al. (2016). Red List of China's Vertebrates. *Biodiv. Sci.* 24(5): 500–551.
- Li, B.G. et al. (2018). The primate extinction crisis in China: immediate challenges and a way forward. *Biodiv. Conserv.* 27: 3301–3327.
- Long, Y., Bleisch, W.V., Richardson, M. and Baoguo, L. 2020. *Rhinopithecus brelichii*. The IUCN Red List of Threatened Species 2020: e.T19595A185220311.
- Qi, X.G., Garber, P.A., Huang, Z.P., Huang, K. and Li, B.G. (2014). Satellite telemetry and social modeling offer new insights into the origin of primate multilevel societies. *Nature Commun.* 5: 5296.
- Quan, G.Q. and Xie, J.H. (1981). Notes on *Rhinopithecus roxellanae brelichii* Thomas. *Acta Theriologica Sinica.* 1: 113–116.
- Wang, S.W. and Zhou, J. (2021). Limited heredity diversity of the critically endangered Guizhou golden monkeys. *Res. Ecol.* 3(2): 53–55.
- Tan, C.L. and Bleisch, W. (2016). Guizhou snub-nosed monkey. In: N. Rowe and M. Myers (eds.), *All the World's Primates*, pp. 624–625. Charlestown, RI: Pogonias Press.
- Xiang, Z.F., Nie, S.G., Lei, X.P., Chang, Z.F., Wei, F.W. and Li, M. (2009). Current status and conservation of the gray snub-nosed monkey *Rhinopithecus brelichii* (Colobinae) in Guizhou, China. *Biol. Conserv.* 142: 469e476.
- Zhou, J. and Deng, H. (2019). Two Endemic primate species in China: Hainan gibbon and Guizhou snub-Nosed monkey. In: E.C. Carmona, C.M. Musarella and A.C. Ortiz (eds.), *Endemic Species*. Intech Open. doi.10.5772/intechopen.85933
- Zhou, X. et al. (2014). Whole-genome sequencing of the snub-nosed monkey provides insights into folivory and evolutionary history. *Nat. Genet.* doi.10.1038/ng.3137

ASIA



GAOLIGONG HOOLOCK GIBBON

or Skywalker Hoolock Gibbon

Hoolock tianxing Fan et al., 2017

China, Myanmar
(2018, 2022)

Pengfei Fan, Hanlan Fei, Lu Zhang and Susan M. Cheyne

Hoolock gibbons were first described scientifically by Harlan (1834) under the name *Simia hoolock*. They were subsequently transferred to the genus *Hylobates*, and then assigned to their own distinct subgenus (later elevated to genus), first *Bunopithecus* (later restricted to an extinct Quaternary gibbon from China) (Prouty et al. 1983; Groves 2001) and then *Hoolock* (Mootnick and Groves 2005). Taxonomic variation between different hoolock populations was first recognized by Groves (1967), who identified a major east-west morphological division and described *Hylobates hoolock leuconedys* to distinguish eastern hoolock populations from those in the west, geographically isolated by the Chindwin River. Both subspecies were latterly elevated to full species: the western (*Hoolock hoolock*) and eastern hoolock (*H. leuconedys*) gibbons. Fan et al. (2017) assessed the morphological and genetic characteristics of wild gibbons and museum specimens to evaluate the taxonomic status of the hoolock population in China. The results suggested that hoolocks distributed to the east of the Irrawaddy and Nmai Hka rivers, which were previously assigned to *H. leuconedys*, are morphologically and genetically distinct from those to the west of the rivers, resulting in them now being recognized as a new species: the Gaoligong Hoolock Gibbon or Skywalker Hoolock Gibbon, *Hoolock tianxing* Fan et al. 2017.

Hoolock tianxing was once widely distributed around the west bank of the Salween River, west of Yunnan, China, but >90% of its habitat was lost by 1994 (Fan et al. 2017). In 2009, the population was estimated to be <200 individuals (Fan et al. 2011). In 2017, a second population survey

estimated that the total population was less than 150 individuals, made up of 26 family groups and 11 solitary individuals across 17 subpopulations (Zhang et al. 2020). The largest subpopulation has seven groups, and five of the subpopulations only have one group remaining. Although the population remained relatively stable from 2009 to 2017, it is isolated from other populations by distance, villages and roads, and has a low birth rate. For example, the reproductive rates of three mature females were tracked between 2008 and 2020. One of these females produced two offspring in this time (November 2008 and December 2012), whilst the others produced just one (2008 and 2012). *Hoolock tianxing* is listed as Endangered on the IUCN Red List of Threatened Species (Fan et al. 2020).

Agricultural encroachment, commercial logging, habitat fragmentation and isolation, and hunting (for bushmeat and pet trade) are major threats to *H. tianxing*. The population is also threatened by stochastic loss, in which subpopulations are reduced to 1-2 groups with no opportunity for dispersal or gene-flow. Population linking, protection and habitat restoration are urgently needed, and the translocation of non-viable sub-populations may also be required. There is also a hoolock population in Myanmar. While unstudied, it is likely that the population faces similar difficulties to those in China, (i.e., habitat loss and poaching) but there is comparatively less conservation action and law enforcement in Myanmar. As the population in China decreases, the importance of the Myanmar population increases. Therefore, although demand for conservation intervention in Myanmar is high, a



careful approach is advised to safely navigate the recent political unrest.

The following actions are needed: (1) Raise awareness of this species, especially in China through targeted campaigns; (2) Determine population status in Myanmar through population surveys; (3) Address threats at a local scale through an ethnographic approach; and (4) Investigate possibilities for connecting populated forest fragments and/or translocation of isolated groups/individuals.

- Fan, P.-F., Xiao, W., Huo, S., Ai, H.S., Wang, T.C. and Lin, R.T. (2011). Distribution and conservation status of *Hoolock leuconedys* in China. *Oryx* 45 (1): 129–134.
- Fan, P.-F., He, K., Chen, X., Ortiz, A., Zhang, B., Zhao, C., Li, Y.-Q., Zhang, H.-B., Kimock, C., Wang, W.-Z., Groves, C., Turvey, S.T., Roos, C., Helgen, K.M. and Jiang, X.-L. (2017). Description of a new species of hoolock gibbon (Primates: Hylobatidae) based on integrative taxonomy. *Am. J. Primatol.* 79: e22631. 15pp.
- Fan, P.-F., Turvey, S.T. and Bryant, J.V. 2020. *Hoolock tianxing* (amended version of 2019 assessment). The IUCN Red List of Threatened Species 2020: e.T118355648A166597159.
- Groves, C.P. (1967). Geographic variation in the hoolock or white-browed gibbon (*Hylobates hoolock* Harlan, 1834). *Folia Primatol.* 7: 276–283.
- Groves C.P. (2001). *Primate Taxonomy*. Washington, DC: Smithsonian Institution Press.
- Harlan, R. (1834). Description of a species of Orang, from the north-eastern province of British East India, lately the Kingdom of Assam. *Trans. Am. Phil. Soc.* 4: 52–59.
- Mootnick, A. and Groves, C.P. (2005). A new generic name for the hoolock gibbon (Hylobatidae). *Int. J. Primatol.* 26(4): 971–976.
- Prouty, L.A., Buchanan, P.D., Pollitzer, W.S. and Mootnick A.R. (1983). *Bunopithecus*: A genus-level taxon for the hoolock gibbon (*Hylobates hoolock*). *Am. J. Primatol.* 5: 83–87.
- Zhang, L., Guan, Z., Fei, H., Yan, L., Turvey, S.T. and Fan, P. (2020). Influence of traditional knowledge on conservation of the skywalker hoolock gibbon (*Hoolock tianxing*) outside nature reserves. *Biol. Conserv.* 241: 108276.

ASIA



TAPANULI ORANGUTAN

Pongo tapanuliensis Nurcahyo, Meijaard, Nowak, Fredriksson
& Groves in Nater et al., 2017

Indonesia
(2018, 2022)

Serge Wich, Erik Meijaard, Didik Prasetyo, Wanda Kuswanda,
Panut Hadisiswoyo and Jatna Supriatna

The Tapanuli Orangutan, *Pongo tapanuliensis*, was only formally described in 2017 when it was shown that an isolated orangutan population in the Batang Toru region (which used to be considered the southernmost range of extant Sumatran orangutans, *Pongo abelii*), south of Lake Toba, is distinct from other Sumatran and Bornean populations (Nater et al. 2017). Through a comparison of cranio-mandibular and dental characters from an orangutan killed during human-orangutan conflict to a comparative sample of adult male orangutans of similar developmental stage, Nater et al. (2017) found consistent differences between the Batang Toru individual and other extant Ponginae. Comparisons of adult male long calls from two Tapanuli males with those of a large sample of Bornean and Sumatran males also revealed a unique mix of long call characteristics. Model-based approaches based on the analyses of 37 orangutan genomes supported the morphological results, revealing that the deepest split in the evolutionary history of extant orangutans occurred around 3.38 million years ago between the Batang Toru population and those to the north of Lake Toba. In comparison, the Bornean Orangutan and Sumatran Orangutan separated much later at about 674 ka. The analyses show that there was some gene flow between the Sumatran and Tapanuli Orangutan species until 10–20 ka. Combined, these analyses supported a new classification of orangutans into three extant species.

Due to high levels of habitat conversion and fragmentation, along with illegal hunting and poaching, the Tapanuli Orangutan is estimated

to have experienced a significant population reduction in the past 150 years (Nowak et al. 2017, Meijaard et al. 2021). With a population estimate of 767 individuals (95% confidence intervals: 231–1,597 individuals; Wich et al. 2019), the Tapanuli Orangutan is the least numerous of all great ape species. Its distribution is separated by around 100 km from the closest population of the Sumatran Orangutan to the north. A combination of small population size and geographic isolation is something of particularly high conservation concern. This may lead to inbreeding depression (Hedrick and Kalinowski 2000) and threaten population persistence (Allendorf et al. 2013). For example, in the conflict area of South Tapanuli, only 155 individuals were found (95% confidence interval: 121–187 individuals; Kuswanda et al. 2020). Nater et al. (2017) recorded extensive runs of homozygosity in the genomes of two Tapanuli Orangutan individuals, pointing to the occurrence of recent inbreeding.

The only known population of Tapanuli Orangutans is in the uplands of the Batang Toru Ecosystem, an area of roughly 1,500 km² consisting of three forest blocks, of which 1,023 km² is suitable orangutan habitat (Wich et al. 2016, 2019, Rahman et al. 2019, Kuswanda et al. 2021a). Most of this is ecologically suboptimal upland forest (>500 m asl, up to 1800 m asl), covering the upper watersheds of nine river systems and providing fresh water for over 100,000 people across Tapanuli, which covers 26 sub-districts and 187 villages (Putro et al. 2019). Forest loss data indicate that orangutan habitat below 500 m asl was reduced by 60% between 1985 and 2007 for both the Tapanuli



and the Sumatran Orangutan (Wich *et al.* 2008, 2011). A recent analysis indicated that the current Tapanuli Orangutan distribution is approximately 2.5% and 5.0% of what it was in the 1890s and 1940s, respectively (Meijaard *et al.* 2021). It is thought that more Tapanuli Orangutan habitat will be lost as significant areas of forest within its range remain under considerable threat (Wich *et al.* 2016, 2019, Sloan *et al.* 2018) from habitat conversion for small-scale agriculture, crop-conflict and related killing, mining exploration and exploitation, a hydroelectric scheme, geothermal development and agricultural plantations. The habitat of the Tapanuli Orangutan consists of 7% conservation forest, 64% protection forest, 4% production forest and the remaining 25% in other use areas/cultivated land (Putro *et al.* 2019). Orangutan populations are easy to find on land managed by farmers and this poses a high threat to orangutans.

Across the species' range, the protected areas are not immune from the above threats (Wich *et al.* 2008, 2011, 2016) and orangutans in these areas are also hunted (Wich *et al.* 2012). Due to their slow life history, with a generation time of at least 25 years, and an interbirth interval of 8-9 years, orangutans on Sumatra are unable to sustain substantial and continual loss of individuals (Wich *et al.* 2004, 2009, Marshall *et al.* 2009, Kuswanda *et al.* 2021b). Recent studies indicate that the eastern subpopulation may be growing (Kuswanda *et al.* 2021b). Nevertheless, annual removal rates (killing, translocations, rescues) appear to exceed those needed for maintaining viable populations (Meijaard *et al.* 2021), while disease risk poses another significant threat (Sherman *et al.* 2021).

The Tapanuli Orangutan was more widespread until quite recently as indicated by the Meijaard *et al.* (2021) study, with sightings further south in the lowland peat swamp forests in the Lumut area (Wich *et al.* 2003) and several nests encountered during a rapid survey in 2010 (G. Fredriksson pers. obs.). The forests in the Lumut area have, however, been almost completely converted to oil-palm plantations in recent years. Observations were also made of a male orangutan in the Adiankoting subdistrict in North Tapanuli, north of the Batang Toru West forest block, during a human conflict situation where the orangutan was shot at with

an air rifle when it was found foraging on Durian fruits (G. Fredriksson pers. obs.). The persistence of viable subpopulations in these areas is not known.

Tapanuli Orangutans have been observed feeding on a number of tree species that have not previously been recorded in orangutan diets. These unique species include *Gymnostoma sumatranum* from the Casuarinaceae family, and *Dacrycarpus imbricatus*, *Dacrydium beccarii*, *Dacrydium comosum*, and *Podocarpus neriifolius* from the Podocarpaceae family. At the Sumatran Orangutan Conservation Programme's (SOCP) long-term monitoring station in the Batang Toru Ecosystem, 21.9% of all feeding observations recorded between 2011 and 2015 were represented by five conifer species (Araucariaceae and Podocarpaceae) and one non-conifer evergreen species (Casuarinaceae). Seeds of *Agathis borneensis* from the Araucariaceae family have been considered a 'fallback' fruit, frequently consumed when few other fruits are available (Nater et al. 2017; SOCP unpubl. data). In agroforestry, orangutans have also been identified consuming *Hevea brasiliensis* and *Coffea arabica* fruits (Kuswanda et al. 2021c). Thus, a significant proportion of the dietary profile of Tapanuli Orangutans is markedly different from that of previously studied orangutan populations. This may indicate that this is a refugee species that has been pushed out of more optimal lowland habitat by past hunting (Meijaard et al. 2021).

Due to the extremely rugged terrain, external threats have been primarily limited to illegal clearing of protected and production forests, hunting and killing during crop conflict, and trade in young orangutans (Wich et al. 2012, 2016, Kuswanda et al. 2021b). In the southwest corner of the Batang Toru Ecosystem, a large gold and silver mine has converted key lowland habitat of the Tapanuli Orangutan and retains controversial mining permits overlapping parts of the remaining Tapanuli Orangutan range. Recent expansion of the mine has led to further deforestation in the area where the Tapanuli Orangutan occurs.

A hydro-electric development has been underway in the Tapanuli Orangutan's range since 2017

(Laurance et al. 2020, Prasetyo et al. 2021). Opinions about impacts differ significantly, even among orangutan conservation scientists and practitioners. On the one hand, opponents of the dam argue that the dam could impact roughly 100 km² of Tapanuli Orangutan habitat, or nearly 10% of the entire species population (Sloan et al. 2018). The dam would jeopardize the chances of maintaining and restoring habitat corridors between the western and eastern Tapanuli Orangutan ranges and a strict nature reserve with a small population of Tapanuli Orangutans (Wich et al. 2019). If the connectivity between these populations is not restored, it is argued that the long-term survival of the Tapanuli Orangutan will be severely threatened (Wich et al. 2019).

Proponents of the dam, on the other hand, have argued that the dam is a legitimate development program by the Indonesian government needed to meet Sumatra's clean energy needs. Most of the infrastructure development is carried out on rubber plantations and community agricultural lands that are no longer habitat for orangutans. The hydro-dam company has also implemented various conservation programs, such as the development of arboreal bridges and vegetation corridors, re-vegetation of degraded areas, and the establishment of a special conservation program for the species. They believe that these measures will reduce the total impact of the hydroelectric project and that, in fact, the hydrocompany can make a significant positive contribution to the likelihood of survival of the species (Prasetyo et al. 2021).

In order to safeguard the future of the most endangered great ape species, all possible efforts must now be made to prevent any further degradation of Tapanuli Orangutan habitat, and to reconnect its three habitat fragments to restore genetic exchange. As it currently stands, two of the three habitat fragments do not have viable populations, leaving only one viable but highly threatened population to safeguard the future of the species. Lastly, field management activities need to be established to prevent further hunting and encroachment, with clear and enforced boundary demarcation, and active human-orangutan conflict mitigation efforts must be put in place. The Tapanuli Selatan government is urged to legalize the animal (such

as orangutan) corridor plan that was stated in the ¹Provincial Strategic Area regulations number 2, 2017 and number 5, 2017 and the ²Tapanuli Selatan district regulation number 63, 2020.

- Allendorf, F.W., Luikart, G.H. and Aitken, S.N. (2013). *Conservation and the Genetics of Populations*. 2nd Edition. New York, NY: Blackwell Publishing.
- Hedrick, P.W. and Kalinowski, S.T. (2000). Inbreeding depression in conservation biology. *Ann. Rev. Ecol. Evol. Syst.* 31(1): 139–162.
- Kuswanda, W., Harahap, R.H., Alikodra, H.S. and Sibarani, R. (2020). Nest characteristics and populations of Tapanuli Orangutans in Batangtoru Landscape, South Tapanuli District, Indonesia. *Biodiversitas* 21: 3398–3408.
- Kuswanda, W., Harahap, R.H., Alikodra, H.S. and Sibarani, R. (2021a). Characteristics of the Tapanuli Orangutan habitat in the conflict area of Batang Toru Landscape, North Sumatra, Indonesia. *For. Soc.* 5: 90–108.
- Kuswanda, W., Alikodra, H.S., Margules, C. and Supriatna, J. (2021b). The estimation of demographic parameters and a growth model for Tapanuli orangutan in the Batang Toru Landscape, South Tapanuli Regency, Indonesia. *Glob. Ecol. Conserv.* 31: e01832.
- Kuswanda, W., Harahap, R.H., Alikodra, H.S. and Sibarani, R. (2021c). Causal factors and models of human-Tapanuli orangutan conflict in Batang Toru landscape, North Sumatra, Indonesia. *Agric. Nat. Resour.* 55: 377–386.
- Laurance, W.F., Wich, S.A., Onrizal, O., Fredriksson, G., Usher, G., Santika, T., Byler, D., Mittermeier, R.A., Kormos, R., Williamson, E.A. and Meijaard, E. (2020). Tapanuli orangutan endangered by Sumatran hydropower scheme. *Nat. Ecol. Evol.* 4: 1438–1439.
- Marshall, A.J. et al. (2009). Orangutan population biology, life history, and conservation. Perspectives from population viability analysis models. In: S.A. Wich, S.S. Utami Atmoko, T. Mitra Setia, and C.P. van Schaik (eds.), *Orangutans: Geographic Variation in Behavioral Ecology and Conservation*, pp. 311–326. Oxford, UK: Oxford University Press.
- Meijaard, E., N'imatullah, S., Dennis, R., Sherman, J. and Wich, S.A. (2021) The historical drivers of decline of the Tapanuli orangutan. *PLoS One* 16(1): e0238087.
- Nater, A. et al. (2017). Morphometric, behavioral, and genomic evidence for a new orangutan species. *Curr. Biol.* 27(22): P3487–P3498.
- Nowak, M.G., Rianti, P., Wich, S.A., Meijaard, E. and Fredriksson, G. (2017). *Pongo tapanuliensis*. The IUCN Red List of Threatened Species 2017: e.T120588639A120588662.
- Prasetyo, D., Hadiprakarsa, Y., Kuswanda, W. and Sugardjito, J. (2021). Population status of Tapanuli orangutan (*Pongo tapanuliensis*) within the renewable energy development and its management implications. *For. Soc.* 5(2): 478–493.
- Putro, H.R., Rinaldi, D., Rahman, D.A. and Kuswanda, W. (2019). *The Ecology of Tapanuli Orangutan*. Bogor, Indonesia: Working Group of Batang Toru Sustainable Landscape Management Press.
- Rahman, D.E., Rinaldi, D., Kuswanda, W., Siregar, R., Noor, F.C.H., Hakim, F., Arief, H. and Putro, H.R. (2019). Determining the landscape priority and their threats for the Critically Endangered *Pongo tapanuliensis* population in Indonesia. *Biodiversitas* 20: 3584–3592.
- Sherman, J., Unwin, S., Travis, D.A., Oram, F., Wich, S.A., Jaya, R.L., Voigt, M., Santika, T., Massingham, E., Seaman, D.J.I., Meijaard, E. and Ancrenaz, M. (2021). Disease risk and conservation implications of orangutan translocations. *Front. Vet. Sci.* 8: 10.3389/fvets.2021.749547.
- Sloan, S., Supriatna, J., Campbell, M.J., Alamgir, M. and Laurance, W.F. (2018). Newly discovered orangutan species requires urgent habitat protection. *Curr. Biol.* 28 (11): 650–651.
- Wich, S.A., Singleton, I., Utami-Atmoko, S.S., Geurts, M.L., Rijksen, H.D. and van Schaik, C.P. (2003). The status of the Sumatran orangutan *Pongo abelii*: an update. *Oryx* 37(1): 49–54.
- Wich, S.A., Utami-Atmoko, S.S., Setia, T.M., Rijksen, H.D., Schürmann, C., Van Hooff, J.A. and van Schaik, C.P. (2004). Life history of wild Sumatran orangutans (*Pongo abelii*). *J. Hum. Evol.* 1;47 (6): 385–398.
- Wich, S.A., Meijaard, E., Marshall, A.J., Husson, S., Ancrenaz, M., Lacy, R.C., van Schaik, C.P., Sugardjito, J., Simorangkir, T., Traylor-Holzer, K. and Doughty, M. (2008). Distribution and conservation status of the orangutan (*Pongo* spp.) on Borneo and Sumatra: how many remain? *Oryx* 42(3): 329–39.
- Wich, S.A., de Vries, H., Ancrenaz, M., Perkins, L., Shumaker, R.W., Suzuki, A. and van Schaik, C.P. (2009). Orangutans life history variation. In: S.A. Wich, S.S. Utami-Atmoko, T.M. Setia and C.P. van Schaik (eds.), *Orangutans: Geographic Variation in Behavioral Ecology and Conservation*, pp. 65–75. New York, USA: Oxford University Press.
- Wich, S.A., Riswan, J.J., Jenson, J., Refisch, J. and Nellesmann, C. (2011). *Orangutans and the economics of sustainable forest management in Sumatra*. Norway: UNEP/GRASP/PanEco/YEL/ICRAF/GRID-Arendal.
- Wich, S.A., Fredriksson, G.M., Usher, G., Peters, H.H., Priatna, D., Basalamah, F., Susanto, W. and Kühl, H. (2012). Hunting of Sumatran orangutans and its importance in determining distribution and density. *Biol. Conserv.* 146(1): 163–169.
- Wich, S.A., Singleton, I., Nowak, M.G., Utami Atmoko, S.S., Nisam, G., Mhd Arif, S., Putra, R.H., Ardi, R., Fredriksson, G., Usher, G., Gaveau, D.L.A. and Kühl, H.S. (2016). Land-cover changes predict steep declines for the Sumatran orangutan (*Pongo abelii*). *Sci. Adv.* 2: e1500789.
- Wich, S.A., Fredriksson, G., Usher, G., Kühl, H.S. and Nowak, M.G. (2019). The Tapanuli orangutan: Status, threats, and steps for improved conservation. *Conserv. Sci. Pract.* 1: e33. 10.1111/csp2.33.

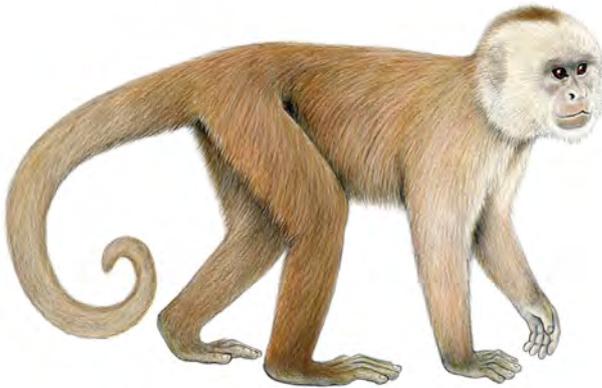
¹ Nos. 2 & 5, 2017. URL: <smilebatangtoru.ipb.ac.id/3b2b7e730db54ebaa1bddd0769f83c80/Publication-Documen/20200805200336.DinasSDACKTR_SM2POK-JA_20200805.pdf>.
² No. 63, 2020. URL: <perbupno.63tahun2020.pdf (jdih.go.id)>.



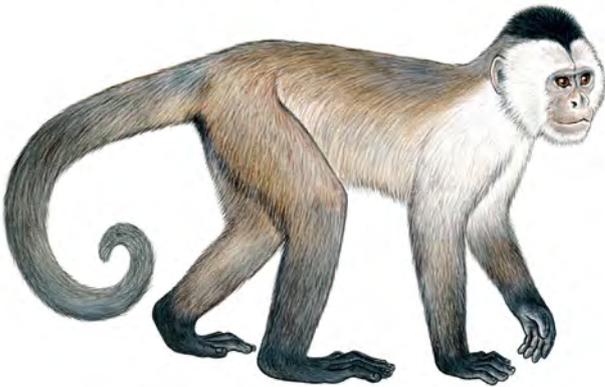
**Groves's
Titi Monkey**
*Plecturocebus
grovesi*



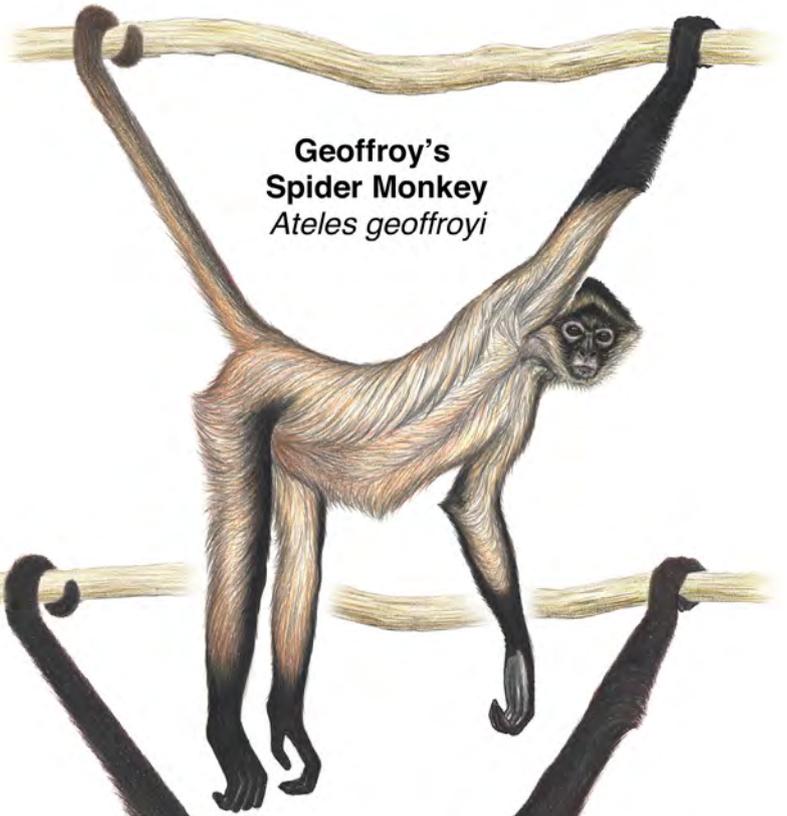
**Buffy-headed
Marmoset**
Callithrix flaviceps



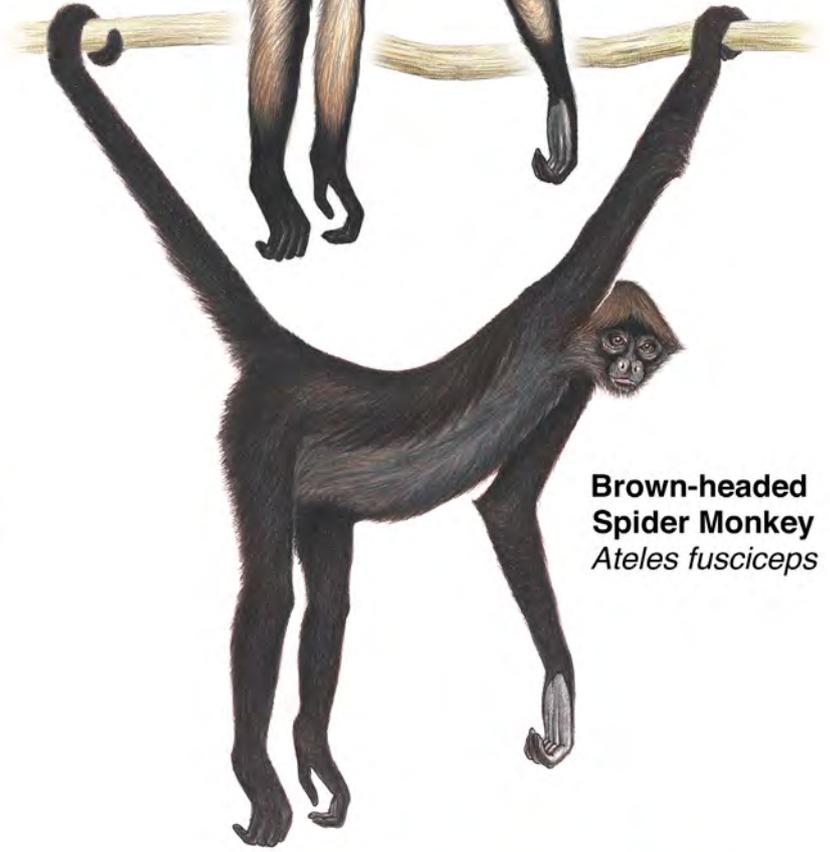
Ecuadorian White-fronted Capuchin
Cebus aequatorialis



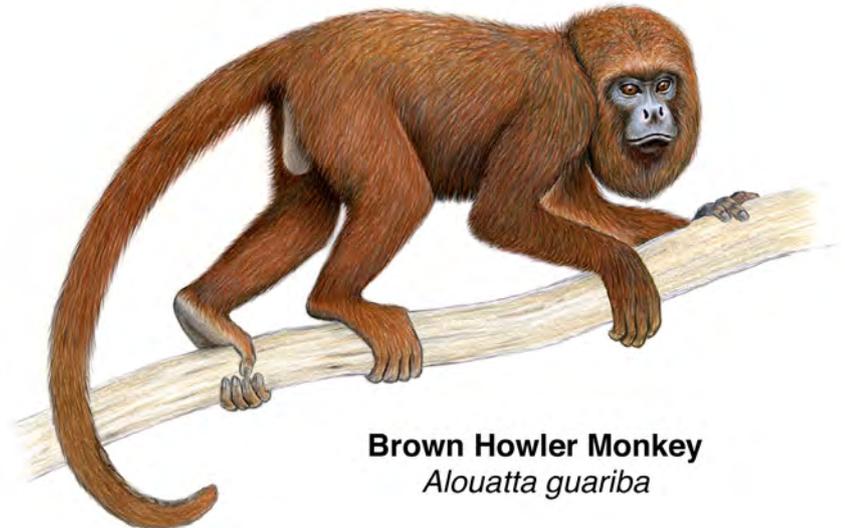
Ka'apor Capuchin
Cebus kaapori



**Geoffroy's
Spider Monkey**
Ateles geoffroyi

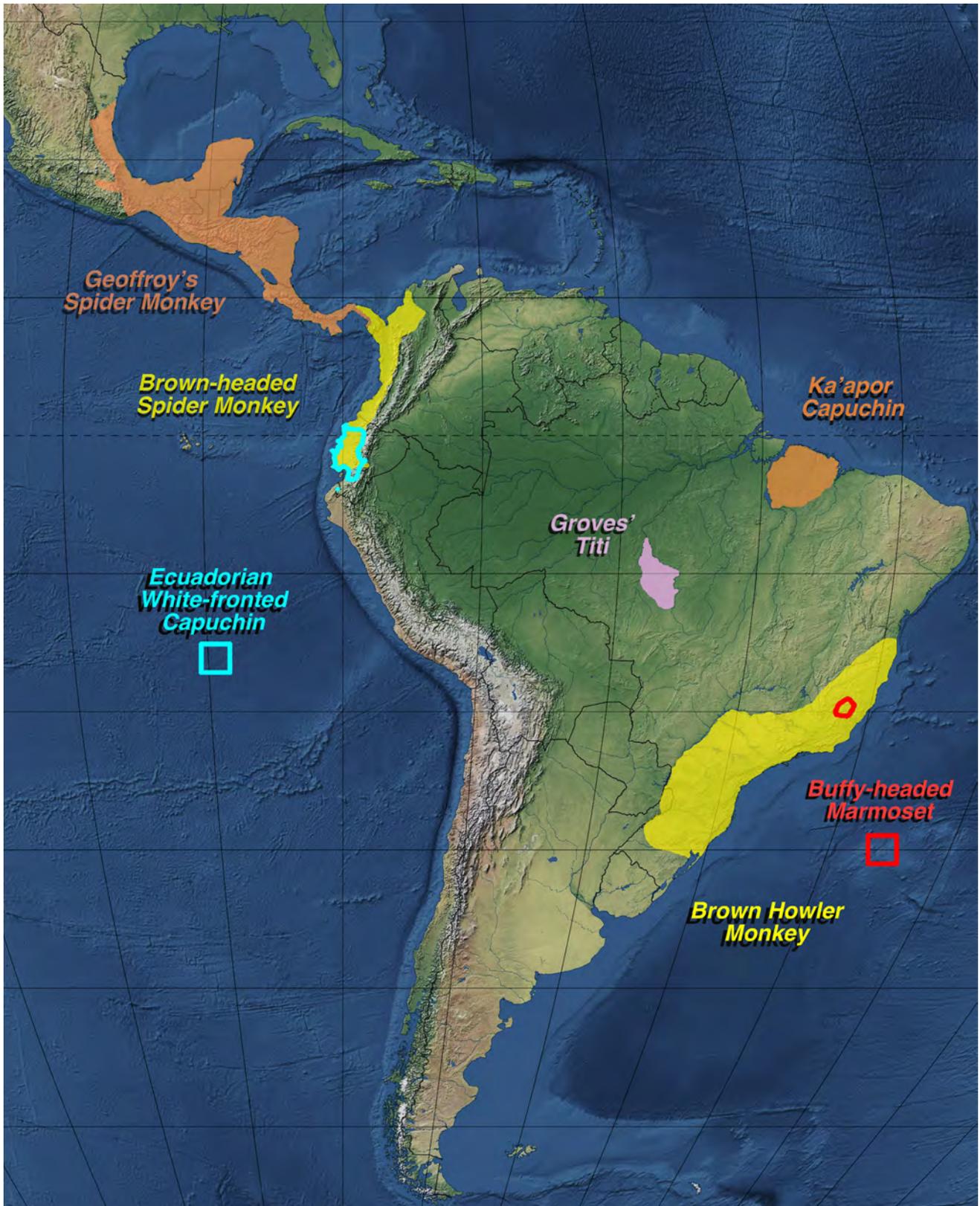


**Brown-headed
Spider Monkey**
Ateles fusciceps



Brown Howler Monkey
Alouatta guariba

NEOTROPICS



NEOTROPICS



BUFFY-HEADED MARMOSET

Callithrix flaviceps (Thomas, 1903)

Brazil
(2022)

Fabiano R. de Melo, Orlando Vital, Sarisha Trindade do Carmo, Rodrigo Salles de Carvalho, Mônica M. Valença-Montenegro, Sérgio Lucena Mendes and Leandro Jerusalinsky

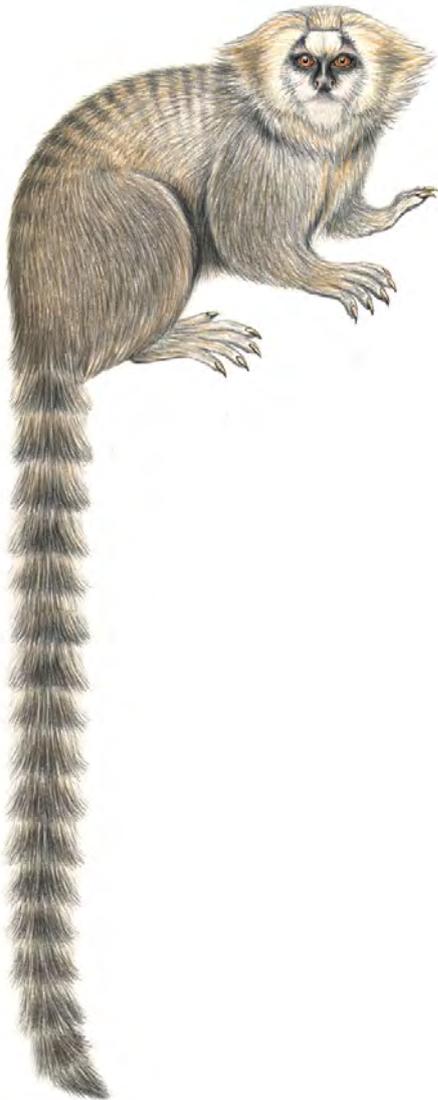
The Buffy-headed Marmoset, *Callithrix flaviceps*, is a small primate endemic to the Atlantic Forest of Southeast Brazil. It occurs in the Serra da Mantiqueira, southern Espírito Santo, south of the Rio Doce at least to the state boundary with Rio de Janeiro. In the past, its range possibly reached the north of the state of Rio de Janeiro, in the municipalities of Natividade, Porciúncula and the north of Bom Jesus do Itabapoana, when this area was covered with native forests (Melo *et al.* 2021). It extends west into eastern Minas Gerais in scattered localities in the highly fragmented forests of the Rio Manhuaçu basin as far as Manhuaçu (40°02'W), as noted by Coimbra-Filho (1986a), Coimbra-Filho *et al.* (1981) and Mendes and Melo (2007), reaching an area of approximately 30,000 km² – among the smallest ranges (Extent of Occurrence) of any platyrrhine (Ferrari and Mendes 1991).

In the past, the eastern Brazilian marmosets of the “*jacchus* group” were considered to be subspecies of *Callithrix jacchus*, following Hershkovitz (1977). All are now considered to be full species (Vivo 1991, Mendes 1997a, 1997b, Marroig *et al.* 2004, Coimbra-Filho *et al.* 2006). Coimbra-Filho (1986a, 1986b, 1990) and Coimbra-Filho *et al.* (1993) argued that *Callithrix flaviceps* should be considered a subspecies of *C. aurita*. The similarities between *C. flaviceps* and *C. aurita* in pelage patterns such as the ear tufts and the skull-like facial mask, ecological adaptations, ontogeny (the infants are extremely similar), vocalizations and clinal variation in overall pelage color, are the basis for this opinion (Coimbra-Filho 1986a, 1986b, Coimbra-Filho *et al.* 1993). Ferrari *et al.* (1996), however, rejected the subspecies status of *C. flaviceps* based on

ecological and behavioral studies of groups of *C. flaviceps* and *C. aurita*.

As with the other marmosets, *C. flaviceps* eats fruits, flowers, nectar, plant exudates (gums, saps, latex), fungi and animal prey (including frogs, snails, lizards, spiders, and insects) (Ferrari 1988, 1991a, Corrêa *et al.* 2000, Hilário and Ferrari 2010a). Marmosets also have morphological and behavioral adaptations for gouging tree trunks, branches, and vines of certain species to stimulate the flow of gum, which they eat, forming a notable component of their diet (Coimbra-Filho 1972, Rylands 1984). Nevertheless, *C. flaviceps* rarely gouges trees in order to stimulate exudate production and feeds primarily on exudates already available (Ferrari 1991b, Hilário and Ferrari 2010a).

Buffy-headed Marmosets live in extended family groups of 3 to 20 individuals (Alves 1986, Ferrari 1991b, Ferrari and Digby 1996, Guimarães 1998, Hilário and Ferrari 2010a), and groups present weak territoriality and occupy large home ranges (33.9 to 138.3 ha) compared to other congeneric species (Ferrari 1991, Guimarães 1998, Hilário 2009). Generally, only a single dominant female breeds, although up to four females have been seen to reproduce simultaneously in one large group (Ferrari 1991, Guimarães 1998, Hilário and Ferrari 2010b). Births often occur twice a year, however, the reproductive peak in the dry season is less pronounced (Ferrari 1991), with some populations even avoiding reproduction in this season (Hilário and Ferrari 2010a).



Callithrix flaviceps and *C. aurita* are the southernmost marmosets in terms of the natural range of the genus. *Callithrix jacchus*, *C. penicillata* and *C. geoffroyi* have been introduced further south in the Brazilian states of São Paulo, Paraná, Santa Catarina, Rio Grande do Sul and in Argentina (Santos *et al.* 2005). They occur in the montane Atlantic coastal forest and forests of the inland plateau, at altitudes up to 1,200 m where dry season temperatures can fall close to freezing (Ferrari *et al.* 1996). They show some level of tolerance and flexibility to habitat disturbance, being sometimes rare in old growth forest with sparse understories (Ferrari 1988, Ferrari and Mendes 1991). There is a natural hybrid zone with *C. aurita*, in the region of Carangola, Tombos and Caiana municipalities, in south-eastern Minas Gerais (Coimbra-Filho *et al.* 1993, Cosenza 1993, Mendes 1997a, Cosenza and Melo 1998).

Callithrix flaviceps has a restricted range in an area where the forest is extremely fragmented due to expanding agriculture, cattle ranching, tree plantations (*Eucalyptus*), urbanization, mining and dam construction (Coimbra-Filho 1986a, 1990, Ferrari and Mendes 1991, Mendes and Melo 2007). Mendes and Melo (2007) surveyed forest fragments in the Zona da Mata of the state of Minas Gerais, and recorded the presence of introduced populations of *Callithrix jacchus*, *C. penicillata*, and *C. geoffroyi*, which they believe are displacing *C. flaviceps*. They recommended awareness campaigns to reduce the habit of releasing exotic marmosets in the forests surrounding the town of Manhuaçu. Since this study, the presence of invasive congeners, resulting in mixed groups and hybrid specimens, has unfortunately become common and results in ecological competition and genetic erosion for the native and threatened *Callithrix flaviceps* (see Malukiewicz *et al.* 2021). A recent survey in the Caratinga Biological Station/Reserva Particular do Patrimônio Natural (RPPN) Feliciano Miguel Abdala indicated a 90% population decline since 2005, primarily due to a yellow fever outbreak (Possamai *et al.* 2019). Other subpopulations were highly impacted by this epidemic in Espírito Santo (S.L. Mendes, pers. obs.), and this may be the case throughout the species' range.

This species has been estimated to have a mean density of 7.1 individuals/km² (range: 3.4 to 18

individuals/km²) in the Augusto Ruschi Biological Reserve, Espírito Santo (Pinto *et al.* 1993), while Hilário (2009) recorded a density of 15.4 individuals/km². At the Caratinga Biological Station/RPPN Feliciano Miguel Abdala, Minas Gerais, the recorded densities were 40 individuals/km² (Ferrari 1988) and 13 individuals/km² (Almeida-Silva *et al.* 2005). A recent study of occupancy in the northwest boundary of the species' range (in Atlantic Forest patches in private reserves and their surroundings in the central region of Minas Gerais), detected healthy, pure-breeding groups in 25 of 145 sites surveyed, ranging from 2–12 individuals, and two hybrid groups (Carmo 2022). Using a conservative approach (with the lowest density reported for the species), we estimate a total population of 4,440, consisting of less than 2,500 mature individuals (Brazil, ICMBio 2018). Considering the highly fragmented landscape in which *C. flaviceps* occurs, it is also unlikely that any subpopulation has more than 250 mature individuals (Melo *et al.* 2019).

A population reduction of at least 80% over 18 years (three generations) has been inferred based on cumulative and synergistic impacts of the historical habitat loss in the species' restricted range, the diminished and severally fragmented habitat remnants, ecological competition and genetic erosion caused by the invasion of congeners, and the recent yellow fever outbreak. Thus, *Callithrix flaviceps* was classified as Critically Endangered on the IUCN Red List of Threatened Species (Melo *et al.* 2021), as it was for the national Brazilian assessment (ICMBio in prep.).

The larger protected areas where the species occurs are the Caparaó National Park, the Augusto Ruschi Biological Reserve, the Rio Doce State Park, and the Pedra Azul State Reserve. It is also present in a series of privately owned reserves, including the Caratinga Biological Station/RPPN Feliciano Miguel Abdala, the RPPN Mata do Sossego, and the Montes Verdes Forest Reserve. It is not clear, however, whether (and to what extent) these areas are free from the invasive and hybrid forms. This highlights the crucial need to develop effective methods to control the invasive congeners and the resulting hybrid populations, as well as implementing recovery strategies for native populations of *C. flaviceps*.

The Mountain Marmosets Conservation Center of the Federal University of Viçosa (CCSS-UFV) was recently created with the specific goal to breed and maintain captive groups of *C. aurita* and *C. flaviceps*, and to set up an *ex situ* management program to preserve the species' genetic diversity and support releases in key areas. A group of researchers and managers from several institutions (universities, NGOs, zoos, public agencies) has established a series of tools and methodologies to increase our knowledge of the species, including developing a *Callithrix* occurrence database to identify priority areas for surveying, conserving, and managing populations of these species. These initiatives are part of the Mountain Marmosets Conservation Program (MMCP), which is developing an operational agenda for the effective implementation of the conservation strategies established by the *National Action Plan for the Conservation of the Atlantic Forest Primates and the Maned Sloth* (Brazil, ICMBio, 2018).

- Almeida-Silva, B., Cunha, A.A., Boubli, J.P., Mendes, S.L. and Strier, K.B. (2005). Population density and vertical stratification of four primate species at the Estação Biológica de Caratinga/RPPN-FMA, Minas Gerais, Brazil. *Neotrop. Primates* 13: 25–30.
- Alves, M.C. (1986). Observações sobre o *Callithrix flaviceps* (Thomas, 1903) na Estação Ecológica de Caratinga – EBC/FBCN, MG (Callitrichidae, Primates). In: M.T. de Mello (ed.), *A Primatologia no Brasil – 2*, pp. 205–206. Sociedade Brasileira de Primatologia, Brasília.
- Brazil, ICMBio (2018). Aprova o *Plano de Ação Nacional para a Conservação dos Primatas da Mata Atlântica e da Preguiça-de-Coleira*. Portaria nº 702, de 07 de agosto de 2018 – Instituto Chico Mendes de Conservação da Biodiversidade. *Diário Oficial da União – Seção 1* 153: 57.
- Carmo, S.T. (2022). Probabilidade de Ocupação e Detecção de Sagui-da-Serra (*Callithrix flaviceps* Thomas, 1903) (Primates: Callitrichidae) na RPPN Fazenda Macedônia e em Fragmentos de Mata Atlântica no Seu Entorno, Ipaba, MG. Masters dissertation, Universidade Federal de Viçosa, MG, Brazil.
- Coimbra-Filho, A.F. (1972). Aspectos inéditos do comportamento de sagüis do gênero *Callithrix* (Callitrichidae, Primates). *Revista Brasil. Biol.* 32: 505–512.
- Coimbra-Filho, A.F. (1986a). Sagui-da-serra *Callithrix flaviceps* (Thomas, 1903). *FBCN/Inf., Rio de Janeiro* 10(1): 3.
- Coimbra-Filho, A.F. (1986b). Sagui-da-serra-escuro *Callithrix aurita* (E. Geoffroy, 1812). *FBCN/Inf., Rio de Janeiro* 10(2): 3.

- Coimbra-Filho, A.F. (1990). Sistemática, distribuição geográfica e situação atual dos símios brasileiros (Platyrrhini, Primates). *Revista Brasil. Biol.* 50: 1063–1079.
- Coimbra-Filho, A.F., Mittermeier, R.A. and Constable, I.D. (1981). *Callithrix flaviceps* (Thomas, 1903) recorded from Minas Gerais, Brazil (Callitrichidae, Primates). *Rev. Brasil. Biol.* 41(1): 141–147.
- Coimbra-Filho, A.F., Pissinatti, A. and Rylands, A.B. (1993). Experimental multiple hybridisms among *Callithrix* species from eastern Brazil. In: A.B. Rylands (ed.), *Marmosets and Tamarins: Systematics, Ecology, and Behaviour*, pp. 95–120. Oxford, UK: Oxford University Press.
- Coimbra-Filho, A.F., Mittermeier, R.A., Rylands, A.B., Mendes, S.L., Kierulff, M.C.M. and Pinto, L.P. de S. (2006). The taxonomic status of Wied's black-tufted-ear marmoset, *Callithrix kuhlii* (Callitrichidae, Primates). *Primate Conserv.* (21): 1–24.
- Corrêa, H.K.M., Coutinho, P.E.G. and Ferrari, S.F. (2000). Between-year differences in the feeding ecology of highland marmosets (*Callithrix aurita* and *Callithrix flaviceps*) in south-eastern Brazil. *J. Zool., Lond.* 252: 421–427.
- Cosenza, B.A.P. (1993). *Primatas do Município de Carangola*. Minas Gerais, Carangola.
- Cosenza, B.A.P. and de Melo, F.R. (1998). Primates of the Serra do Brigadeiro State Park, Minas Gerais, Brazil. *Neotrop. Primates*. 6: 18–20.
- Ferrari, S.F. (1988). The Ecology and Behavior of the Buffy-headed Marmoset, *Callithrix flaviceps* (O. Thomas, 1903). Doctoral thesis, University College, London.
- Ferrari, S.F. (1991a). Diet for a small primate. *Nat. Hist.* 100:168–173.
- Ferrari, S.F. (1991b). Preliminary report on a field study of *Callithrix flaviceps*. In: A.B. Rylands and A.T. Bernardes (eds.), *A Primatologia no Brasil – 3*, pp. 159–171. Belo Horizonte, Brazil: Sociedade Brasileira de Primatologia.
- Ferrari, S.F. and Digby, L.J. (1996). Wild *Callithrix* groups: stable extended families? *Am. J. Primatol.* 38: 19–27.
- Ferrari, S.F. and Mendes, S.L. (1991). Buffy-headed marmosets 10 years on. *Oryx* 25: 105–109.
- Ferrari, S.F., Corrêa, M.K.M. and Coutinho, P.E.G. (1996). Ecology of the southern marmosets (*Callithrix aurita* and *Callithrix flaviceps*) – how different, how similar? In: M.A. Norconk, A.L. Rosenberger and P.A. Garber (eds.), *Adaptive Radiations of Neotropical Primates*, pp. 157–171. New York: Plenum Press.
- Guimarães, A. (1998). Ecologia, Comportamento Reprodutivo e Marcação de Cheiro em Um Grupo de *Callithrix flaviceps* (Callitrichidae, Primates), na Estação Biológica de Caratinga, Minas Gerais. Masters thesis, Universidade Federal de Minas Gerais, Belo Horizonte, MG, Brazil.
- Hershkovitz, P. (1977). *Living New World monkeys (Platyrrhini), With an Introduction to Primates*. Chicago, IL: University of Chicago Press.
- Hilário, R.R. (2009). Padrão de Atividades, Dieta e Uso do Habitat por *Callithrix flaviceps* na Reserva Biológica Augusto Ruschi, Santa Teresa, ES. Masters thesis, Universidade Federal de Minas Gerais, Belo Horizonte, MG, Brazil.
- Hilário, R.R. and Ferrari, S.F. (2010a). Feeding ecology of a group of buffy-headed marmosets (*Callithrix flaviceps*): fungi as a preferred resource. *Am. J. Primatol.* 72: 515–521.
- Hilário, R.R. and Ferrari, S.F. (2010b). Four breeding females in a free-ranging group of buffy-headed marmosets (*Callithrix flaviceps*). *Folia Primatol.* 81: 31–40.
- Malukiewicz, J. et al. (2021). An introduction to the *Callithrix* genus and overview of recent advances in marmoset research. *ILAR Journal* 61(2–3): 110–138.
- Marroig, G., Cropp, S. and Cheverud, J.M. (2004). Systematics and evolution of the *jacchus* group of marmosets (Platyrrhini). *Am. J. Phys. Anthropol.* 123: 11–22.
- Melo, F.R., Hilário, R.R., Ferraz, D.S., Pereira, D.G., Biccamarques, J.C., Jerusalinsky, L., Mittermeier, R.A., Ruiz-Miranda, C.R., Oliveira, L. and Valença-Montenegro, M.M. (2021). *Callithrix flaviceps* (amended version of 2020 assessment). The IUCN Red List of Threatened Species 2021: e.T3571A191700879.
- Mendes, S.L. (1997a). Hybridization in free-ranging *Callithrix flaviceps* and the taxonomy of the Atlantic Forest marmosets. *Neotrop. Primates*. 5(1): 6–8.
- Mendes, S.L. (1997b). Padrões Biogeográficas e Vocais em *Callithrix* do Grupo *jacchus* (Primates, Callitrichidae). Doctoral thesis, Universidade Estadual de Campinas, Campinas, SP, Brazil.
- Mendes, C.S.L. and Melo, F.R. de (2007). Situação atual do sagüi-da-serra (*Callithrix flaviceps*) em fragmentos florestais na Zona da Mata de Minas Gerais. In: J.C. Biccamarques (ed.), *A Primatologia no Brasil – 10*, pp. 163–180. Porto Alegre.
- Pinto, L.P.S., Costa, C.M.R., Strier, K.B. and da Fonseca, G.A.B. (1993). Habitat, density, and group size of primates in a Brazilian tropical forest. *Folia Primatol.* 61: 135–143.
- Possamai, C.B., Mendes, S.L. and Strier, K.B. (2019). Decline of a primate community following a yellow fever outbreak in the Brazilian Atlantic Forest. Abstract: 42nd meeting of the American Society of Primatologists, University of Wisconsin, Madison, August 21–24, 2019.
- Rylands, A.B. (1984). Exudate-eating and tree-gouging by marmosets (Callitrichidae, Primates). In: A.C. Chadwick and S.L. Sutton (eds.), *Tropical Rain Forest: The Leeds Symposium*, pp. 155–168. Leeds, UK: Leeds Philosophical and Literary Society.
- Santos, C.V., Luz, K.P. and Sant'anna, F.S. (2005). As três espécies de primatas do gênero *Callithrix* (*C. jacchus*, *C. penicillata* e *C. geoffroyi*) introduzidos na Ilha de Santa Catarina – SC: importância de pesquisa na implantação do manejo. In: *Resumos: XI Congresso Brasileiro de Primatologia, Porto Alegre, RS, Brasil*. 13 a 18 de fevereiro de 2005. [Abstract]
- Vivo, M. de. 1991. *Taxonomia de Callithrix Erxleben, 1777 (Callitrichidae, Primates)*. Belo Horizonte: Fundação Biodiversitas.

NEOTROPICS

© Fabiano R. de Melo



KA'APOR CAPUCHIN

Cebus kaapori Queiroz, 1992

Brazil
(2012, 2014, 2016, 2022)

Gerson Buss, Tatiane dos Santos Cardoso, Helder Queiroz, Ana Cristina Mendes de Oliveira, Fabiano R. de Melo and Leandro Jerusalinsky

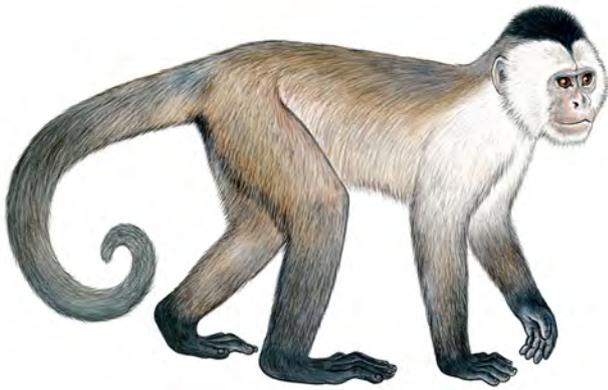
The Ka'apor Capuchin (*Cebus kaapori*), first described just over 30 years ago, is endemic to the eastern edge of the Brazilian Amazon, in the so-called Centro de Endemismo Belém (Belém Endemism Center), in the north-east of the state of Pará and the north-west of the state of Maranhão (Queiroz 1992). Its range extends from the east of the lower Rio Tocantins to the Rio Grajaú, where it enters the Zona dos Cocais (Queiroz 1992, Ferrari and Queiroz 1994, Ferrari and Souza 1994, Silva and Cerqueira 1998, Carvalho *et al.* 1999, Cunha *et al.* 2007). The Extent of Occurrence is 206,081 km² (Butti *et al.* in prep.). This species is usually observed in tall lowland terra firma forest, generally below 300 m above sea level, and has not been recorded in seasonally inundated or secondary forest (Silva Jr. *et al.* 2009, 2010, Rylands and Mittermeier 2013). It is generally seen in small groups of up to ten individuals, sometimes accompanying the Endangered Black Saki (*Chiropotes satanas*) (Ferrari and Lopes 1996, Carvalho *et al.* 1999). Besides surveys and abundance studies, recent research has provided additional ecological information about the species (Oliveira *et al.* 2014).

Due to the threats of habitat loss and hunting, and a drastic population reduction, *C. kaapori* is classified as Critically Endangered on the IUCN Red List of Threatened Species (Fialho *et al.* 2021), likewise in the national assessment of Brazil (Brazil, MMA 2014, Fialho *et al.* 2018). Lopes and Ferrari (1993) and Ferrari and Queiroz (1994) concluded that *C. kaapori* is one of the most threatened of all Amazonian primates. The Ka'apor Capuchin inhabits a densely populated region with the highest level of deforestation

and habitat degradation in the entire Brazilian Amazon (Carvalho *et al.* 1999). More than 70% of the forest has been destroyed, converted to farmland and pasture (Almeida and Vieira 2010). Deforestation continues, and most of the remaining forests are isolated and degraded patches in farmland where this species is also hunted. Habitat loss across the species' range from 1985 to 2020 was estimated at 32.8% (Butti *et al.* in prep.). A species distribution model indicates that *C. kaapori* could lose all of its forests because of climate change and deforestation over the next 30 years (da Silva *et al.* 2022).

Cebus kaapori occurs in two protected areas: the Lago de Tucuruí Environmental Protection Area of 5,687 km² that allows for sustainable use; and the Gurupi Biological Reserve of 2,712 km² that is under strict protection. In 2015, Gurupi and contiguous indigenous lands were seriously affected by forest fires. The Chico Mendes Institute for Biodiversity Conservation (ICMbio) estimated that 1,330 km² of the Gurupi reserve was impacted (Buss *et al.* 2017), reducing the available habitat for *C. kaapori*.

Lopes (1993) recorded three groups over 480 km surveyed in the Gurupi Biological Reserve (0.06 groups/10 km). Carvalho *et al.* (1999) registered a relative abundance of 0.99 groups/10 km in the Fazenda Cauaxi, in Paragominas. More recently, Buss *et al.* (2017) found 0.25 groups/10 km in a survey of 320 km, in the Gurupi reserve. These results indicate that the Ka'apor Capuchin is naturally rare; it is hunted and is susceptible to any, even light, disturbance, or degradation of its habitat. Selective logging of fruit trees that form a significant part of the species' diet is a



considerable threat (Lopes 1993). Its rarity may be related to competition with the sympatric Black-capped Capuchin (*Sapajus apella*) and naturally low densities may reflect the need for large home ranges.

A Population Viability Analysis using Vortex software indicated only three viable populations over the next 100 years (Campos 2009): a complex of Indigenous Territories in the state of Maranhão (Caru, Awá, Alto Turiaçu, Araribóia); Alto Rio Guama, an Indigenous Territory in the state of Pará; and the Gurupi Biological Reserve along the border between the two states.

Ka'apor Capuchins are maintained in only a few zoological institutions, such as São Paulo Zoo (Fundação Parque Zoológico de São Paulo), Rio de Janeiro Zoo (BioParque do Rio de Janeiro) and the National Primate Center (Centro Nacional de Primatas [CENP], linked to the Brazilian Ministry of Health) (Mônica M. Valença-Montenegro - ICMBio/CPB, pers. comm.). Guajá Indians often keep them as pets (Queiroz 1992).

A study on the ecology of *C. kaapori* in the Gurupi Biological Reserve, aiming to generate the first systematic information on home range, habitat use, diet and activity pattern of the species in continuous forest, is being carried out by Tatiane S. Cardoso. Preliminary data indicate large home ranges of approximately 300 ha for a group with 12 individuals, among the largest estimated for the genus *Cebus* (Cardoso 2021).

Strategies to promote the conservation of *C. kaapori* are included in the *Brazilian National Action Plan for the Conservation of the Amazonian Primates* (Brazil, MMA 2017). The Gurupi Biological Reserve is one of the study areas of the project "Primates in Protected Areas of the Brazilian Amazon: assessing the impacts of forest fires over endangered primates," coordinated by the National Center for Research and Conservation of Brazilian Primates (ICMBio/CPB) and supported by Re:wild. This project aims to evaluate the occurrence and abundance, conservation status and impacts of fires on endangered primate populations in protected areas along the Brazilian Amazon's Arc of Deforestation, to provide information to support further protection and management actions.

- Almeida, A.S. and Vieira, I.C.G. (2010). Centro de Endemismo Belém: status da vegetação remanescente e desafios para a conservação da biodiversidade e restauração ecológica. *REU Sorocaba* 36(3): 95–111.
- Brazil, MMA. (2014). Reconhecer como espécies da fauna brasileira ameaçadas de extinção aquelas constantes da “Lista Nacional Oficial de Espécies da Fauna Ameaçadas de Extinção.” Portaria 444, de 17 de dezembro de 2014. Ministério do Meio Ambiente. *Diário Oficial da União*, Seção 1, número 245: 121–126.
- Brazil, MMA. (2017). Aprova o Plano de Ação Nacional para a Conservação dos Primatas Amazônicos – PAN Primatas Amazônicos. Portaria 792, de 01 de dezembro de 2017. Ministério do Meio Ambiente. *Diário Oficial da União*, Seção 1, número 232: 24–61.
- Buss, G., Fialho, M.S., Jerusalinsky, L., Azevedo, R.B., Alves, S.L., Vidal, M.D. and Mendonça, E.N. (2017). Abundância e densidade de primatas na Reserva Biológica do Gurupi, Maranhão, Brasil. *Biodiv. Brasil*. 7(2): 47–57.
- Butti, M., Pacca, L., Santos, P.M., Alonso, A.C., Buss, G., Ludwig, G., Jerusalinsky, L. and Martins, A.B. In prep. Habitat loss estimation to assess terrestrial mammal species extinction risk: an open data framework.
- Campos, I.B. (2009). Identificando Vacíos Clave de Información y Posibles Acciones Conservacionistas a través de un Análisis de Viabilidade Poblacional para *Cebus kaapori* Queiroz (1992) (Cebidae-Primate), un Primate del Este Amazónico en Peligro Crítico de Extinción. Master's thesis, Universitat de Barcelona, Barcelona, Spain.
- Cardoso, T.S. (2021). Ecologia Comportamental de *Cebus kaapori* na Reserva Biológica do Gurupi, Maranhão. Relatório Técnico. Programa de Capacitação Institucional (PCI/CNPq). Belém, PA: Museu Paraense Emílio Goeldi.
- Carvalho, O., Jr, de Pinto, A.C.B. and Galetti, M. (1999). New observations on *Cebus kaapori* in eastern Brazilian Amazonia. *Neotrop. Primates* 7: 41–43.
- Cunha, F.A., Lopes, M.A., Dantas, S. de M., Carmo, N.A.S. do and Silva S. do S.B. da. (2007). Registro de ocorrência de *Cebus kaapori* (Cebidae: Primates) na APA Lago de Tucuruí. *Neotrop. Primates*. 14: 84–85.
- da Silva, L.B., Oliveira, G.L., Frederico, R.G., Loyola, R., Zacarias, D., Ribeiro, B.R. and Mendes-Oliveira, A.C. (2022). How future climate change and deforestation can drastically affect the species of monkey endemic to the eastern Amazon, and priorities for conservation. *Biodiv. Conserv.* 18pp. doi.org/10.1007/s10531-022-02373-1
- Ferrari, S.F. and Lopes, M.A. (1996). Primate populations in eastern Amazonia. In: M.A. Norconk, A.L. Rosenberger and P.A. Garber (eds.), *Adaptive Radiations of Neotropical Primates*, pp. 53–67. New York: Plenum Press.
- Ferrari, S.F. and Queiroz, H.L. (1994). Two new Brazilian primates discovered, endangered. *Oryx* 28: 31–36.
- Ferrari, S.F. and de Souza Jr., A.P. (1994). More untufted capuchins in southeastern Amazonia? *Neotrop. Primates* 21: 9–10.
- Fialho, M.S., Moura, E.F., Ravetta, A.L., Laroque, P.O. and Queiroz, H.L. (2018). Avaliação do Risco de Extinção de *Cebus kaapori* Queiroz, 1992. In: Instituto Chico Mendes de Conservação da Biodiversidade (ed.), *Livro Vermelho da Fauna Brasileira Ameaçada de Extinção: Volume II – Mamíferos*, pp. 253–259. Brasília: MMA, ICMBio.
- Fialho, M.S., Jerusalinsky, L., Moura, E.F., Ravetta, A.L., Laroque, P.O., Queiroz, H.L., Boubli, J.P. and Lynch Alfaro, J.W. (2021). *Cebus kaapori* (amended version of 2020 assessment). The IUCN Red List of Threatened Species 2021: e.T40019A191704766.
- Lopes, M.A. (1993). Conservação do Cuxiú-preto, *Chiropotes satanas satanas* (Cebidae: Primates) e de Outros Mamíferos na Amazônia Oriental. Master's thesis, Universidade Federal do Pará, Belém.
- Lopes, M.A. and Ferrari, S.F. (1993). Primate conservation in eastern Brazilian Amazonia. *Neotrop. Primates* 1: 8–9.
- Oliveira, S.G., Alfaro, J.W. and Veiga, L.M. (2014). Activity budget, diet, and habitat use in the critically endangered Ka'apor capuchin monkey (*Cebus kaapori*) in Pará State, Brazil: a preliminary comparison to other capuchin monkeys. *Am. J. Primatol.* 76(10): 919–931.
- Queiroz, H.L. (1992). A new species of capuchin monkey, genus *Cebus* Erxleben 1977 (Cebidae, Primates), from eastern Brazilian Amazonia. *Goeldiana Zool.* 15: 1–13.
- Rylands, A.B. and Mittermeier, R.A. (2013). Ka'apor capuchin *Cebus kaapori*. In: R.A. Mittermeier, A.B. Rylands and D.E. Wilson (eds.), *Handbook of the Mammals of the World. Volume 3. Primates*, p. 410. Barcelona: Lynx Edicions.
- Silva Jr., J.S. and Cerqueira, R. (1998). New data and a historical sketch on the geographical distribution of the Ka'apor capuchin, *Cebus kaapori* Queiroz, 1992. *Neotrop. Primates* 6: 118–121.
- Silva Jr., J.S., Lima, E.M., Camargo, C.C. and Ramos, R.M. (2009). Mamíferos de médio e grande porte. In: M.A. Monteiro, M.C.N. Coelho and E.J.S. Barbosa (eds.), *Atlas Sócioambiental: Municípios de Tomé-Açu, Aurora do Pará, Ipixuna do Pará, Paragominas e Ulianópolis*, pp. 125–300. Belém, Pará: Núcleo de Altos Estudos Amazônicos (NAEA).
- Silva Jr., J.S., Ohana J.A.B., Silva, C.R., Cardoso, E.M., Avelar, A.A., Silva, V.F. and Silva, L.S. (2010). Mamíferos terrestres de médio e grande porte no litoral da Amazônia Brasileira. In: L.M. Pessoa, W.C. Tavares and S. Siciliano (eds.), *Mamíferos de Restingas e Manguezais*, pp. 19–44. Rio de Janeiro: Sociedade Brasileira de Mastozoologia. Museu Nacional do Rio de Janeiro.

NEOTROPICS



ECUADORIAN WHITE-FRONTED CAPUCHIN

Cebus aequatorialis J.A. Allen, 1914

Ecuador, Peru
(2018, 2022)

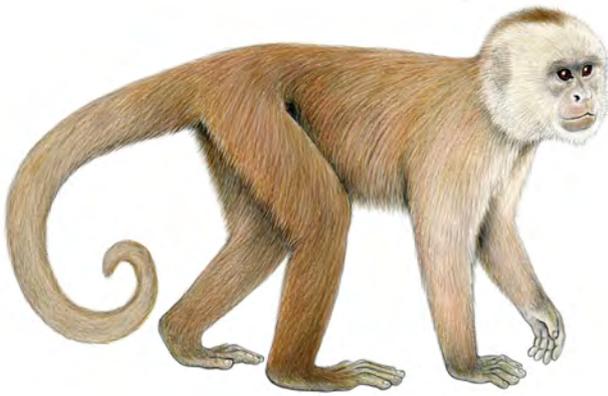
Stella de la Torre, Fanny Cornejo, María Fernanda Solórzano, Laura Cervera, Diego G. Tirira, Felipe Alfonso-Cortes, Nathalia Fuentes, Esteban Rivera and Mónica Alzamora

The Ecuadorian White-fronted Capuchin, *Cebus aequatorialis*, is classified as Critically Endangered on the IUCN Red List of Threatened Species (Tirira 2011, 2021a, Moscoso *et al.* 2021). It is found in western Ecuador and northwestern Peru from sea level to 2420 m (Tirira 2017, Brito *et al.* 2018, Moscoso *et al.* 2021). In the north of its range, most records now are south of the Río Guayllabamba, and its southernmost distribution appears to be the Cerros de Amotape National Park in Peru (Tirira 2017, Cervera *et al.* 2018a, 2018b, Moscoso *et al.* 2021). The species is included in CITES Appendix II and it is illegal to hunt or trade *C. aequatorialis* in both Ecuador (Tirira 2011) and Peru (SERFOR 2015).

The species inhabits tropical and subtropical forests of the Chocó and Tumbes eco-regions (Albuja 2002, Albuja and Arcos 2007). It occurs in primary and secondary forest as well as orchards and occasionally goes to the ground (Campos and Jack 2013, Tirira 2017). It feeds mainly on mature fruits, complementing its diet with animal prey (insects, eggs, and small vertebrates). In Ecuador, about 30 different plant species are known to be part of its diet (Albuja *et al.* 2018). Groups vary in size from 5 to 20 individuals. The adult sex ratio appears to be 1:1 or mildly skewed towards females 0.8:1 (Jack and Campos 2012, Rylands *et al.* 2013). Group home range size appears to be large, at about 500 ha (Jack and Campos 2012, Rylands *et al.* 2013, Cervera *et al.* 2018b), but more studies are needed to confirm this estimation.

The reproductive biology of *C. aequatorialis* is unknown. In other species of the genus, sexual maturity in females occurs when they are 4–7 years old and one year later in males. However, both sexes only reach adult body size at about 15 years old (Rylands *et al.* 2013). Considering that successful reproduction usually occurs only when animals have attained adult body size, the generation time is estimated to be about 15–16 years (Moscoso *et al.* 2021).

The main threats to *C. aequatorialis* are forest loss and fragmentation, which have been particularly severe in western Ecuador. About 70% of the original forest cover in this region has been converted, mainly for agriculture and ranching (Ministerio del Ambiente 2012, Sierra 2013, Gonzalez-Jaramillo 2016, Cervera *et al.* 2018a). It is estimated that the species distribution has been reduced to less than 1% of its original range in the last few decades (Albuja and Arcos 2007), and different modelling methods have indicated that only 5,000 km² (Campos and Jack 2013) or 8,600 km² (Albuja *et al.* 2018) of suitable habitat remains. A recent assessment by Tirira (2021b) estimated that the remaining area of native forests for the species in Ecuador is 10,701 km², representing an 83% reduction of its historical area of occurrence and a 75% reduction of its suitable habitat (suitable habitat within the area of occurrence). The author found that only 39% of the remaining area is under protection (national and private protected areas) and, based on current deforestation trends, estimated an additional 7% loss of suitable habitat by 2050.



To date, however, the presence of the species in most of this estimated area has not been confirmed.

Cebus aequatorialis is considered a pest in plantations of corn as well as bananas, plantain, and cacao, and hence is persecuted, poisoned, and hunted. In some areas of mangrove, local people see it as a competitor in crab-hunting and persecute it. Captive animals have been observed in local villages in western Ecuador (Moscoso *et al.* 2021). The species is also used as a tourist attraction in some areas, such as the western slopes of the Cotopaxi province, where capuchins have been habituated to approach the vicinities of road restaurants to obtain food. The owners of the restaurants give visitors bananas and other fruits to attract the capuchins (F. Alfonso-Cortes and N. Fuentes, pers. obs.).

In Ecuador, *C. aequatorialis* has mostly been reported to occur in public and private protected areas (see below), which are the only sites with sufficient forest to support the species. In disturbed areas, i.e., most localities in Ecuador, the species is elusive, tending to flee upon sighting. In a census of four species of western Ecuadorian primates carried out from October 2016 – March 2017, in 83 localities of 13 provinces, only 13 out of 260 records (5%) were of *C. aequatorialis* (Cervera *et al.* 2018a). Surveys from previous years evidenced a relatively wide variability in local abundance (Cervera *et al.* 2018b). In central-western Ecuador, Jack and Campos (2012) estimated densities of 2–22 ind/km² (mean 2.4 ind/km²). In central and southwestern Ecuador, Albuja and Arcos (2007) estimated densities of 3.5 and 3.9 ind/km².

Information about the species' demography and distribution in western Ecuador has been provided by Albuja and Arcos (2007), Jack and Campos (2012), Campos and Jack (2013) and Cervera *et al.* (2018a). According to a recent assessment carried out by Tirira (2021b), the habitat of this species is severely fragmented. The largest forest fragment, located between Cordillera Chongón-Colonche and Machalilla National Park, corresponds to 21% of the suitable habitat; the average area for fragments larger than 1 km² (n = 730) is about 13 km². It is predicted that about 8%

of the species suitable habitat would be lost by 2050 due to climate change (Tirira 2021b).

A recent survey determined two conservation priority areas for the species, covering a total of 129 km² of forest in the Azuay province, in southwestern Ecuador. Connectivity between the two areas is limited, however, and the possibility of mining activities taking place in these areas creates a complex scenario for the species' viability (Tirira and Gallo-Viracocha 2021). In primate censuses carried out by Proyecto Washu (PW) in a 600-ha forest fragment in the canton Flavio Alfaro of the Manabí province in 2019, *C. aequatorialis* was encountered three times (Duch-Latorre *et al.* 2019). In 2020, PW surveyed 41 forest fragments (ranging in size from 10 to 100 ha) in northern and eastern Manabí and recorded the presence of the species in only four fragments (9.7%), with a total of six encounters. The number of individuals in the sightings ranged from 5 to 12 individuals (Rivera *et al.* 2020). In November 2021, PW and *Naturaleza y Conservación Internacional* (NCI) carried out a primate survey in the Cazaderos Private Reserve, in Loja province; but the species was not found (Vega *et al.* 2022). Other, smaller, short-term studies have provided information about local abundance and conservation threats (Moscoso-Silva 2013, Solórzano 2014, Cervera *et al.* 2015), but the species remains poorly studied across most of its potential range.

In Peru, studies on *C. aequatorialis* are scarce. It is known to occur only in government protected areas that provide a certain degree of protection. However, there is very little information on its status in these protected areas and limited capacity to monitor them. In these areas, Hurtado *et al.* (2016) reported a group size of 3–12 individuals and an encounter rate of 0.3 ind/km (based on 7 sightings during 112 km of transects). Previously, group sizes of 3–5 individuals were reported in 1980 (Saavedra and Velarde 1980) and 1994 (Encarnación and Cook 1998). Improving forest connectivity along Ecuador and Peru's border is imperative to maintain the species in both countries (Hurtado *et al.* 2016). Between October 2019 and April 2020, Fundación Yunkawasi observed and followed a group of 10 individuals and a single male in the sector known as Campo Verde inside the Cerros de Amotape National Park. With the

data from this study, they estimated a density of 1.36 ind/km². The species has been recorded by park rangers in a conservation unit adjacent to the Cerros de Amotape National Park called the Angostura Faical Regional Conservation Area.

Given the degree of fragmentation across the species' range, targeted efforts are required to better understand its relationship with humans and how the disturbed landscape affects its demography, ecology, and behavior. The Peruvian population in the protected areas can be used as a baseline for comparisons. This information is imperative for conservation planning, so that actions such as the creation of habitat corridors, conservation education, and resolution of human-wildlife conflicts can be undertaken. Improving forest connectivity along Ecuador and Peru's border is imperative to maintain the species in both countries (Hurtado *et al.* 2016). In 2019, a bi-national collaborative project led by the Universidad San Francisco de Quito, in Ecuador, and Fundación Yunkawasi, in Perú, was initiated to address these research and management priorities. Although several project activities that were planned for 2020 and 2021 were not carried out because of the COVID-19 pandemic, local field assistants were able to intermittently monitor two groups of the species in the fragmented Ecuadorian forests of La Libertad parish, in the El Oro province, close to the Peruvian border. Data from these monitoring efforts are being analyzed and will be published in 2022 (de la Torre *et al.* in prep.). The activities of this bi-national project are expected to resume in 2022.

The species has been reported to occur in various public and private protected areas. In Ecuador (Cervera *et al.* 2018b) these are: Chocó Andino de Pichincha, Parque Nacional Machalilla, Reserva Ecológica Los Ilinizas, Reserva Ecológica Mache-Chindul, Reserva Ecológica Manglares Churute, Refugio de Vida Silvestre Manglares Estuario Río Muisne, Refugio de Vida Silvestre Marino y Costera Pacoche, Área importante para las Aves Tito Santos, Bosque Protector Puyango, Bosque Protector Bellavista, Bosque Protector Buenaventura, Bosque Protector Cambugán, Bosque Protector Cerro de Hayas, Bosque Protector Cerro Blanco, Bosque Protector Jama-Coaque, Bosque Protector Yaku Sinchi,

Bosque Protector Jauneche, Bosque Protector La Hesperia, Bosque Protector La Otonga, Bosque Protector Lalo Loor, Bosque Protector Maquipucuna, Bosque Protector Mashpi, Bosque Protector Mindo- Nambillo, Bosque Protector Río Guajalito. In Peru, it is reported from Cerros de Amotape National Park, Angostura Faical Regional Conservation Area, and Tumbes National Reserve. Finally, it is also reported from Bosques de Paz, a bi-national reserve of Ecuador and Peru.

- Albuja, L. (2002). Mamíferos del Ecuador. In: G. Ceballos and J.A. Simonetti (eds.), *Diversidad y Conservación de Los Mamíferos Neotropicales*, pp. 271–327. Mexico City: CONABIO / Universidad Nacional Autónoma de México.
- Albuja, L. and Arcos, R. (2007). Evaluación de las poblaciones de *Cebus albifrons* cf. *aequatorialis* en los bosques suroccidentales ecuatorianos. *Revista Politécnica*. 27(4), *Biología* 7: 58–67.
- Albuja, L., Moreno-Cárdenas, P. and Solórzano, M.F. (2018). Aspectos taxonómicos y ecológicos del capuchino ecuatoriano, *Cebus albifrons aequatorialis* (Primates: Cebidae) en el Ecuador. In: B. Urbani, M. Kowalewski, R.G.T. Cunha, S. de la Torre and L. Cortés-Ortiz (eds.), *La Primatología en Latinoamérica 2 – A Primatología na America Latina 2. Tomo II Costa Rica-Venezuela*, pp. 411–426. Caracas, Venezuela: Ediciones IVIC, Instituto Venezolano de Investigaciones Científicas.
- Brito, J., Garzón-Santomaro, C., Mena-Valenzuela, P., González-Romero, D. and Mena-Jaén, J. (2018). *Mamíferos de la Provincia de El Oro: Una Guía de Identificación de Especies de Mamíferos Páramo al Mar*. Serie de Publicaciones Misceláneas 8. Quito, Ecuador: Gobierno Autónomo Descentralizado de la provincia de El Oro e Instituto Nacional de Biodiversidad.
- Campos, F.A. and Jack, K.M. (2013). A potential distribution model and conservation plan for the Critically Endangered Ecuadorian Capuchin, *Cebus albifrons aequatorialis*. *Int. J. Primatol.* 34(5): 899–916.
- Cervera, L., Lizcano, D.J., Tirira, D.G. and Donati, G. (2015). Surveying two endangered primate species (*Alouatta palliata aequatorialis* and *Cebus aequatorialis*) in the Pacoche Marine and Coastal Wildlife Refuge, West Ecuador. *Int. J. Primatol.* 36(5): 933–947.
- Cervera, L. et al. (2018a). Working together towards one goal: results of the first primate census in western Ecuador. *Primate Conserv.* (32): 49–56.
- Cervera, L. et al. (eds.), *Estado de Conservación de los Primates del Ecuador*, pp. 54–63. Publicación Especial sobre los mamíferos del Ecuador 12. Quito, Ecuador: Grupo de Estudio de Primates del Ecuador and Asociación Ecuatoriana de Mastozoología.
- Duch-Latorre, I., Alfonso-Cortes, F., de la Torre, S. and Strier, K. (2019). First Assessment of the Brown-headed Spider Monkey, *Ateles fusciceps fusciceps*, in the Forest Fragment Rio de Oro, Ecuador. Technical report. Washington, DC: Primate Action Fund, Re:wild.
- Ecuador, Ministerio del Ambiente. (2012). *Línea Base de Deforestación del Ecuador Continental*. Quito, Ecuador.
- Encarnación, F. and Cook, G. (1998). Primates of the tropical forest of the Pacific Coast of Peru: the Tumbes Reserved Zone. *Primate Conserv.* (18): 15–20.
- Gonzalez-Jaramillo, V., Fries, A., Rollenbeck, R., Paladines, J., Onate-Valdivieso, F. and Bendix, J. (2016). Assessment of deforestation during the last decades in Ecuador using NOAA-AVHRR satellite data. *Erdkunde*. 70(3): 217–235.
- Jack, K.M. and Campos, F.A. (2012). Distribution, abundance, and spatial ecology of the Critically Endangered Ecuadorian Capuchin (*Cebus albifrons aequatorialis*). *Trop. Conserv. Sci.* 5(2): 173–191.
- Hurtado, C.M., Serrano-Villavicencio, J.S. and Pacheco, V. (2016). Population density and primate conservation in the Noreste Biosphere Reserve, Tumbes, Peru. *Revista Peru. Biol.* 23(2): 151–158.
- Moscoso-Silva, F.J. (2013). Estado de Conservación del Hábitat del Mono Machín (*Cebus albifrons aequatorialis*) en la Localidad de Las Tolas, Noroccidente del Distrito Metropolitano de Quito, Provincia de Pichincha. Bachelor's dissertation, Pontificia Universidad Católica del Ecuador, Quito, Ecuador.
- Moscoso, P., de la Torre, S., Cornejo, F.M., Mittermeier, R.A., Lynch, J.W. and Heymann, E.W. (2021). *Cebus aequatorialis* (amended version of 2020 assessment). The IUCN Red List of Threatened Species 2021: e.T4081A191702052.
- Peru, SERFOR. (2015). *Ley Forestal y de Fauna Silvestre Ley N° 29763 y sus Reglamentos*. Depósito Legal en la Biblioteca Nacional del Perú N° 2015-17751. Lima, Peru: Servicio Nacional Forestal y de Fauna Silvestre (SERFOR).
- Rivera, E., Estay-Araya, S., Alfonso-Cortes, F. and Fuentes, N. (2020). *Monitoreo de Primates en la Línea de Transmisión La Concordia – Pedernales 230kV*. Unpublished report. Quito, Ecuador: Corporación Eléctrica Nacional.
- Rylands, A.B., Mittermeier, R.A., Bezerra, B.M., Paim, F.P. and Queiroz, H.L. (2013). Family Cebidae (squirrel monkeys and capuchins). In: R.A. Mittermeier, A.B. Rylands and D.E. Wilson (eds.), *Handbook of the Mammals of the World. Volume 3: Primates*, pp. 348–413. Barcelona: Lynx Edicions.
- Saavedra, C.J. and Velarde, D. (1980). Evaluación Preliminar de la Distribución y el Estatus del Coto de Tumbes (*Alouatta palliata*) en el Bosque Nacional de Tumbes. Unpublished report. Lima: Dirección General Forestal y de Fauna. Ministerio de Agricultura.
- Sierra, R. (2013). *Patrones y Factores de Deforestación en el Ecuador Continental, 1990–2010, y un Acercamiento a los Próximos 10 Años*. Quito: Conservación Internacional Ecuador y Forest Trends.
- Solórzano, M.F. (2014). Estado de Conservación de las Poblaciones del Capuchino Ecuatoriano (*Cebus aequatorialis*), al Noroccidente del Distrito Metropolitano de Quito (DMQ), Localidad de Las Tolas, Provincia de Pichincha. Bachelor's thesis, Universidad Central del Ecuador, Quito.
- Tirira, D.G. (ed.). (2011). *Libro Rojo de los Mamíferos del Ecuador*. 2nd edition. Publicación especial sobre los mamíferos del Ecuador 8. Quito: Fundación Mamíferos

- y Conservación, Pontificia Universidad Católica del Ecuador and Ministerio del Ambiente del Ecuador.
- Tirira, D.G. (2017). *A Field Guide to the Mammals of Ecuador*. Publicación Especial sobre los mamíferos del Ecuador 10. Quito, Ecuador: Asociación Ecuatoriana de Mastozoología and Editorial Murciélago Blanco.
- Tirira, D.G. (ed.) (2021a). Lista Roja de los mamíferos del Ecuador. In: *Libro Rojo de los Mamíferos del Ecuador*. 3rd edition. Publicación Especial sobre los mamíferos del Ecuador 13. Quito, Ecuador: Asociación Ecuatoriana de Mastozoología, Fundación Mamíferos y Conservación, Pontificia Universidad Católica del Ecuador and Ministerio del Ambiente, Agua y Transición Ecológica del Ecuador.
- Tirira, D.G. (2021b). Primates del Ecuador: Aportes al Conocimiento de su Diversidad, Distribución y Conservación. Doctoral dissertation, Universidad de Salamanca, Salamanca, Spain.
- Tirira, D.G. and Gallo-Viracocha, F. (2021). Áreas prioritarias para la conservación y vulnerabilidad al cambio climático de *Alouatta palliata aequatorialis* (Atelidae) y *Cebus aequatorialis* (Cebidae) en la provincia de Azuay, Ecuador. *Mammal. Aequatorialis* 3: 37–57.
- Vega, S., Alfonso-Cortes, F., Rivera, E., Fuentes, N., Nuñez, D. and Sanmartín, D. (2022). Primer Censo de Primates en el Bosque Seco de la Reserva Cazaderos, Provincia de Loja. Unpublished report. Loja, Ecuador: Naturaleza y Cultura Internacional.

NEOTROPICS



GROVES' TITI MONKEY

Plecturocebus grovesi Boubli et al. 2019

Brazil
(2022)

Jean Philippe Boubli, Gustavo Rodrigues Canale, Thiago B.F. Semedo,
Fabiano R. de Melo and Leandro Jerusalinsky

Groves' Titi Monkey, *Plecturocebus grovesi*, occurs in the southern Brazilian Amazon and its ecotonal zone with the Brazilian Cerrado. It is a member of the subfamily Callicebinae, the most diverse group of Amazonian primates.

Titi monkeys of the genus *Plecturocebus* are small (about 1 kg). They are monogamous – the male provides much of the infant care (Spence-Aizenberg et al. 2016), they duet and, when the pair are together, they tend to intertwine their tails. The Amazonian species use all forest strata, but forage and travel mostly in the dense understory (0.5 to 10 m). They sometimes go to the ground at times of fruit scarcity (Souza-Alves et al. 2019). The small groups – an adult pair and one or two offspring – have small home ranges, generally less than 10 ha. Small fruits (whole fruits, pulp, aril, and seeds) and insects make up the bulk of their diet (Bicca-Marques and Heymann 2013). *Plecturocebus grovesi* has yet to be studied in the wild.

The range of Groves' Titi is delimited by the rios Juruena and Arinos in the west and the Rio Teles-Pires in the east. To the north, the range reaches the Juruena National Park, while the southernmost record is approximately 10°S. It is probable that the Amazon forest – Cerrado ecotone – marks the limit to its range in the south (about 13°S). More surveys, however, are needed to confirm this (Boubli et al. 2019).

Boubli et al. (2019) estimated that, to date, 42% of its forest habitat has been lost (excluding savannas), corresponding to 39% of the species' total distribution (forest and savannas). In addition, they forecast further habitat loss over

the next 24 years, which will amount to 50% under an optimistic "governance" scenario or to 86% under a "business-as-usual" scenario. The latter is most likely, given the current process of protected area downgrading, downsizing, and degazettement (PADDD) in the Brazilian Amazon and the planned complex of hydroelectric dams for this region (Bernard et al. 2014, Ferreira et al. 2014, Pack et al. 2016, Fernandes et al. 2017, UHE Teles-Pires 2018). Based on these studies, and other evidence, Groves' Titi was classified as Critically Endangered on the IUCN Red List of Threatened Species (Boubli et al. 2020). This was substantiated by evidence that a future population reduction of at least 80% is suspected to take place over the next three generations (c. 24 years) (Veiga et al. 2011, Defler and García 2012, Boubli et al. 2019, 2020). The species was assessed as Endangered in the Brazilian national assessment, using the same criterion, but adopting the "governance" scenario as more probable, thus projecting a population reduction of at least 50% in the next three generations (Brazil, ICMBio in prep.).

Habitat destruction and fragmentation is widespread in the species' range. Its distribution is entirely within the Amazon's arc of deforestation, the fast-advancing agribusiness frontier of Brazil. This region contains the largest tropical ecotone in the world, where the megadiverse Amazon forests meet tropical savanna, the Brazilian Cerrado, the latter one of the most threatened biodiversity hotspots. Habitat restoration in the southwestern Amazon might be extremely difficult and costly in the following decades, due to the savannization of forests associated with longer droughts and higher temperatures.



Members of the Mato Grosso state legislature are trying to pass the ordinance law PL-337/2022 which will withdraw Mato Grosso state from the Legal Amazon umbrella; all Brazilian States within the Legal Amazon status are obliged by law to preserve 80% of their forest cover. If this new ordinance is approved, deforestation will quickly escalate to a level that will put at risk many southern Amazonian species including the already Critically Endangered Groves' Titi Monkey.

Forest loss must be mitigated or avoided by the creation of private and governmental reserves, the enforcement of the law to protect forest set-asides ('Legal Reserves'), and the replacement of large areas of chemical-dependent monocultures of commodity crops by more sustainable models of land use, such as agroforests and agroecological food production. Forest degradation must also be avoided by the prevention of fires and logging, which has recently been stimulated by land-grabbers incited by the lack of enforcement. The geographic range of Groves' Titi Monkeys encompasses nine protected areas in Mato Grosso, most of them located in the north portion of the species distribution, but with only one record to date for Groves' Titi Monkeys in one of them. These protected areas range from indigenous lands (Kaiaby, Batelhão, Apiaká-Kayabi and Apiaká do Pontal e Isolados), to national parks (Parque Nacional do Juruena), state reserves (Reserva Ecológica Apiacás) and privately-owned, sustainable-use reserves (RPPN Reserva Ecológica América Amazônia, RPPN Reserva Ecológica Verde Amazônia). There are no protected areas in the central and southern portions of the species distribution.

The inclusion of *Plecturocebus grovesi* in the *National Action Plan for the Conservation of the Amazonian Primates* (Brazil/ICMBio 2017) – the Brazilian public policy to establish conservation strategies for threatened species – will take place the moment the species is formally recognized as under extinction risk and included in the National Official List of Threatened Species (expected to occur in 2022 or 2023). We suggest that Groves' Titi Monkey be adopted as the flagship species for Mato Grosso – the species is endemic to this state, it is charismatic, and it is now listed here as one of the World's 25 Most Endangered Primates.

We can use the species to raise local awareness in order to mitigate threats to the forests where the titi still struggles to survive in the Brazilian epicenter of agribusiness.

- Bernard, E., Penna, L.A.O. and Araujo, E. (2014). Downgrading, downsizing, degazettement, and reclassification of protected areas in Brazil. *Conserv. Biol.* 28: 939–950.
- Bicca-Marques, J.C. and Heymann, E.W. (2013). Ecology and behavior of titi monkeys (genus *Callicebus*). In: L.M. Veiga, A.A. Barnett, S.F. Ferrari and M.A. Norconk (eds.), *Evolutionary Biology and Conservation of Titis, Sakis and Uacaris*, pp. 196–207. Cambridge: Cambridge University Press.
- Boubli, J.P., Byrne, H., da Silva, M.N.F., Silva-Júnior, J., Costa Araújo, R., Bertuol, F., Gonçalves, J., de Melo, F.R., Rylands, A.B., Mittermeier, R.A., Silva, F.E., Nash, S.D., Canale, G., Alencar, R. de M., Rossi, R.V., Carneiro, J., Sampaio, I., Farias, I.P., Schneider, H. and Hrbek, T. (2019). On a new species of titi monkey (Primates: *Plecturocebus* Byrne et al., 2016), from Alta Floresta, southern Amazon, Brazil. *Mol. Phylogenet. Evol.* 132: 117–137.
- Boubli, J., de Melo, F.R. and Rylands, A.B. (2020). *Plecturocebus grovesi*. The IUCN Red List of Threatened Species 2020: e.T172272064A172272430.
- Brazil, MMA. (2017). Aprova o Plano de Ação Nacional para a Conservação dos Primatas Amazônicos – PAN Primatas Amazônicos. Portaria 792, de 01 de dezembro de 2017. Ministério do Meio Ambiente. *Diário Oficial da União*, Seção 1, número 232: 24–61.
- Defler, T.R. and Garcia, J. (2012). *Plecturocebus caquetensis*. The IUCN Red List of Threatened Species 2012: e.T14699281A14699284.
- Fernandes, G.W. et al. (2017). Dismantling Brazil's science threatens global biodiversity heritage. *Perspect. Ecol. Conserv.* 15(3): 239–243.
- Ferreira, J. et al. (2014). Brazil's environmental leadership at risk. *Science*. 346: 706–707.
- Pack, S.M., Ferreira, M.N., Krithivasan, R., Murrow, J., Bernard, E. and Mascia, M.B. (2016). Protected Area Downgrading, Downsizing, and Degazettement (PADDD) in the Amazon. *Biol. Conserv.* 197, 32–39.
- Souza-Alves, J.P. et al. (2019). Terrestrial behavior in titi monkeys (*Callicebus*, *Cheracebus*, and *Plecturocebus*): potential correlates, patterns, and differences between genera. *Int. J. Primatol.* 40(4): 553–572.
- Spence-Aizenberg, A., Di Fiore, A. and Fernandez-Duque, E. (2016). Social monogamy, male-female relationships, and biparental care in wild titi monkeys (*Callicebus discolor*). *Primates* 57(1): 103–112.
- UHE Teles-Pires. (2018). Available online: <http://www.uhetelespires.com.br/site/?page_id=27#body>. Accessed 1 July 2018).
- Veiga, L.M., Boveda-Penalba, A., Vermeer, J., Tello-Alvarado, J.C. and Cornejo, F. (2011). *Plecturocebus oenanthe*. The IUCN Red List of Threatened Species 2011: e.T3553A9939083.

NEOTROPICS



BROWN HOWLER MONKEY

Alouatta guariba (Humboldt, 1812)

Argentina, Brazil
(2012, 2014, 2016, 2018, 2022)

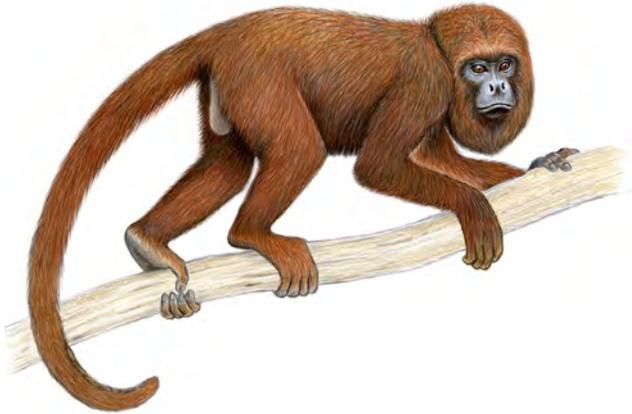
Luciana I. Oklander, Gerson Buss, Júlio César Bicca-Marques, Zelinda B. Hirano,
Óscar M. Chaves, Márcia M. Assis Jardim, Mônica M. Valença-Montenegro
Sérgio L. Mendes, Leonardo G. Neves, Martin Kowalewski, Fabiano R. de Melo,
Anthony B. Rylands and Leandro Jerusalinsky

Alouatta guariba is endemic to the Atlantic Forest in eastern Brazil and northeastern Argentina. In the south, its range is limited by the Camaquã river basin in the state of Rio Grande do Sul (Printes *et al.* 2001) and, in the past, to the north by the Rio Paraguaçu in the state of Bahia (Gregorin 2006). The western boundary is marked by the limits of the Atlantic Forest. In Argentina, the species only occurs in the province of Misiones (Agostini *et al.* 2014), while in Brazil it is present in the states of Rio Grande do Sul, Santa Catarina, Paraná, São Paulo, Rio de Janeiro, Minas Gerais, Espírito Santo, and Bahia (Bicca-Marques *et al.* 2018, Neves *et al.* 2018). Although somewhat uncertain, there are currently two subspecies recognized: the Southern Brown Howler, *A. guariba clamitans* Cabrera, 1940, and the Northern Brown Howler, *Alouatta g. guariba*, north of the rios Jequitinhonha or Doce (Rylands *et al.* 2000, Glander 2013).

The Brown Howler is a folivore-frugivore, including more or less fruit in its diet according to seasonal availability (Neville *et al.* 1988, Chaves and Bicca-Marques 2013, 2016, Chaves *et al.* 2018). As such, Brown Howlers are important seed dispersers for numerous plant species (Chaves *et al.* 2018). Home range size varies between study sites but averages 13 ha (Fortes *et al.* 2015). Ranges of 15 groups studied varied from 1.8 to 33 ha (Miranda and Passos 2011). Day range varies from 50 m to 1,677 m (Fortes *et al.* 2015). Groups average 4 to 6 individuals but can be as large as 13 (Jardim 2005, Miranda and Passos 2005, Ingberman *et al.* 2009). Uni-male,

uni-female, and multimale-multifemale groups have been reported (Glander 2013). The size of an adult male is 50–60 cm (head-body) and 52–67 cm (tail), while an adult female is 44–54 cm (head-body) and 48–57 cm (tail). Adult males weigh 5.3–7.2 kg and adult females weigh 4.1–5 kg (Glander 2013). Longevity is estimated at 15–20 years (Strier 2004). Females reach sexual maturity at between three and six years and males at five years (Strier *et al.* 2001), the gestation period is approximately 190 days (Steinmetz 2000, Jardim, 2005). Females have singletons, with an interbirth interval of 9–22 months (Strier *et al.* 2001).

As for all the Atlantic Forest primates, the Brown Howler has suffered extensive habitat loss since the European arrival in Brazil more than five centuries ago. The principal economic cycles during colonization broadly devastated the forest cover in this region, which today concentrates around 70% of the Brazilian population (about 150 million people), as well as the principal capital cities, with corresponding industrial activity and urbanization (Scarano and Ceotto 2015). In Brazil, the Atlantic Forest has been reduced to 11.7% of its original coverage (Ribeiro *et al.* 2009). The remaining forest is immensely fragmented into hundreds of thousands of patches, the great majority of which are 50 ha or less (Ribeiro *et al.* 2009), hence unsuitable to support viable Brown Howler Monkey populations in the long term. Being one of the largest primates in the Atlantic Forest, the species has been extensively hunted, and also suffers to some extent from the pet trade.



Disease epidemics are an additional and very serious threat. Howlers are highly susceptible to yellow fever, and two recent outbreaks (2008/2009, 2016/2021), have severely affected their numbers throughout the Atlantic Forest (Holzmann *et al.* 2010, Almeida *et al.* 2012, Bicca-Marques *et al.* 2017, Silva *et al.* 2020, Andrade *et al.* 2021). Due to misinformation and the dissemination of the fear that humans could be infected directly through contact or proximity with monkeys, howlers were persecuted, with many injured and killed during the outbreaks (Bicca-Marques and Freitas 2010, Bicca-Marques *et al.* 2017, Bicca-Marques 2018). In the next few decades, pathogen exposure could act synergistically with other threats such as habitat loss, putting populations at high extinction risk (Bicca-Marques *et al.* 2020).

In the south, Brown Howlers (*Alouatta guariba clamitans*) occur in lowland forests along Brazil's coast as well as in higher elevation submontane and montane forests and seasonal semi-deciduous forests inland (Bicca-Marques *et al.* 2018). In southern Brazil and northeast Argentina, they also occupy a transition of mixed Upper Paraná Atlantic Forest and *Araucaria* Moist Forest (Miranda and Passos 2005, Agostini *et al.* 2014). Aguiar *et al.* (2007) recorded the species in periodically flooded and semi-deciduous forests in the Rio Paraná floodplains.

The primary threats are widespread forest loss and fragmentation throughout the subspecies' range due to logging, agriculture, and cattle-ranching (Bicca-Marques 2018). The most common causes of death and injury of Brown Howlers in urban and peri-urban (and even, rural) regions of southern Brazil are electrocution on power lines (37%), dog attacks (34%), vehicle collisions (17%), and human mistreatments (12%) (Chaves *et al.* 2022).

The design and implementation of conservation strategies for the Southern Brown Howlers in urban and peri-urban regions (e.g., establishment of urban protected areas/biological corridors, installation of wildlife crossings, and insulating of power lines) are crucial for the long-term survival of these animals (Jerusalinsky *et al.* 2010, Printes *et al.* 2010, Alfaya *et al.* 2020, Chaves *et al.* 2022). Although some local population census data are available, the total remaining population is unknown but certainly declining. In Argentina, the

situation is even worse, and only few populations persist with no more than 20–50 adult individuals (Agostini *et al.* 2014, Moreno *et al.* 2015).

The Southern Brown Howler is listed as Vulnerable on the Brazilian list of threatened fauna (Brazil, MMA 2014, Bicca-Marques *et al.* 2018) and as Critically Endangered on the Argentinian Red list of mammals (Agostini *et al.* 2019). On the IUCN Red List of Threatened Species, it is currently categorized as Vulnerable (Jerusalinsky *et al.* 2021), but it may be a candidate for the Endangered category after the 2016–2021 yellow fever outbreak (Bicca-Marques *et al.* 2017).

Recently a *National Conservation Plan for the Primates of Argentina* was officially recognized by the government. One of its specific objectives includes, “Evaluating and reducing the impacts of yellow fever on primates in Argentina.” Evaluation of the recovery of *A. g. clamitans* populations through an *ex situ* conservation program is given high priority – analyzing the possibility of starting a program of reproduction and reintroduction and/or translocation of specimens with the coordination and guidance of IUCN experts.

The Northern Brown Howler Monkey (*Alouatta guariba guariba*) inhabits lowland, submontane, and montane Brazilian Atlantic Forest. It has a considerably more restricted range than *A. g. clamitans* and is classified as Critically Endangered both on the Brazilian list of threatened fauna (Brazil MMA 2014, Neves *et al.* 2018) and the IUCN Red List of Threatened Species (Neves *et al.* 2021). It has been listed as one of the world’s 25 most threatened primates since 2012 (Neves *et al.* 2017, Buss *et al.* 2019). Adding the locations in the lower reaches of the Jequitinhonha basin reported by Rylands *et al.* (1988) and the small populations of *A. g. guariba* discovered in the last decade, the total population is unlikely to sum more than 250 mature individuals, and no subpopulation is believed to have more than 50 mature individuals (Neves *et al.* 2017, 2018). Overall, the main threats to the wild populations of this subspecies are habitat fragmentation, hunting, and the very small sizes of the scattered populations (Neves *et al.* 2021) and, like the southern subspecies, probably risk of electrocution, vehicle collision,

and dog attack in the urban and peri-urban areas they inhabit (Chaves *et al.* 2022). Finally, the potential impact of COVID-19 and other associated infectious diseases on the survival of both Brown Howler subspecies is unknown, but it cannot be discounted. Further investigations on the topic are crucial.

There are protected areas in the Northern Brown Howler’s range in the state of Bahia and north-eastern Minas Gerais, all created since 1980. Nevertheless, the only strictly protected area where the species has been confirmed is the Mata Escura Biological Reserve (51,046 ha), just north of the middle Rio Jequitinhonha (Melo 2004, 2005).

The two subspecies of *Alouatta guariba* are included in the *Brazilian National Action Plan for Conservation of the Atlantic Rainforest Primates and Maned Sloth* (Brazil MMA 2018), and the southern subspecies also in the *Primate Conservation Action Plan of Argentina* (Argentina, MADS 2021). These plans provide measures to identify important areas for conservation in order to (a) restore, maintain and increase habitat and its connectivity, (b) mitigate the impact of roads and power lines, and (c) assess and mitigate the impact of epizootics on the species.

The National Center for Research and Conservation of Brazilian Primates (ICMBio/CPB) is planning to establish the “Population Management Program for *Alouatta guariba*” during 2022, as part of the Brazilian action plan and following the new national official guidelines (Brazil ICMBio 2021). The main aim of this program is to promote population restoration, to counteract recent population declines and suspected local extinctions following the Yellow Fever outbreaks. This program may result in outcomes contributing to the restoration of the population in Misiones Province, Argentina, now reduced to less than 100 individuals.

Agostini, I., Holzmann, I., Di Bitetti, M.S., Oklander, L.I., Kowalewski, M.M., Beldomenico, P.M., Goenaga, S., Martinez, M., Moreno, E.S., Lestani, E., Desbiez, A.L.J. and Miller, P. (2014). Building a species conservation strategy for the brown howler monkey (*Alouatta guariba*

- clamitans*) in Argentina in the context of yellow fever outbreaks. *Trop. Conserv. Sci.* 7: 26–34.
- Agostini, I., Holzmann, I., Oklander, L.I., Peker, S., Pavé, R. and Kowalewski M. (2019). *Alouatta guariba*. In: SAYDS–SAREM (eds.), *Categorización 2019 de los mamíferos de Argentina según su riesgo de extinción. Lista Roja de los mamíferos de Argentina*. Accessed: 14 March 2022.
- Aguiar, L.M., Mellek, D.M., Abreu, K.C., Boscarato, T.G., Bernadi, I.P., Miranda, J.M.D. and Passos, F.C. (2007). Sympatry between *Alouatta caraya* and *Alouatta clamitans* and the rediscovery of free-ranging potential hybrids in southern Brazil. *Primates* 48: 245–248.
- Alfaya, L.B., Ilha, J.G., Pairet Jr, M.C., Trigo, T.C. and Jardim, M.M.A. (2020). Distribuição espacial e composição social de grupos de bugios-ruivos (*Alouatta guariba clamitans*) em fragmentos florestais no sul do Brasil. *Neotrop. Primates* 26 (2): 33–39.
- Almeida, M.A.B., Santos, E., Cardoso, J.C., Fonseca, D.F., Noll, C.A., Silveira, V.R., Maeda, A.Y., Souza, R.P., Kanamura, C. and Brasil, R.A. (2012). Yellow fever outbreak affecting *Alouatta* populations in southern Brazil (Rio Grande do Sul State) 2008–2009. *Am. J. Primatol.* 74: 68–76.
- Andrade, M.S. et al. (2021). Real-time genomic surveillance during the 2021 re-emergence of the Yellow Fever Virus in Rio Grande do Sul State and Brazil. *Viruses* 13(10): 1976.
- Argentina, MADS. (2021). (2021). Plan Nacional de Conservación de Primates de la Argentina. *Resolución 430/21*. Ministerio de Ambiente y Desarrollo Sustentable (MADS), Buenos Aires. Available online: <<https://argentinambiental.com/legislacion/nacional/resolucion-430-21-plan-nacional-de-conservacion-de-primates-de-la-argentina/>>.
- Bicca-Marques, J.C. (2018) Infectious diseases, scientific discourse and the media: challenges to biodiversity conservation. In: N. Sanz and R. Dennell (eds.), *Primateology, Bio-cultural Diversity and Sustainable Development in Tropical Forests: A Global Perspective*, pp. 226–239. Mexico City: UNESCO.
- Bicca-Marques, J.C. and Freitas, D.S. (2010) The role of monkeys, mosquitoes, and humans in the occurrence of a yellow fever outbreak in a fragmented landscape in south Brazil: protecting howler monkeys is a matter of public health. *Trop. Conserv. Sci.* 3(1): 31–42.
- Bicca-Marques, J.C. et al. (2017). Yellow fever threatens Atlantic Forest primates. *Sci. Adv.* 3 (1): e1600946.
- Bicca-Marques, J.C., Alves, S.L., Ingberman, B., Buss, G., Fries, B.G. Alonso, A.C., Cunha, R.G.T. and Miranda, J.M.D. (2018). *Alouatta guariba clamitans* Cabrera, 1940. In: A.B.M. Machado, G. M. Drummond and A. P. Paglia (eds.), *Livro Vermelho da Fauna Brasileira Ameaçada de Extinção: Volume II – Mamíferos*, pp. 55–161. Brasília, Brazil: Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio).
- Bicca-Marques, J.C., Chaves, Ó.M. and Hass, G.P. (2020) Howler monkey tolerance to habitat shrinking: lifetime warranty or death sentence? *Am. J. Primatol.* 82(4): e23089. doi.10.1002/ajp.23089
- Brazil, ICMBio. (2021). Estabelece os procedimentos para criação e implementação dos Programas de Manejo Populacional de Espécies Ameaçadas da Fauna Brasileira. Instrução Normativa nº 5, de 28 de junho de 2021 – Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio). *Diário Oficial da União*, Seção 1, número 122: 51.
- Brazil, MMA. (2014). Lista Nacional Oficial de Espécies da Fauna Ameaçadas de Extinção. Portaria nº 444, de 17 de dezembro de 2014 – Ministério do Meio Ambiente (MMA). *Diário Oficial da União*, Seção 1, número 245: 121–126.
- Brazil, MMA. (2018). Aprova o Plano de Ação Nacional para a Conservação dos Primatas da Mata Atlântica e da Preguiça-de-Coleira. Portaria nº 702, de 07 de agosto de 2018 – Ministério do Meio Ambiente. *Diário Oficial da União*, Seção 1, número 153: 57.
- Buss, G., Oklander, L.I., Bicca-Marques, J.C., Hirano, Z.B., Chaves, Ó.M., Mendes, S.L., Neves, G., Melo, F.R., Rylands, A.B. and Jerusalinsky, L. (2019). Brown howler monkey *Alouatta guariba* Humboldt, 1812. In: C. Schwitzer et al. (eds.), *Primates in Peril: The World's 25 Most Endangered Primates 2018–2020*, pp. 24–27. Bristol, UK and Washington, DC: IUCN SSC Primate Specialist Group, International Primatological Society, Global Wildlife Conservation, and Bristol Zoological Society.
- Chaves, Ó.M. and Bicca-Marques, J.C. (2013). Dietary flexibility of the brown howler monkey throughout its geographic distribution. *Am. J. Primatol.* 75: 16–29.
- Chaves, Ó.M. and Bicca-Marques, J.C. (2016) Feeding strategies of brown howler monkeys in response to variations in food availability. *PLoS One* 11(2): e0145819.
- Chaves, Ó.M., Bicca-Marques, J.C. and Chapman, C.A. (2018). Quantity and quality of seed dispersal by a large arboreal frugivore in small and large Atlantic Forest fragments. *PLoS One* 13: e0193660.
- Chaves, Ó.M., Souza Jr, J.C., Buss, G., Hirano, Z.M.B., Jardim, M.M.A., Amaral, E.L.S., Godoy, J.C., Peruchi, A.R., Michel, T. and Bicca-Marques, J.C. (2022). Wildlife is imperiled in peri-urban landscapes: threats to arboreal mammals. *Sci. Total Environ.* 821: 152883. doi.10.1016/j.scitotenv.2021.152883
- Fortes, V.B., Bicca-Marques, J.C., Urbani, B., Fernández, V.A. and Pereira, T.S. (2015). Ranging behavior and spatial cognition in howler monkeys. In: M.M. Kowalewski, P.A. Garber, L. Cortés-Ortiz, B. Urbani and D. Youlatos (eds.), *Howler Monkeys: Behavior, Ecology, and Conservation* (pp. 219–255). New York: Springer.
- Glander, K.E. (2013). Brown howler *Alouatta guariba*. In: R.A. Mittermeier, A.B. Rylands and D.E. Wilson (eds.), *Handbook of the Mammals of the World. Volume 3. Primates*, p. 531. Barcelona, Spain: Lynx Edicions.
- Gregorin, R. (2006). Taxonomy and geographic variation of species of the genus *Alouatta* Lacépède (Primates, Atelidae) in Brazil. *Revista Brasil. Zool.* 23: 64–144.
- Holzmann, I., Agostini, I., Areta J.I., Ferreyra, H., Beldomenico, P. and Di Bitetti, M.S. (2010). Impact of yellow fever outbreaks on two howler monkey species (*Alouatta guariba clamitans* and *A. caraya*) in Misiones, Argentina. *Am. J. Primatol.* 72: 475–480.
- Ingberman, I., Fusco-Costa, R. and Monteiro-Filho, E.L.A. (2009). Population survey and demographic features of a coastal island population of *Alouatta clamitans* in Atlantic Forest, southeastern Brazil. *Int. J. Primatol.* 30: 1–14.
- Jardim, M.M.A. (2005). Ecologia Populacional de Bugios-ruivos (*Alouatta guariba*) nos Municípios de Porto Alegre

- e Viamão. PhD thesis, University of Campinas, Campinas, São Paulo, Brazil.
- Jerusalinsky, L. et al. (2021). *Alouatta guariba* (amended version of 2020 assessment). The IUCN Red List of Threatened Species 2021: e.T39916A190417874.
- Jerusalinsky, L., Teixeira, F.Z. Lokschin, L.X., Alonso, A., Jardim, M.M.A., Cabral, J.N.H., Printes R.C. and Buss, G. (2010). Primatology in southern Brazil: a transdisciplinary approach to the conservation of the brown howler monkey *Alouatta guariba clamitans* (Primates, Atelidae). *Iheringia, sér. Zool.* 100: 403–412.
- Melo, F.R. (2004). Primatas e Áreas Prioritárias para a Conservação da Biodiversidade no Vale do Rio Jequitinhonha, Minas Gerais. Doctoral thesis, Universidade Federal de Minas Gerais (UFMG), Belo Horizonte, MG, Brasil.
- Melo, F.R. (2005). A Reserva Biológica Federal da Mata Escura e sua importância como unidade de conservação para os primatas do médio rio Jequitinhonha, Minas Gerais. *Neotrop. Primates* 13: 26–29.
- Miranda, J.M.D. and Passos, F.C. (2005). Composição e dinâmica de grupos de *Alouatta guariba clamitans* Cabrera (Primates, Atelidae) em Floresta Ombrófila Mista no estado do Paraná, Brasil. *Rev. Bras. Zool.* 22: 99–106.
- Miranda, J.M.D. and Passos, F.C. (2011). Home range and space use by *Alouatta clamitans* Cabrera, 1940 in *Araucaria* pine Forest in southern Brazil. In: J.M.D. Miranda and Z.M.B. Hirano (eds.), *A Primatologia no Brasil – 12*, pp. 114–125. Curitiba, PR, Brazil: Sociedade Brasileira de Primatologia.
- Moreno, E.S., Agostini, I., Holzmann, I., Di Bitetti, M.S., Oklander, L.I., Kowalewski, M.M., Beldomenico, P.M., Goenaga, S., Martínez, M., Lestani, E., Desbiez, A.L.J. and Miller, P. (2015). Yellow fever impact on brown howler monkeys (*Alouatta guariba clamitans*) in Argentina: a metamodeling approach based on population viability analysis and epidemiological dynamics. *Mem. Inst. Oswaldo Cruz* 110(7): 865–876.
- Neves, L.G., L. Jerusalinsky, L., Melo, F.R., Rylands, A.B. and Talebi, M. (2017). Northern brown howler *Alouatta guariba guariba* (Humboldt, 1812). In: C. Schwitzer (eds.), *Primates in Peril: The World's 25 Most Endangered Primates 2016–2018*, pp. 96–99. Bristol, UK, and Arlington, VA: IUCN SSC Primate Specialist Group (PSG), International Primatological Society (IPS), Conservation International (CI) and Bristol Zoological Society.
- Neves, L.G., Jerusalinsky, L. and Melo, F.R. (2018). *Alouatta guariba guariba* (Humboldt, 1812). In: A.B.M. Machado, G.M. Drummond and A.P. Paglia (eds.), *Livro Vermelho da Fauna Brasileira Ameaçada de Extinção: Volume II – Mamíferos*, pp. 162–166. Brasília, DF, Brazil: Instituto Chico Mendes de Conservação da Biodiversidade ICMBio
- Neves, L.G., Jerusalinsky, L., Talebi, M., Mittermeier, R.A., Cortés-Ortiz, L. and de Melo, F.R. (2021). *Alouatta guariba* ssp. *guariba* (amended version of 2020 assessment). The IUCN Red List of Threatened Species 2021: e.T39917A190420483.
- Neville, M.K., Glander, K., Braza, F. and Rylands, A.B. (1988). The howling monkeys, genus *Alouatta*. In: R.A. Mittermeier, A.B. Rylands, A.F. Coimbra-Filho and G.A.B. da Fonseca (eds.), *Ecology and Behavior of Neotropical Primates* Volume 2, pp. 349–453. Washington, DC: World Wildlife Fund – US.
- Printes, R.C., Buss, G., Jardim, M.M.A., Fialho, M.S., Dornelles, S.S., Perotto, M., Brutto, L.F.G., Girardi, E., Jerusalinsky, L., Liesenfeld, M.V.A., Lokschin, L.X. and Romanowski, H.P. (2010). The Urban Monkeys Program: a survey of *Alouatta clamitans* in the south of Porto Alegre and its influence on land use policy between 1997 and 2007. *Primate Conserv.* (25): 11–19.
- Printes, R.C., Liesenfeld, M.V.A. and Jerusalinsky, L. (2001). *Alouatta guariba clamitans* Cabrera, 1940: a new southern limit for the species and for Neotropical primates. *Neotrop. Primates* 9: 118–121.
- Ribeiro, M.C., Metzger, J.P., Martensen, A.C., Ponzoni, F.J. and Hirota, M.M. (2009). The Brazilian Atlantic Forest: how much is left, and how is the remaining forest distributed? Implications for conservation. *Biol. Conserv.* 142: 1141–1153.
- Rylands, A.B., Spironello, W.R., Tornisiello, V.L., Lemos de Sá, R.M., Kierulff, M.C.M. and Santos I.B. (1988). Primates of the Rio Jequitinhonha valley, Minas Gerais, Brazil. *Primate Conserv.* (9): 100–109.
- Rylands, A.B., Schneider, H., Langguth, A., Mittermeier, R.A., Groves C.P. and Rodríguez-Luna, E. (2000). An assessment of the diversity of New World primates. *Neotrop. Primates* 8: 61–93.
- Scarano, F.R. and Ceotto, O. (2015). Brazilian Atlantic Forest: impact, vulnerability, and adaptation to climate change. *Biodiv. Conserv.* 24: 2319–2331.
- Silva, N.I.O., Sacchetto, L., de Rezende, I.M., de Souza Trindade, G.S., LaBeaud, A.D., de Thoisy, B. and Drummond, B.P. (2020). Recent sylvatic yellow fever virus transmission in Brazil: the news from an old disease. *Virology* 531: 1–12. doi.org/10.1016/j.virus.2020.09.019
- Steinmetz, S. (2000). Ecology and Behavior of Bugios (*Alouatta fusca clamitans*, Atelidae – Primates) in Intervalos State Park - SP. Masters dissertation, University of São Paulo, SP, Brazil.
- Strier, K.B. (2004). Patrilineal kinship and primate behaviour. In: B. Chapais and C. Berman (eds.), *Kinship and Behaviour in Primates*, pp. 177–199. New York, USA: Oxford University Press.
- Strier, K.B., Mendes, S.L. and Santos, R.R. (2001). Timing of births in sympatric brown howler monkeys (*Alouatta fusca clamitans*) and northern muriquis (*Brachyteles arachnoides hypoxanthus*). *Am. J. Primatol.* 55: 87–100.

NEOTROPICS



BROWN-HEADED SPIDER MONKEY

Ateles fusciceps fusciceps Gray, 1866

Colombia, Ecuador, Panama
(2006, 2012, 2014, 2016, 2022)

Diego G. Tirira, Nathalia Fuentes, Felipe Alfonso-Cortes, Citlalli Morelos-Juárez,
Pedro G. Méndez-Carvajal, Karol M. Gutiérrez-Pineda, Sebastián Montilla,
Alma Hernández-Jaramillo and Alba-Lucía Morales-Jiménez

Brown-headed Spider Monkeys are found in Central and South America, from southeast Panama to Ecuador, west of the Andes along the Chocó Ecoregion (Konstant and Rylands 2013). They occur mostly in evergreen humid tropical and subtropical forests (Tirira 2017), living in groups of up to 35 individuals with fission-fusion dynamics (Eisenberg 1976, Link et al. 2009), forming subgroups ranging from two to ten individuals when they are searching for food (Gavilanez 2006, Estévez-Noboa 2009, Moscoso 2010, Cueva and Pozo-Rivera 2010).

The species inhabits mainly large continuous forest patches in primary or secondary forest (Defler 2004, Tirira 2017), although there is a population inhabiting fragmented landscapes in Ecuador (Cervera and Griffith 2016). Its presence seems to be determined by its habitat requirements, such as continuous canopy cover and high abundance of large and tall trees (Tirira et al. 2011). It prefers the highest levels of the canopy but can also be observed at mid-levels, and occasionally in the understory (Tirira 2017).

The diets of Brown-headed Spider Monkeys consist mainly of ripe fruits (70–90% of its diet) (van Roosmalen and Klein 1988, Konstant and Rylands 2013). Their preferred fruit is generally hard with large pits, including those of various palms, although it also eats soft, small, and multi-seeded fruits (Morelos-Juárez et al. 2015, Fuentes et al. 2018). They also eat fresh leaves, seeds, aerial roots, and some invertebrates, such as

insects. They eat flowers and shoots to a lesser degree (Konstant and Rylands 2013, Morelos-Juárez et al. 2015, Alfonso-Cortes et al. 2022). As is true for the genus, Brown-headed Spider Monkeys are effective seed dispersers (Morelos-Juárez et al. 2018a) and key for the maintenance of high levels of tree diversity in Chocóan forests (Calle-Rendón et al. 2016).

Brown-headed Spider Monkeys can travel up to three km in a day (Morelos-Juárez et al. 2018a). They travel through the canopy by quadrumanous and prehensile-tailed scrambling and brachiation but may also run on all fours along thick branches. Females become sexually mature at four to five years old, but usually do not give birth before seven or eight years of age. The gestation period is 226 to 232 days with females normally giving birth to a single offspring every 2–4 years, after which the youngster clings to its mother's underside for the first few months (Eisenberg 1973).

Defler (2004) suggested that *Ateles fusciceps* should be considered a subspecies of Geoffroy's Spider Monkey (*Ateles geoffroyi*) following Collins and Dubach (2000). However, the taxonomic status of both species was further reviewed, and the evidence suggests that they are valid, distinct species (Rylands et al. 2006, Morales-Jiménez et al. 2015). Preliminary genetic analyses from samples from the south of Colombia and the north of Ecuador show two



different monophyletic clades (Morales-Jiménez *et al.* 2015), and two subspecies are recognized.

The nominate subspecies inhabits the Pacific Coast of Ecuador and possibly southern Colombia, in an altitudinal range of 20 to 2,300 m above sea level, but usually below 1,200 m (Tirira 2017, 2021a). In Ecuador, its range includes the northwestern Andes (Esmeraldas Province), extending to the northwest of Pichincha and Manabí provinces, and to the western borders of Imbabura and Carchi provinces (Tirira 2004, Cervera and Griffith 2016, Morelos-Juárez *et al.* 2018b). Its presence in Colombia is uncertain, but it may be present south of the Río Mira, in Nariño Department, southwestern Colombia (Defler 2004).

Population density estimates in the buffer areas of the Cotacachi-Cayapas National Park and the Awa Ethnic Reserve were 0.2–13.2 individuals/km² (Madden and Albuja V. 1989, Gavilanez 2006, Moscoso 2010, Cueva and Pozo-Rivera 2010, Albuquerque 2014, Urgilés-Verdugo and Gallo-Viracocha 2016, Morelos-Juárez *et al.* 2018a). In 2010, a population size of 104 individuals was calculated in an area of 18 km² located in areas close to the Cotacachi-Cayapas National Park (Moscoso 2010).

Due to its restricted range and the small size of the natural populations, *Ateles fusciceps fusciceps* is classified as Critically Endangered on the IUCN Red List of Threatened Species (Moscoso *et al.* 2021) and in *The Red List of Mammals of Ecuador* (Tirira 2021b). Extensive deforestation, the illegal pet trade, and hunting are the main threats for the species in Ecuador (Tirira *et al.* 2011). For example, the loss of humid tropical and subtropical rainforest in western Ecuador has surpassed 80% of its original area (Ecuador, MAE 2012). Recent assessments indicate that the native remaining forest for the species is from 7,231 to 8,812 km² (Tirira 2021b, Gallo-Viracocha *et al.* in prep.). This is a reduction of approximately 64% of its suitable habitat (only 34% of the remaining forest is under protection). By 2050, the loss of the suitable habitat may reach 73% (Tirira 2021a).

The Ecuadorian Brown-headed Spider Monkey has been reported as extirpated in several locations across its historical and current range,

including the type locality (Hacienda Chinipamba, west of Ibarra, Intag Valley, Imbabura Province), the whole central coast of Ecuador, and the surroundings of the ríos Cayapas, San Miguel, Ónzole and Santiago, in the Esmeraldas Province (Tirira 2004). A survey conducted between 2008 and 2009, found a solitary male of the Ecuadorian Brown-headed Spider Monkey living with a group of Howler Monkeys (*Alouatta palliata*), in the area of Los Bancos, Pichincha Province (Moscoso 2010, Moscoso et al. 2019).

In the province of Manabí, the subspecies remains in several remnant forests of the Flavio Alfaro, El Carmen, and Chone cantons (Cervera and Griffith 2016). Fifty-eight individuals were recorded in this area in at least 22 forest fragments (each ranging in size from 1 to 1,000 ha), with population densities ranging from 7–22 individuals/km² (Alfonso-Cortes et al. 2022).

Despite the high deforestation rates that the Ecuadorian Brown-headed Spider Monkey is facing, and its extirpation in some areas, remaining suitable habitat shows low fragmentation, with 82% of the available habitat in a single large fragment. The average size of fragments larger than 1 km² (n = 143) barely reaches 49 km² (Tirira 2021a). The survival of the species in the future will also depend on the socio-economic situation of local human communities (Mosandl et al. 2008, Pardo 2010).

The most important area for the conservation of the Ecuadorian Brown-headed Spider Monkey is concentrated in the Andean slopes of the Esmeraldas Province (Cotacachi-Cayapas National Park and neighboring areas), and adjacent regions of Imbabura Province (Tirira et al. 2015, Tirira 2021a). The buffer zone of this national park has three small protected areas – El Pambilar Wildlife Reserve and Río Canandé and Tesoro Escondido private protected forests – mainly along the western border. Including some surrounding unprotected forests, this is the area that is harboring the largest subpopulation of this subspecies in Ecuador (Peck et al. 2011, Tirira 2021a).

Another important forest where the species is thought to be present is the Awa Ethnic Forest Reserve, north of the Río Mira and close to the

Colombian border (Tirira et al. 2011, Morelos-Juárez et al. 2018a). However, occasional interviews with Awa elders and rapid biodiversity surveys conducted by the Ecuadorian NGO Fundación Ecominga in neighboring areas to the Awa Ethnic Forest Reserve, show that large mammals, including primates, have been critically diminished or probably extirpated.

Conservation actions for the conservation of this subspecies began with the PRIMENET project in 2005. This initiative performed research and education activities focused on the primate species of northwestern Ecuador and led to training courses for local guides to create groups of parabiologists in the communities (Peck et al. 2011).

Since 2012, *Proyecto Washu/Fundación Naturaleza y Arte* has been working in priority sites for the species, involving community-led development, scientific research, environmental education, and *ex situ* conservation activities. To address the drivers of habitat loss, the project has implemented a Sustainable Matrix Model (SMM) in the buffer zones of private and state reserves in Esmeraldas Province, which integrates the concepts of sustainable development, land sharing (Butsic and Kuemmerle 2015), and agroecological matrices (Perfecto and Vandermeer 2010). These efforts have resulted in 539 ha of the territory being protected by 18 farmer families through conservation agreements that improve their livelihoods (Abondano et al. in press).

At the end of 2018, the *Action Plan for Ecuadorian Primate Species Conservation* was published and approved as a national guideline by the Environmental Ministry of Ecuador (Tirira et al. 2018). It established a series of conservation activities to implement in the next decade, mostly related to environmental policies, *in situ* and *ex situ* management, scientific research, environmental education, and control of illegal wildlife trade and hunting.

The Colombian Black Spider Money, *Ateles fusciceps rufiventris*, was assessed as Critically Endangered in a previous iteration of the IUCN Red List of Threatened Species (Cuarón et al. 2008, Tirira et al. 2017), but was recently

reassessed as Vulnerable (Link *et al.* 2021). It remains as Critically Endangered in Panama (the Panamanian List of Endangered Species; Méndez-Carvajal 2019) and was assessed as Endangered in the *Libro Rojo de los Mamíferos de Colombia* (Defler *et al.* 2006). The reasons for its threatened status are habitat loss and hunting (Méndez-Carvajal 2019; Link *et al.* 2021).

It is restricted to eastern Panama and western Colombia, in an altitudinal range from sea level to 2000–2500 m on the slopes of the Cordillera Occidental of the Andes (Defler 2004). In Panama, its range extends from Lago Bayano through the Panamanian Darien, and includes southeast Panama Province, northern San Blas, and the central and southern areas of the Darien (Méndez-Carvajal 2019). This subspecies occurs in the Darien National Park and Chucantí Private Nature Reserve, in the Maje Mountains (Méndez-Carvajal 2012, Méndez-Carvajal *et al.* 2021). In Colombia, this subspecies is present in lowland and the sub-montane forest (Defler 2004) in the Urabá region, in northwestern Antioquia, north through Córdoba, Sucre, and northern Bolívar departments (north distributional limit on the south bank of the Canal del Dique, Cartagena); west of the Río Cauca to the coast; east to the lower Río Cauca, along the west bank to south-central Antioquia; and south to the Cordillera Occidental of the Andes, in southwestern Colombia, except La Serranía del Baudo, Chocó Department; the southernmost record is in Barbacoas, Nariño Department (Defler 2004, Morales-Jiménez 2005, Konstant and Rylands 2013).

In Colombia, this subspecies has been extirpated from the northern part of its range (the departments of Bolívar, Sucre, and Córdoba) due to habitat destruction and hunting (Miller *et al.* 2004, Correa-Ayram *et al.* 2020). In Panama, the Darien forest has been severely fragmented through both legal and illegal deforestation (Méndez-Carvajal *et al.* 2021). There is ongoing pressure from the Panamanian and Colombian governments to complete the Pan-American Highway through the Darien forest, the so-called Darien gap, and there are illegal oil palm plantations in the Alto Darien Protected Forest in Chupanuno, Boca de Cupe, near the buffer area

of the Darien National Park (Méndez-Carvajal *et al.* 2021).

- Abondano, L., Webber, A., Valencia, L., Gómez-Posada, C., Hending, D., Alfonso-Cortes, F. and Fuentes, N. (in press). Community-based strategies to promote primate conservation in agricultural landscapes: lessons learned from case studies in South America. In: T. McKinney, S. Waters and M. Rodrigues (eds.), *Primates in Anthropogenic Landscapes: Exploring Primate Behavioral Ecology across Human Contexts*. New York: Springer.
- Albuquerque, N. (2014). Densidad Poblacional y Uso de Hábitat de la Comunidad de Primates en el Refugio de Vida Silvestre “El Pambilar”, Provincia de Esmeraldas, Ecuador. Bachelor’s dissertation, Universidad Nacional de Piura, Piura, Ecuador.
- Alfonso-Cortes, F., Fuentes, N., Rivera Román, E.S., Mogro, E. and Camacho, C. (2022). A critically endangered primate species inhabiting a fragmented landscape: the brown-headed spider monkeys (*Ateles fusciceps fusciceps*) in the province of Manabí, Ecuador. In: Abstracts: XXVIIIth Congress of the International Primatological Society, Joint Meeting with the Latin Society of Primatology (SLAPrim), Quito, Ecuador. 9-15 January 2022. (Abstract)
- Butsic, V. and Kuemmerle, T. (2015). Using optimization methods to align food production and biodiversity conservation beyond land sharing and land sparing. *Ecol. Appl.* 25: 589–595.
- Calle-Rendón, B.R., Peck, M.R., Bennett, S.E., Morelos-Juárez, C. and Alfonso-Cortes, F. (2016). Comparison of forest regeneration in two sites with different primate abundances in northwestern Ecuador. *Revista Biol. Trop.* 64: 493–506.
- Cervera, L. and Griffith, D.M. (2016). New population and range extension of the Critically Endangered Ecuadorian brown-headed spider monkey (*Ateles fusciceps fusciceps*) in western Ecuador. *Trop. Conserv. Sci.* 9: 167–177.
- Collins, A.C. and Dubach, J. (2000). Phylogenetic relationships of spider monkeys (*Ateles*) based on mitochondrial DNA variation. *Int. J. Primatol.* 21(3): 381–420.
- Correa-Ayram, C.A., Etter, A., Díaz-Timoté, J.J., Buriticá, S.R., Ramírez, W. and Corzo, G. (2020) Spatiotemporal evaluation of the human footprint in Colombia: four decades of anthropic impact in highly biodiverse ecosystems. *Ecol. Indic.* 117: 106630. 24pp.
- Cuarón, A.D., Shedden, A., Rodríguez-Luna, E., de Grammont, P.C. and Link, A. (2008). *Ateles fusciceps*. The IUCN Red List of Threatened Species 2008. Version 2016.3.
- Cueva, X. and Pozo-Rivera, W.E. (2010). Densidad y tamaño poblacional efectivo del bracilargo en el noroccidente ecuatoriano. *Bol. Técn. 9, Ser. Zool.* 6: 85–97.
- Defler, T.R. (2004). *The Primates of Colombia*. Tropical Field Guide Series. Washington, D.C.: Conservation International.
- Defler, T.R., Rodríguez-Mahecha, J.V. and Palacios, E. (2006). Marimonda chochoana (*Ateles geoffroyi*). In: J.V. Rodríguez-Mahecha, M.S. Alberico, F. Trujillo and J.P. Jorgenson (eds.), *Libro Rojo de los Mamíferos de Colombia*, pp. 128–131. Serie Libros Rojos de Especies

- Amenazadas de Colombia. Bogotá: Conservación Internacional-Colombia and Ministerio del Ambiente, Vivienda y Desarrollo Territorial.
- Ecuador, MAE. (2012). *Línea Base de Deforestación del Ecuador Continental*. Quito: Ministerio del Ambiente del Ecuador (MAE).
- Eisenberg, J.F. (1973). Reproduction in two species of spider monkeys, *Ateles fusciceps* and *Ateles geoffroyi*. *J. Mammal.* 54: 955–957.
- Eisenberg, J.F. (1976). Communication mechanisms and social integration in the black spider monkey (*Ateles fusciceps robustus*), and related species. *Smithson. Contrib. Zool.* 213: 1–108.
- Estévez-Noboa, M.I. (2009). Estudio Poblacional y Uso de Hábitat de *Alouatta palliata*, *Ateles fusciceps* y *Cebus capucinus* en el Bosque Protector Los Cedros, Provincia de Manabí. Bachelor's dissertation, Universidad Central del Ecuador, Quito.
- Fuentes, N., Alfonso-Cortes, F., Duch-Latorre, I., Fonseca, K., Cervera, L., Macías, Q., Loor, A., Kincaid, K. and Urbina, S. (2018). Patrón de actividad, uso de estrato y dieta del mono araña de cabeza café (*Ateles fusciceps*) en fragmentos de bosque del cantón Flavio Alfaro, provincia de Manabí In: D.G. Tirira (ed.), *Libro de Resúmenes, IV Congreso Ecuatoriano de Mastozoología*, pp. 91–92. Loja, Ecuador: Asociación Ecuatoriana de Mastozoología, Ministerio del Ambiente del Ecuador and Universidad Técnica Particular de Loja.
- Gavilanez, M.M. (2006). Demografía, Actividad y Preferencia de Hábitat de Tres Especies de Primates (*Alouatta palliata*, *Ateles fusciceps* y *Cebus capucinus*) en un Bosque Nublado del Noroccidente eEcuadoriano. Bachelor's dissertation, Pontificia Universidad Católica del Ecuador, Quito.
- Konstant, W.R. and Rylands, A.B. (2013). Brown-headed spider monkey *Ateles fusciceps*. In: R.A. Mittermeier, A.B. Rylands and D.E. Wilson (eds.), *Handbook of the Mammals of the World. Volume 3: Primates*, p. 538. Barcelona: Lynx Edicions.
- Link, A., Di Fiore, A. and Spehar, S.N. (2009). Female-directed aggression and social control in spider monkeys. In: M.N. Muller and R.W. Wrangham (eds.), *Sexual Coercion in Primates and Humans: An Evolutionary Perspective on Male Aggression against Females*, pp. 157–183. Cambridge, MA: Harvard University Press.
- Link, A., Defler, T.R., Méndez-Carvajal, P.G., Rodríguez, V., Cortés-Ortiz, L., Shanee, S. and Guzmán-Caro, D.C. (2021). *Ateles fusciceps* ssp. *rufiventris* (amended version of 2020 assessment). The IUCN Red List of Threatened Species 2021. e.T39921A191688429.
- Madden, R.H. and Albuja V.L. (1989). Estado actual de *Ateles fusciceps fusciceps* en el noroccidente ecuatoriano. *Rev. Politécnica* 14: 113–157.
- Méndez-Carvajal, P.G. (2012). Preliminary primate survey at the Chucanti Nature Reserve, Darien Province, Republic of Panama. *Mesoamericana* 16: 22–29.
- Méndez-Carvajal, P.G. (2019). A Long-Term Monitoring Study to Evaluate the Primate Conservation Status in Panama Using Species Distribution Modelling and Complementary Information. Doctoral dissertation, Durham University, Durham, UK.
- Méndez-Carvajal, P.G., Batista, A., Jaramillo, O., Rodríguez-Beitía, B. and Gutiérrez-Pineda, K.M. (2021). Biodiversity assessment at the southeastern side of Darien National Park, Panama: diversity of southwestern Darien. *Mesoamericana* 25: 22–36.
- Miller, L., Savage, A. and Giraldo, H. (2004). Quantifying remaining forested habitat within the historic distribution of the cotton-top tamarin (*Saguinus oedipus*) in Colombia: implications for long-term conservation. *Am. J. Primatol.* 64: 451–457.
- Morales-Jiménez, A.L. (2005). Modelling Distributions for Colombian Spider Monkeys (*Ateles* sp.) using GARP and GIS to Find Priority Areas for Conservation. Master's thesis, Oxford Brookes University, Oxford, UK.
- Morales-Jiménez, A.L., Cortés-Ortiz, L. and Di Fiore, A. (2015). Phylogenetic relationships of Mesoamerican spider monkeys (*Ateles geoffroyi*): molecular evidence suggests the need for a revised taxonomy. *Mol. Phylogenet. Evol.* 82: 484–494.
- Morelos-Juárez, C., Tapia, A., Conde, G. and Peck, M.R. (2015). Diet of the critically endangered brown-headed spider monkey (*Ateles fusciceps fusciceps*) in the Ecuadorian Chocó: conflict between primates and loggers over fruiting tree species. *PeerJ* 3: e1574v1.
- Morelos-Juárez, C., Moscoso, P., Alfonso-Cortes, F., Cervera, L., de la Torre, S., Estévez-Noboa, M.I., Fuentes, N., Peck, M.R., Tapia, A. and Tirira, D.G. (2018a). Mono araña de cabeza marrón *Ateles fusciceps* Gray, 1866. In: D.G. Tirira, S. de la Torre and G. Zapata Ríos (eds.), *Estado de Conservación de los Primates del Ecuador*, pp. 172–183. Publicación Especial sobre los Mamíferos del Ecuador 12. Quito: Grupo de Estudio de Primates del Ecuador and Asociación Ecuatoriana de Mastozoología.
- Morelos-Juárez, C., Tapia, A., Cervera, L., Alfonso-Cortes, F., Fuentes, N., Araguillín, E., Zapata Ríos, G., Spaan, D. and Peck, M.R. (2018b). Distribución actual, ecología y estrategias para la conservación de un primate críticamente amenazado (*Ateles fusciceps fusciceps*) en el Ecuador. In: B. Urbani, M. Kowalewski, R.G.T. Cunha, S. de la Torre and L. Cortés-Ortiz (eds.), *La Primatología en Latinoamérica 2 – A Primatología na América Latina 2. Tomo II. Costa Rica–Venezuela*, pp. 441–452. Caracas: Ediciones IVIC, Instituto Venezolano de Investigaciones Científicas.
- Mosandl, R., Günter, S., Stimm, B. and Weber, M. (2008). Ecuador suffers the highest deforestation rate in South America. In: E. Beck, J. Bendix, I. Kottke, F. Makeschin and R. Mosandl (eds.), *Gradients in a Tropical Mountain Ecosystem of Ecuador*, pp. 37–40. Berlin: Springer.
- Moscoso, P. (2010). Estado Poblacional del Mono Araña de Cabeza Café (*Ateles fusciceps*) en el Noroccidente del Ecuador, con Notas Ecológicas de Una Relación Interspecifica con *Alouatta palliata*. Bachelor's dissertation, Pontificia Universidad Católica del Ecuador, Quito.
- Moscoso, P., Shanee, S., Burneo, S.F., Fuentes, N., Alfonso-Cortes, F., Obando, M. and Tirira, D.G. (2019). Prolonged inter-specific association between *Ateles fusciceps fusciceps* and *Alouatta palliata aequatorialis* (Atelidae) in a forest fragment in north western Ecuador. *Neotrop. Primates* 25: 11–20.
- Moscoso, P., Link, A., de la Torre, S., Shanee, S. and Cortes-Ortiz, L. (2021). *Ateles fusciceps* ssp. *fusciceps* (amended version of 2020 assessment). The IUCN Red List of Threatened Species 2021: e.T39922A1916879

- Pardo, M. (2010). Cambio climático y pobreza: una mala combinación. In: M. Pardo and M. Rodríguez (eds.), *Cambio Climático y Lucha Contra la Pobreza*, pp. 1–24. Madrid: Fundación Carolina and Siglo XXI de España Editores, S.A.
- Peck, M.R., Thorn, J., Mariscal, A., Baird, A., Tirira, D.G. and Kniveton, D. (2011). Focusing conservation efforts for the critically endangered brown-headed Spider Monkey (*Ateles fusciceps*) using remote sensing, modeling, and playback survey methods. *Int. J. Primatol.* 32: 134–148.
- Perfecto, I. and Vandermeer, J. (2010). The agroecological matrix as alternative to the land-sparing/agriculture intensification model. *PNAS* 107: 5786–5791.
- Rylands, A.B., Groves, C.P., Mittermeier, R.A., Cortés-Ortiz, L. and Hines, J.J. (2006). Taxonomy and distributions of Mesoamerican primates. In: A. Estrada, P. Garber, M. Pavelka and L. Luecke (eds.), *New Perspectives in the Study of Mesoamerican Primates*, pp. 29–79. New York: Springer.
- Tirira, D.G. (2004). Present status of the brown-headed spider monkey (*Ateles fusciceps* Gray, 1866) (Primates: Atelidae) in Ecuador. *Lyonia* 13: 1–8.
- Tirira, D.G. (2017). *A Field Guide to the Mammals of Ecuador*. Publicación Especial sobre los Mamíferos del Ecuador 10. Quito, Ecuador: Asociación Ecuatoriana de Mastozoología and Editorial Murciélago Blanco.
- Tirira, D.G. (2021a). *Primates del Ecuador: Aportes al Conocimiento de su Diversidad, Distribución y Conservación*. Doctoral dissertation, Universidad de Salamanca, Salamanca, Spain.
- Tirira, D.G. (ed.) (2021b). Lista Roja de los mamíferos del Ecuador. In: *Libro Rojo de los Mamíferos del Ecuador*. 3rd ed. Publicación especial sobre los mamíferos del Ecuador 13. Quito, Ecuador: Asociación Ecuatoriana de Mastozoología, Fundación Mamíferos y Conservación, Pontificia Universidad Católica del Ecuador and Ministerio del Ambiente, Agua y Transición Ecológica del Ecuador.
- Tirira, D.G., Gavilanez, M.M., Moscoso, P., Arcos, R., de la Torre, S., Pozo-Rivera, W.E. and Peck, M.R. (2011). Mono araña de cabeza marrón (*Ateles fusciceps*). In: D.G. Tirira (ed.), *Libro Rojo de los Mamíferos del Ecuador*, 2nd ed., pp. 73–75. Publicación Especial sobre los Mamíferos del Ecuador 8. Quito, Ecuador: Fundación Mamíferos y Conservación, Pontificia Universidad Católica del Ecuador and Ministerio del Ambiente del Ecuador.
- Tirira, D.G., Morales-Jiménez, A.L. and Moscoso, P. (2015). Ecuadorian Brown-headed Spider Monkey *Ateles fusciceps fusciceps* Gray, 1866. In: C. Schwitzer et al. (eds.), *Primates in Peril: The World's 25 Most Endangered Primates, 2014–2016*, pp. 76–77. Arlington, VA, Bristol, UK: IUCN SSC Primate Specialist Group (PSG), International Primatological Society (IPS), Conservation International (CI), and Bristol Zoological Society.
- Tirira, D.G., Méndez-Carvajal, P.G. and Morales-Jiménez, A.L. (2017). Brown-headed spider monkey (*Ateles fusciceps* Gray, 1866). In: C. Schwitzer et al. (eds.), *Primates in Peril: The World's 25 Most Endangered Primates, 2016–2018*, pp. 83–87. Arlington, VA, Bristol, UK: IUCN SSC Primate Specialist Group, International Primatological Society, Conservation International and Bristol Zoological Society.
- Tirira, D.G., de la Torre, S. and Zapata Ríos, G. (eds.). (2018). *Plan de Acción para la Conservación de los Primates del Ecuador*. Quito: Ministerio del Ambiente del Ecuador, Grupo de Estudio de Primates del Ecuador and Asociación Ecuatoriana de Mastozoología.
- Urgilés-Verdugo, C.A. and Gallo-Viracocha, F. (2016). Ocupación del mono bracilargo (*Ateles fusciceps*) en la Reserva Ecológica Cotacachi-Cayapas. In: D.G. Tirira (ed.), *Libro de Resúmenes, III Congreso Ecuatoriano de Mastozoología*, pp. 141–142. Santa Elena, Ecuador: Asociación Ecuatoriana de Mastozoología, Ministerio del Ambiente del Ecuador and Universidad Estatal Península de Santa Elena.
- Van Roosmalen, M.G.M. and Klein, L.L. (1988). The spider monkeys, genus *Ateles*. In: R.A. Mittermeier, A.B. Rylands, A.F. Coimbra-Filho and G.A.B. da Fonseca (eds.), *The Ecology and Behavior of Neotropical Primates*, Volume 2, pp. 455–537. Washington, DC: World Wildlife Fund – U.S.

NEOTROPICS



GEOFFROY'S SPIDER MONKEY

Ateles geoffroyi Kühl, 1820

Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua,
Panama, and possibly Colombia
(2016, 2018, 2022)

Pedro G. Méndez-Carvajal, Melissa E. Rodríguez, Gilberto Pozo-Montuy, Óscar M. Chaves,
Ronald Sánchez-Porras, Karol M. Gutiérrez-Pineda, Denise Spaan, Eduardo J. Pinel Ramos
and Karla Zaldaña-Orantes

Geoffroy's Spider Monkey, *Ateles geoffroyi*, occurs in Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, and Panama (Rylands *et al.* 2006). It is listed as Endangered (EN) on the IUCN Red List of Threatened Species because of a suspected population decline of more than 50% over the next 45 years (three generations), that is by 2063. Kellogg and Goldman (1944) identified nine subspecies of *A. geoffroyi*, but three have been synonymized: *A. g. pan* (syn. of *A. g. vellerosus*; Silva-López *et al.* 1996); *A. g. yucatanensis* (syn. of *A. g. vellerosus*; Silva-López *et al.* 1996, Morales-Jiménez *et al.* 2015); and *A. g. panamensis* (syn. of *A. g. ornatus*; Napier, 1976; Morales-Jiménez *et al.* 2015). More molecular information and sample locations are needed (Ruiz-García *et al.* 2016) to confirm the current taxonomy: *A. g. azuerensis* (Critically Endangered; Méndez-Carvajal and Cortez-Ortíz, 2020); *A. g. frontatus* (Vulnerable; Solano *et al.* 2020a); *A. g. geoffroyi* (Critically Endangered; Williams-Guillén *et al.* 2020); *A. g. grisescens* (Data Deficient; Méndez-Carvajal and Cortez-Ortíz, 2020), *A. g. ornatus* (Vulnerable; Solano *et al.* 2020b), and *A. g. vellerosus* (Endangered; Rosales-Meda *et al.* 2020).

The genus *Ateles* has long been considered to be the most threatened primate taxon in the Neotropics (Weghorst *et al.* 2016). *Ateles geoffroyi* has a long gestation period (226–232 days) compared to other Mesoamerican primates (Melin *et al.* 2020) and 69–91% of its diet consists of fruit (González-Zamora *et al.* 2009). Spider monkeys have large home ranges and are more

vulnerable to habitat loss, fragmentation, and human presence than other Mesoamerican primates such as *Alouatta*, *Saimiri*, and *Cebus* (Méndez-Carvajal 2013, Solano-Rojas 2018, Mansell and McKinney 2021). This species has one of the largest distributions of the Mesoamerican primates, and its populations are threatened by high rates of deforestation, habitat loss, livestock farming, and hunting (Méndez-Carvajal *et al.* 2019, Cortés-Ortiz *et al.* 2021).

Due to their high degree of fission-fusion dynamics, surveying populations of Geoffroy's Spider Monkey is inherently difficult because subgroups change in size and membership throughout the day. The situation is further complicated by the diversity of landcover types that these spider monkeys occur in, limiting the use of a single method for all sites. As such, a wide range of methods have been employed to locate populations and determine their size, including line-transect surveys (Serio-Silva *et al.* 2006), camera trapping (Méndez-Carvajal 2014), and the use of drones (Spaan *et al.* 2019). Although they provide valuable information on the species' presence in an area, population density estimates obtained from different survey methods cannot be compared. Large gaps remain in our understanding of the distribution and numbers of Geoffroy's Spider Monkeys across their geographic range, hampering the identification of priority areas for their conservation. Funds dedicated to improving survey methods, training in survey techniques,



and the interchange of expertise are urgently needed to fill these gaps.

The Azuero Spider Monkey, *A. g. azuerensis*, was studied for the first time in the regions of La Vaca and Coto in Panama (Carpenter 1935). Its range and population size have been assessed by the NGO Fundación Pro-Conservación de los Primates Panameños (FCPP), which has been monitoring its populations since 2001. It has been extirpated in Chiriqui Province and western and northern Veraguas province, and appears to be present only in the Azuero Peninsula – southwest of Veraguas Province and the provinces of Herrera and Los Santos. More precisely, it is found in the southern areas near the Cerro Hoya National Park, and in the fragmented landscape between Punta Duarte, La Barra, Guanico, Quema, La Tronosa Forest Reserve, La Miel, and Pedasi. Only ten subgroups and five complete groups have been detected, with a mean of 3.8 individuals/subgroup (SE ± 0.6 , range 2–7) and a mean of 12.5 individuals/group (SE ± 3.7 , range 10–22). Their density in fragmented habitats is estimated at 1.4 individuals/km² (Méndez-Carvajal 2019), with an approximate total population of <150 individuals (Méndez-Carvajal and Ruiz-Bernard 2009, Méndez-Carvajal 2013). Conservation measures led by FCPP involve community volunteers from Azuero, and include environmental education, the creation of an educational guide for the primates of Azuero, primate surveys, and biodiversity monitoring in the Azuero Peninsula (Méndez-Carvajal et al. 2013).

The Black-handed Spider Monkey, *A. g. frontatus*, ranges from northern Nicaragua to northwestern Costa Rica. In Costa Rica, they are found in the Santa Rosa, Rincón de la Vieja, and Palo Verde national parks and the Lomas Barbudal Biological Reserve (Matamoros and Seal 1997). There are some reports in the Murciélagos and the Bahía Salinas communities in Costa Rica (Sánchez-Porrás et al. 2018), Caño Negro National Wildlife Refuge (Ó. M. Chaves, pers. obs.), and the basins of the ríos Principolca, Tuma and Ulice (Sánchez-Porrás et al. 2021). It has also been recorded in Metagalpa and the Nicaraguan highlands (Allen 1914, Solano et al. 2020a).

The Nicaraguan Spider Monkey, *A. g. geoffroyi*, was described from San Juan del Norte, Martina Bay, southeastern Nicaragua (Kellogg and Goldman 1944). Based on phenotypical characteristics, it could be present in Los Chiles, El Concho, Upala, and Las Delicias in Costa Rica, but further molecular analysis is needed (Morales-Jiménez *et al.* 2015, Williams-Guillén *et al.* 2020, Sánchez-Porras *et al.* 2021).

Philip Sclater described the Hooded Spider Monkey, *A. g. griseus*, in a manuscript catalogue of the mammals in the London Zoological Gardens that he wrote in 1865. Gray (1866) quoted Sclater's diagnosis of the 'Grizzled Spider Monkey': "Fur moderately long, black, with many silvery-white hairs interspersed; tail black, underside greyish; hair of the forehead moderately long; thumb none." (p.732). He attributed the authorship to Sclater. The type specimen is preserved in the British Museum of Natural History, London (Gray 1866, Napier 1976). The type locality is unknown. Kellogg and Goldman (1944) suggested it might hail from the Río Tuyra basin, Panama, probably extending southeastward through the Serranía del Sapo in extreme southeastern Panama and the Cordillera de Baudó of northwestern Colombia. Hernández-Camacho and Cooper (1976) indicated that *Ateles g. griseus* occurs in Colombia: "[In Colombia, it] is known only from the vicinity of Juradó very near the Panamanian border on the Pacific coast. It is undoubtedly restricted by the Baudó mountains to a narrow coastal strip that may extend as far south as Cabo Corrientes." (p.66). Méndez-Carvajal and Cortés-Ortiz (2020) confirmed that it had never been seen in the wild. In 2021, the FCPP team located a group of 16 spider monkeys at Homenaje, between Ipetí-Maje and the Chucantí Private Natural Reserve on the Pacific side of eastern Panama, which Méndez-Carvajal (2021) believes could be *A. g. griseus*. It is largely black, with a fringe of whitish hairs on the chin and cheeks. FCPP and the Grupo de Investigación de Primatología from Universidad de Panamá (GIP-UP) are carrying out a genetic study to confirm the identity of these spider monkeys. Conservation proposals and measures are underway together with Panama's Environment Ministry, including the possibility of creating a protected area in the Serranía del

Maje, alongside other forests in the region where the subspecies is believed to occur (Méndez-Carvajal 2021).

The Ornate Spider Monkey, *A. g. ornatus*, also known as the Panamanian Spider Monkey, occurs in Costa Rica and Panama. In Costa Rica, it is known to be in the Osa Peninsula, Carara Biological Reserve, and Corcovado National Park (Matamoros and Seal 1997). There is an introduced population of about 15 individuals on Nancital Island, in the Isla Negritos Biological Reserve, Golfo de Nicoya and Puntarenas, Costa Rica (Chaves *et al.* 2022). In Panama, this species occurs on the northern side of the Caribbean coast, Bocas del Toro, the northern coast of Veraguas Province. Although the species is also found in the Coclé and north Colón provinces, it is rarer due to Ngobe indigenous hunting and deforestation from mining (Méndez-Carvajal *et al.* 2019). It is present in the following reserves in Panama: Palo Seco Protected Forest, La Amistad International Park, the national parks of Santa Fe, Omar Torrijos, Chagres, Portobelo, and San Lorenzo, and the San Blas Mountain Range and some areas near the northern of Darien province. There is an introduced population of around 20 individuals on Barro Colorado Island in the Panama Canal watershed (Milton and Hopkins 2006).

The Mexican Spider Monkey, *A. g. vellerosus*, is present in Mexico, Belize, Guatemala, Honduras, and El Salvador (Cortés-Ortiz *et al.* 2021). In Mexico, the subspecies occurs in the states of Veracruz, Oaxaca, Chiapas, Tabasco, Campeche, Quintana Roo, and Yucatán. The population density of *A. g. vellerosus* is between 2.9 and 9.3 individuals/km² in Montes Azules Biosphere Reserve in Marqués Comillas ejido, Chiapas, Mexico (Chaves *et al.* 2011). Population densities have been recorded as being between 2.14 to 40.8 ind/km² in the Cañón del Sumidero National Park and Selva El Ocote Biosphere Reserve in Chiapas (Pozo-Montuy *et al.* 2016) and between 41.5 and 122.7 ind/km² in the Areas Voluntarily Dedicated to Conservation (ADVC) Cerro Chango and Soledad Vista Hermosa in Chinantla, Oaxaca (Pozo-Montuy *et al.* 2016, Pozo-Montuy and Pinacho-Guendulain 2021). There are other, difficult-to-access regions, where encounter rates range between 0.5 and 1 individuals/

km (in the El Triunfo, La Sepultura, and La Encrucijada Biosphere Reserves in Chiapas and in the Yum Balam Flora and Fauna Protection Area in Quintana Roo; Pozo-Montuy *et al.* 2018, Pinacho-Guendulain and Pozo-Montuy in press). The subspecies is believed to have been extirpated in the Pantanos de Centla Biosphere Reserve (Pozo-Montuy *et al.* 2021), but is found in the Calakmul Biosphere Reserve, Baláan K'aax and Otoch Ma'ax Yetel Kooch Fauna and Flora Protected Areas and in human-modified landscapes throughout the Yucatán Peninsula (Spaan *et al.* 2020).

In Guatemala it occurs in Petén, Alta Verapaz, Baja Verapaz, Izabal, Sololá, Huehuetenango and Quiché in Guatemala (Ponce-Santizo *et al.* 2009) and in Belize in the Runaway Creek Nature Reserve (Hartwell *et al.* 2021). In El Salvador, its presence has been registered in Chaguantique, Normandía, El Nacascolo and El Tercio (Usulután Department) and Montecristo, Cerro el Mono and Conchagua in (Rodríguez-Menjívar 2007). New records have been obtained of spider monkeys at the Laguna Olomega and in Cerro El Caballito, Jucuarán, also in El Salvador (Pineda-Peraza *et al.* 2017; Pineda-Peraza *et al.* 2020). The phylogenetic study by Morales-Jiménez *et al.* (2015) using mtDNA failed to identify the subspecies for El Salvador. It seems to form a separate clade from *Ateles geoffroyi vellerosus*.

The Maya Biosphere Reserve (MBR) in the north of Guatemala, covering 2.2 million ha, is the largest and most important protected habitat for the subspecies (68.6% of its original forests). Conservation actions are maintained by several organizations to preserve this important forest block in Guatemala (Ponce-Santizo *et al.* 2009, Rosales-Meda *et al.* 2020). In Honduras, *A. g. vellerosus* is in several protected areas, mainly those in the northern part of the country in the departments of Atlantida, Colon, Olancho and Gracias a Dios (Hines 2005, Zambrano 2008, Guillén and Guillén 2013, Espinal *et al.* 2016). There are no data on population densities for Honduras. Hines (2005) reported a mean subgroup size of 6.93 ± 4.53 individuals in Pico Bonito National Park.

Ateles g. vellerosus is threatened by habitat loss due to forest fires, subsistence farming and

industrial agricultural (e.g., oil palm plantations) and infrastructure development (e.g., road and rail construction), and the primate pet trade. It is hunted for food by indigenous people at Marqués de Comillas, Chiapas (Ó.M. Chaves pers. comm.). Conservation activities on its behalf include environmental education, community science and awareness campaigns, human-wildlife conflict mitigation and the improvement of survey methods (Spaan *et al.* 2019). Some educational materials are available (<www.cobius.org>). These activities have been implemented by the NGOs ConMonoMaya, Conservación de la Biodiversidad del Usumacinta A.C., and Miku Conservación A.C. in Mexico and Asociación Territorios Vivos El Salvador (ATVES) in El Salvador. Additionally, community monitoring with the involvement of more than 200 local people has been carried out throughout southeast Mexico by Conservación de la Biodiversidad del Usumacinta (COBIUS AC).

- Allen, J.A. (1914). New South American monkeys. *Bull. Am. Mus. Nat. Hist.* 33: 647–655.
- Carpenter, C.R. (1935). Behaviour of red spider monkeys in Panama. *J. Mammal.* 16: 171–180.
- Chaves, Ó.M., Stoner, K.E. and Arroyo-Rodríguez, V. (2011). Seasonal differences in activity patterns of Geoffroy's spider monkeys (*Ateles geoffroyi*) living in continuous and fragmented forests in southern Mexico. *Int. J. Primatol.* 32: 960–973.
- Chaves, Ó.M., Retana, M., Chacón, E., Obregón, A., Mena, L. and Gómez, E. (2022). Evaluación Preliminar de la Población de Monos Araña (*Ateles geoffroyi*) en la Reserva Biológica Islas Negritos, Golfo de Nicoya, Puntarenas. Informe técnico. Escuela de Biología, Universidad de Costa Rica, San José. 20pp. doi 10.13140/RG.2.2.19774.77121
- Cortés-Ortiz, L., Solano-Rojas, D., Rosales-Meda, M., Williams-Guillén, K., Méndez-Carvajal, P.G., Marsh, L.K., Canales-Espinosa, D. and Mittermeier, R.A. (2021). *Ateles geoffroyi* (amended version of 2020 assessment). The IUCN Red List of Threatened Species 2021: e.T2279A191688782.
- Espinal, J.M., Mora, J.M., Ruedas, L.A., López, L.-I. and Marineros, L. (2016). A case of albinism in the Central American spider monkey, *Ateles geoffroyi*, in Honduras. *Mastozool. Neotrop.* 23: 63–69.
- Gray, J.E. (1866). Notice of some new species of spider monkeys (*Ateles*) in the collection of the British Museum. *Proc. Zool. Soc. Lond.* 1865: 732–733.
- González-Zamora, A., Arroyo-Rodríguez, V., Chaves, Ó.M., Sánchez-López, S., Stoner, K.E. and P. Riba-Hernández. (2009). Diet of spider monkeys (*Ateles geoffroyi*) in Mesoamerica: current knowledge and future directions. *Am. J. Primatol.* 71: 8–20.

- Guillén, I.E., and Guillén, R.I. (2013). *Plan de Manejo y Normas de Uso y Manejo del Parque Nacional Montaña de Botaderos 2013–2024*. National Institute for Conservation, Forestry Development, Protected Areas and Wildlife (ICF).
- Hartwell, K.S., Notman, H., Kalbitzer, U., Chapman, C.A., and Pavelka, M.M. (2021). Fruit availability has a complex relationship with fission-fusion dynamics in spider monkeys. *Primates* 62: 165–175.
- Hernández-Camacho, J. and Cooper, R.W. (1976). The non-human primates of Colombia. In: R.W. Thorington, Jr. and P.G. Heltne (eds.), *Neotropical Primates: Field Studies and Conservation*, pp. 35–69. Washington, DC: National Academy of Sciences.
- Hines, J.J. (2005). Ecology and Taxonomy of *Ateles geoffroyi* in Parque Nacional Pico Bonito, Atlántida, Honduras. Doctoral thesis, Australian National University, Canberra, Australia.
- Kellogg, R. and Goldman, E.A. (1944). Review of the spider monkeys. *Proc. U. S. Natl. Mus.* 96: 1–45.
- Mansell, N.L. and McKinney, T. (2021). Interactions between humans and Panamanian white-faced capuchin monkeys (*Cebus imitator*). *Int. J. Primatol.* 42: 548–562.
- Matamoros, Y. and Seal, U.S. (1997). *Informe Final. Taller para la Conservación Asesoramiento y Manejo Planificado para los Primates Mesoamericanos*. Parque Zoológico Simón Bolívar, San José, Costa Rica, 23–25 Junio 1997. Sección 6. Primates de Costa Rica, pp. 76–131. IUCN/SSC Conservation Breeding Specialist Group (CBSG), Apple Valley, Minnesota. <http://www.cbsg.org/content/mesoamerican-primate-camp-1997>.
- Melin, A.D. et al. (2020). Primate life history, social dynamics, ecology, and conservation: contributions from long-term research in the Área de Conservación Guanacaste, Costa Rica. *Biotropica* 52: 1041–1064.
- Méndez-Carvajal, P.G. (2013). Population size, distribution and conservation status of howler monkeys (*Alouatta coibensis trabeata*) and spider monkeys (*Ateles geoffroyi azuerensis*) on the Azuero Peninsula, Panama. *Primate Conserv.* (26): 3–15.
- Méndez-Carvajal, P.G. (2014). The Orion Camera System, a new method for deploying camera traps in tree canopy to study arboreal primates and other mammals: a case study in Panama. *Mesoamericana* 18(1): 9–23.
- Méndez-Carvajal, P.G. (2019). A Long-term Monitoring Study to Evaluate the Primate Conservation Status in Panama using Species Distribution Modelling and Complementary Information. Doctoral thesis, Durham University, United Kingdom.
- Méndez-Carvajal, P.G. (2021). El mono araña negro del Darién es encontrado después de 70 años. *Imagina* 15: 51–52.
- Méndez-Carvajal, P.G. and Cortés-Ortiz, L. (2020). *Ateles geoffroyi* ssp. *grisescens*. The IUCN Red List of Threatened Species 2020: e.T2287A17979753.
- Méndez-Carvajal, P.G. and Ruiz-Bernard, I. (2009). Estudio poblacional del mono araña de Azuero (*Ateles geoffroyi azuerensis*), Península de Azuero, Panamá. *Tecnociencia* 11(1): 24–44.
- Méndez-Carvajal, P.G., Ruiz-Bernard, I., González, Y., Sánchez, K., Franco, V., Silva, S. and De León, G. (2013). Strategies for the conservation of two Critically Endangered, endemic primates in Panama. *Primate Conserv.* (27): 13–21.
- Méndez-Carvajal, P.G., Rodríguez, M.E., Pozo-Montuy, G., Chaves, Ó.M., Ponce, G., Rodríguez-Beitía, B. and Portillo, H. (2019). Central American Spider Monkey; *Ateles geoffroyi* Kühl, 1820, Mexico, Guatemala, Nicaragua, Honduras, El Salvador, Costa Rica, Panama (2016–2018). In: C. Schwitzer et al. (eds.), *Primates in Peril: The World's 25 Most Endangered Primates 2018–2020*, pp. 98–101. Washington, DC: IUCN SSC Primate Specialist Group, International Primatological Society, Global Wildlife Conservation, and Bristol Zoological Society.
- Milton, K. and Hopkins, M.E. (2006). Growth of a reintroduced spider monkey (*Ateles geoffroyi*) population on Barro Colorado Island, Panama. In: A. Estrada, P. Garber, M. Pavelka, L. Luecke (eds.), *New Perspectives in the Study of Mesoamerican Primates: Distribution, Ecology, Behavior and Conservation*, pp. 417–435. New York: Springer.
- Morales-Jiménez, A.L., Cortés-Ortiz, L. and Di Fiore, A. (2015). Phylogenetic relationships of Mesoamerican spider monkeys (*Ateles geoffroyi*): molecular evidence suggests the need for a revised taxonomy. *Mol. Phylogenet. Evol.* 82: 484–494.
- Napier, P.H. (1976). *Catalogue of the Primates in the British Museum (Natural History). Part I. Families Callitrichidae and Cebidae*. London: British Museum (Natural History).
- Pinacho Guendulain, B. and Pozo Montuy, G. (In press). Abundancia y distribución del mono araña (*Ateles geoffroyi*) en el APFF Yum Balam. Pozo-Montuy, G. and Mendoza, E. (eds). *Diversidad de vertebrados en el Área de Protección de Flora y Fauna Yum Balam*, pp. 185–215. Mexico: Conservación de la Biodiversidad del Usumacinta AC.
- Ponce-Santizo, G., García, R., Moreira, J., Balas, R., Ruano, G., Mérida, M., Córdova, F., Méndez, V., López, Y., Castellanos, E., Burgos, M. and Lima, R. (2009). Abundancia y Densidad de Primates en la Comisión Forestal Yaloch, Reserva de Biosfera Maya, Guatemala. Estudio Piloto. Reporte interno. New York, NY: Wildlife Conservation Society – Programa para Guatemala.
- Pozo-Montuy, G., Pinacho-Guendulain, B., Bonilla-Alcacer, A., Martínez-Jiménez, L.F., Domínguez-Martínez, L.A. and Ramos-Fernández, G. (2016). *Reporte técnico del Proyecto Fortalecimiento de Acciones de Conservación de Primates y su Hábitat en el Complejo Selva Zoque*. Conservación de la Biodiversidad del Usumacinta A.C., Comisión Nacional de Áreas Naturales Protegidas – Programa de Conservación de Especies en Riesgo 2016. Tuxtla Gutiérrez, Chiapas, México.
- Pozo-Montuy G., Pinacho Guendulain, B. and Domínguez Martínez, L.A. (2018). *Fortalecimiento de Acciones para la Conservación del Mono Araña en la Sierra Madre y Costa de Chiapas*. Conservación de la Biodiversidad del Usumacinta A.C., Comisión Nacional de Áreas Naturales Protegidas, Programa de Conservación de Especies en Riesgo 2018. Tuxtla Gutiérrez, Chiapas, México.
- Pozo-Montuy, G., Miranda-Chan, M.J., de la Cruz Córdova, S.A. and Pinacho Guendulain, B. (2021). Population state of black saragwato monkeys (*Alouatta pigra*) in the Biosphere Reserve of Pantanos de Centla. *Ecosist. Rec. Agropec.* 8(1): e2672.

- Pozo-Montuy, G. and Pinacho Guendulain, B. (2021). *Monitoreo del Mono Araña en las ADVC Cerro Chango y Reserva Ejidal Vista Hermosa: Conocimiento, Cultura y Manejo Integral*. Conservación de la Biodiversidad del Usumacinta A.C., Comisión Nacional de Áreas Naturales Protegidas, Programa para la Protección y Restauración de Ecosistemas y Especies Prioritarias 2021. Tuxtpec, Oaxaca, México.
- Pineda-Peraza, L.A., Segura-Yanes, J.H., Medina-Zeledón, K.E., Flores-Márquez, J.I. and López, M.Á. (2017). Redescubrimiento de una población de mono araña (*Ateles geoffroyi*) en la laguna de Olomega, El Salvador. *Acta Zool. Mexicana* 33(3): 532–537.
- Pineda-Peraza, L.A., Rivera, E. and Guerra, E. (2020). Confirmación de presencia de Mono Araña (*Ateles geoffroyi*) en las montañas de Jucuarán, El Salvador. *Bioma* 55: 6-9.
- Rodríguez-Menjívar, M. (2007). *Monitoreo Poblacional de Mono Araña (Ateles geoffroyi) en el Área Natural Protegida Normandía, Usulután, El Salvador*. El Salvador; Centro de Cooperación Integral sobre Tecnologías Alternativas.
- Ruiz-García, M., Lichilín, N., Escobar-Armel, P., Rodríguez, G. and Gutiérrez-Espeleta, G. (2016). Historical genetic demography and some insights into the systematics of *Ateles* (Atelidae, Primates) by means of diverse mitochondrial genes. In: M. Ruiz-García, J.M. Shostell (eds.), *Phylogeny, Molecular Genetics, Evolutionary Biology and Conservation of the Neotropical Primates*, Chapter 13. New York: Nova Science Publisher Inc.
- Rylands, A.B., Groves, C.P., Mittermeier, R.A., Cortés-Ortiz, L. and Hines, J.J. (2006). Taxonomy and distributions of Mesoamerican primates. In: A. Estrada, P.A. Garber, M.M. Pavelka and L. Luecke (eds.), *New Perspectives in the Study of Mesoamerican Primates*, pp. 29–79. New York: Springer.
- Rosales-Meda, M., Cortes-Ortiz, L., Canales Espinosa, D., Marsh, L.K., Rylands, A.B. and Mittermeier, R.A. (2020). *Ateles geoffroyi* ssp. *vellerosus*. The IUCN Red List of Threatened Species 2020: e.T160872795A17979441.
- Sánchez-Porras, R., Chinchilla-Carmona, M., Valerio-Campos, I. and J.C., Vengas (2018). Análisis morfométrico del mono araña, *Ateles geoffroyi* (Primates: Cebidae) Costa Rica. In: *La Primatología en Latinoamérica. Tomo II Costa Rica-Venezuela*, pp. 377-383. Caracas, Venezuela: Ediciones I.V.I.C., Instituto Venezolano de Investigaciones Científicas (IVIC)/
- Sanchez-Porras, R., Brenes, Cambronero, L., Moya-Calderón, M., Azofeifa-Rojas, I. (2021). Primer Censo Nacional de Primates de Costa Rica, Informe anual Universidad de Costa Rica, Sede de Occidente, Posgrado en Desarrollo Sostenible. Costa Rica. 13pp.
- Slater, P.L. (1865). List of Vertebrate Animals in the Zoological Gardens. 3rd edition. Manuscript.
- Serio-Silva, J.C., Rico-Gray, V. and Ramos-Fernández, G., (2006). Mapping primate populations in the Yucatan Peninsula, Mexico: a first assessment. In: A. Estrada, P.A. Garber, M.M. Pavelka and L. Luecke (eds.), *New Perspectives in the Study of Mesoamerican Primates*, pp. 489–511. New York: Springer.
- Silva-López, G., Motta-Gill, J., and Sánchez-Hernández, A. I. (1996). Taxonomic notes on *Ateles geoffroyi*. *Neotrop. Primates* 4(2):41–44.
- Solano-Rojas, D. (2018). Importancia de los bosques secundarios para el mono tití centroamericano (*Saimiri oerstedii oerstedii*) en la península de Osa, Costa Rica. In: B. Urbani, M. Kowalewski, R.G.T. Cunha, S. de la Torre, and L. Cortés-Ortiz (eds.), *La Primatología en Latinoamérica*, pp. 385–395. Caracas: Instituto Venezolano de Investigaciones Científicas.
- Solano-Rojas, D., Williams-Guillén, K. and Cortés-Ortiz, L. (2020a). *Ateles geoffroyi* ssp. *frontatus*. The IUCN Red List of Threatened Species 2020: e.T2280A17979622.
- Solano-Rojas, D., Cortes-Ortiz, L. and Méndez-Carvajal, P. (2020b). *Ateles geoffroyi* ssp. *ornatus*. The IUCN Red List of Threatened Species 2020: e.T2289A17979560.
- Spaan, D., Burke, C., McAree, O., Aureli, F., Rangel-Rivera, C.E., Hutschenreiter, A., Longmore, S.N., McWhirter, P.R. and Wich, S.A. (2019). Thermal infrared imaging from drones offers a major advance for spider monkey surveys. *Drones* 3: 34.
- Spaan, D., Ramos-Fernández, G., Bonilla-Moheno, M., Schaffner, C.M., Morales-Mávil, J.E., Slater, K. and Aureli, F. (2020). Anthropogenic habitat disturbance and food availability affect the abundance of an endangered primate: a regional approach. *Mammal. Biol.* 100: 325–333.
- Weghorst, J.A., Hines, J.J. and Méndez-Carvajal, P.G. (2016). Central American Spider Monkey *Ateles geoffroyi*. In: N. Rowe and M. Myers (eds.), *All the World's Primates*. pp. 263–266. Charlestown, RI: Pogonias Press.
- Williams-Guillén, K., Solano, D. and Cortés-Ortiz, L. (2020). *Ateles geoffroyi* ssp. *geoffroyi*. The IUCN Red List of Threatened Species 2020: e.T43901A17979679.

OTHER SPECIES CONSIDERED

MADAGASCAR – AYE-AYE

***Daubentonia madagascariensis* (Gmelin, 1788)**

Madagascar
(2016, 2018)

Timothy M. Sefczek, Jeannin Nicolas Rakotondrazandry, Doménico R. Randimbiharirinina, Faranky Ravelomandrato, Herinandrasana Pollensio, Noa E. Rasoanaivo, Romeo Rakotondrina, Jonah Ratsimbazafy, Brigitte M. Raharivololona, Solofonirina Rasoloharijaona, Herimalala Raveloson, John Zaonarivelo, Aristide Andrianarimisa, George Perry, Felix Rakotondraparany and Edward E. Louis Jr.

The Aye-aye (*Daubentonia madagascariensis*) is the only extant species in the family Daubentoniidae (Simpson 1945). Aye-ayes have the widest distribution of any Malagasy primate – they are absent only from southwest of the island (Sterling and McCreless 2006). Their ecological flexibility means they can persist in different forest types, such as moist evergreen and dry deciduous forests, and of varying quality, including primary, disturbed, and heavily degraded habitats (Ancrenaz *et al.* 1994, Randimbiharirinina *et al.* 2018, Sefczek *et al.* 2020a). Nevertheless, their huge individual home ranges (Sefczek *et al.* 2020b) and presumed low population densities make them susceptible to continued anthropogenic disturbance (Perry *et al.* 2012), i.e., forest degradation and fragmentation, slash-and-burn agriculture, and hunting associated with local superstitions (Randimbiharirinina *et al.* 2021).

- Ancrenaz, M., Lackman-Ancrenaz, I. and Mundy, N. (1994). Field observations of aye-ayes (*Daubentonia madagascariensis*) in Madagascar. *Folia Primatol.* 62: 22–36.
- Perry, G.H., Reeves, D., Melsted, P., Ratan, A., Miller, W., Michelini, K., Louis, Jr., E.E., Pritchard, J.K., Mason, C.E., and Gilad, Y. (2012). A genome sequence resource for the aye-aye (*Daubentonia madagascariensis*), a nocturnal lemur from Madagascar. *Genome Biol. Evol.* 4: 126–135.
- Randimbiharirinina, D.R., Raharivololona, B.M., Hawkins, M.T.R., Frasier, C.L., Culligan, R.R., Sefczek, T.M., Randriamampionona, R. and Louis, Jr., E.E. (2018). Behaviour and ecology of male aye-ayes (*Daubentonia madagascariensis*) in the Kianjavato Classified Forest, south-eastern Madagascar. *Folia Primatol.* 89: 123–137.
- Randimbiharirinina, D.R., Richter, T., Raharivololona, B.M., Ratsimbazafy, J.H. and Schübler, D. (2021). To tell a different story: unexpected diversity in local attitudes towards endangered aye-ayes *Daubentonia madagascariensis* offers new opportunities for conservation. *People and Nature* 3: 484–498.
- Sefczek, T.M., Randimbiharirinina, D.R., Raharivololona, B.M., Razafimahaleo, H., Randrianarison, O. and Louis, Jr., E.E. (2020a). Re-assessing the applicability of the Jarman/Bell model and Kay's threshold to the insectivorous aye-aye (*Daubentonia madagascariensis*). *Am. J. Phys. Anthropol.* 171: 336–341.
- Sefczek, T.M., Hagenson, R.A., Randimbiharirinina, D.R., Rakotondrazandry, J.N. and Louis Jr., E.E. (2020b). Home range size and seasonal variation in habitat use of aye-ayes (*Daubentonia madagascariensis*) in Torotorofotsy, Madagascar. *Folia Primatol.* 91: 558–574.
- Simpson, G.G. (1945). The principles of classification and classification of mammals. *Bull. Am. Mus. Nat. Hist.* 85: 62.
- Sterling, E.J. and McCreless, E. (2006). Adaptations in the aye-aye: a review. In: L. Gould and M.L. Sauther (eds.), *Lemurs: Ecology and Adaptation*, pp. 161–186. New York, NY: Springer.

MADAGASCAR – LAKE ALAOTRA GENTLE LEMUR

***Haplemur alaotrensis* Rumpler, 1975**

Madagascar
(2000, 2014, 2016, 2018)

Lena M. Reibelt, Herizo T. Andrianandrasana, Richard Lewis, Fidy Ralainasolo, Jonah Ratsimbazafy, Lucile Mialisoa Raveloarimalala and Patrick O. Waeber

The Critically Endangered Lake Alaotra Gentle Lemur (*Haplemur alaotrensis*) is restricted to the wetlands fringing Lake Alaotra, a Ramsar Site and protected area in north-eastern Madagascar. This limited geographical range and ever-increasing pressures have brought the “bandro” close to extinction. The first published census estimated some 7,500–11,000 individuals (Mutschler and

Feistner 1995) but the population has since declined with only an estimated 2,500 individuals in 2005 (Ralainasolo *et al.* 2006). Subpopulations are isolated due to a high degree of habitat fragmentation and the permanent conversion of marshes for agricultural production. A case in point is the priority conservation zone “Park Bandro” (Ratsimbazafy *et al.* 2013, Raveloarimalala and Reibelt 2016), where more than half of the area was lost due to a fire in 2021. Very few lemurs have been spotted since. The principal threats to *Hapalemur alaotrensis* remain habitat loss, habitat degradation, and hunting, which are exacerbated with extended droughts that result in an increased need for people to take water from the lake and marsh system (Ralainasolo *et al.* 2006, Copsey *et al.* 2009a, 2009b, Guillera-Arroita *et al.* 2010). Conservation and management of the Alaotra Protected Area (IUCN category V) is challenging for many reasons but primarily due to overstretched resources which are insufficient to fund the running of this vast protected area. In close partnership with the authorities, Durrell Wildlife Conservation Trust and Madagascar Wildlife Conservation implement community-based projects around the lake, focusing on supporting the local resource-management associations, participatory ecological monitoring, and environmental education (Andrianandrasana *et al.* 2005, Rendigs *et al.* 2015, Waeber *et al.* 2018). For more information on the biology, ecology, and conservation efforts on behalf of *Hapalemur alaotrensis* see Reibelt *et al.* (2017, 2019). Since the onset of COVID-19 in early 2020, eco-tourism has become obsolete, putting further strain on the monitoring and patrolling of the vast conservation area.

- Andrianandrasana, H.T., Randriamahefasoam J., Durbin, J., Lewis, R.E. and Ratsimbazafy, J.H. (2005). Participatory ecological monitoring of the Alaotra wetlands in Madagascar. *Biodiv. Conserv.* 14: 2757–2774.
- Copsey, J.A., Jones, J.P.G., Andrianandrasana, H., Rajaonarison, L.H. and Fa, J.E. (2009a). Burning to fish: local explanations for wetland burning in Lac Alaotra, Madagascar. *Oryx* 43: 403–406.
- Copsey, J.A., Rajaonarison, L.H., Ranriamihamina, R. and Rakotoniaina, L.J. (2009b). Voices from the marsh: livelihood concerns of fishers and rice cultivators in the Alaotra wetland. *Madagascar Conserv. Develop.* 4: 25–30.
- Guillera-Arroita, G., Lahoz-Monfort, J.J., Milner-Gulland, E.J., Young, R.P. and Nicholson, E. (2010). Monitoring and conservation of the Critically Endangered Alaotran gentle lemur *Hapalemur alaotrensis*. *Madagascar Conserv. Develop.* 5: 103–109.
- Mutschler, T. and A.T.C. Feistner. (1995). Conservation status and distribution of the Alaotran gentle lemur *Hapalemur griseus alaotrensis*. *Oryx* 29: 267–274.
- Ralainasolo, F.B., Waeber, P.O., Ratsimbazafy, J., Durbin, J. and Lewis, R. (2006). The Alaotra gentle lemur: population estimation and subsequent implications. *Madagascar Conserv. Develop.* 1: 9–10.
- Ratsimbazafy, J.R., Ralainasolo, F.B., Rendigs, A., Mantilla Contreras, J., Andrianandrasana, H., Mandimbahasina, A.R., Nievergelt, C.M., Lewis, R. and Waeber, P.O. (2013). Gone in a puff of smoke? *Hapalemur alaotrensis* at great risk of extinction. *Lemur News* 17: 14–18.
- Raveloarimalala, L.M. and Reibelt, L.M. (2016). Update on management of Park Bandro and population numbers of *Hapalemur alaotrensis*. *Lemur News* 20: 2.
- Reibelt L.M., Ratsimbazafy J. and Waeber P.O. (2017). Lac Alaotra bamboo lemur *Hapalemur alaotrensis* (Rumpler, 1975). In: C. Schwitzer *et al.* (eds.), *Primates in Peril: The World's 25 Most Endangered Primates 2016–2018*, pp. 32–34. Arlington, VA, and Bristol, UK: IUCN SSC Primate Specialist Group, International Primatological Society, Conservation International and Bristol Zoological Society.
- Reibelt L.M., Andrianandrasana, H.T., Ralainasolo, F., Raveloarimalala, L.M., Lewis, R., Ratsimbazafy, J. and Waeber, P.O. (2019). Lake Alaotra Gentle Lemur *Hapalemur alaotrensis* (Rumpler, 1975). In: C. Schwitzer *et al.* (eds.), *Primates in Peril: The World's 25 Most Endangered Primates 2018–2020*, pp. 9–11. Washington, D.C. and Bristol, UK: IUCN SSC Primate Specialist Group, International Primatological Society, Global Wildlife Conservation and Bristol Zoological Society.
- Rendigs, A., Reibelt, L.M., Ralainasolo, F.B., Ratsimbazafy, J.H. and Waeber, P.O. (2015). Ten years into the marshes – *Hapalemur alaotrensis* conservation, one step forward and two steps back? *Madagascar Conserv. Develop.* 10: 13–20.
- Waeber, P.O., Ratsimbazafy, J.H., Andrianandrasana, H., Ralainasolo, F.B. and Nievergelt, C.M. (2018). *Hapalemur alaotrensis*, a conservation case study from the swamps of Alaotra, Madagascar. In: A.A. Barnett, I. Matsuda and K. Nowak (eds.), *Primates in Flooded Habitats: Ecology and Conservation*, pp. 293–296. Cambridge, UK: Cambridge University Press.

MADAGASCAR – GOLDEN-CROWNED SIFAKA

***Propithecus tattersalli* Simons, 1988**

Madagascar
(2000)

Brandon Semel, Rio Heriniaina, Jordi Salmona and Meredith Semel

The Golden-Crowned Sifaka (*Propithecus tattersalli*) is Critically Endangered and endemic to forest patches encompassed by the Loky and Manambato rivers in northeastern Madagascar (Vargas *et al.* 2000). Surveys conducted in 2006–2008 suggested a population of about 18,000 (estimated range of 11,000–26,000) (Quéméré *et al.* 2010). A more recent study estimated that 10,222–12,631 sifakas remain and found fewer sifakas in all four forest patches surveyed in 2006–2008 (B. Semel *et al.* in review a). Genetic studies suggest a small effective population size of 430–795 and a significant population decline since the mid-Holocene transition about 4,200 years ago (Quéméré *et al.* 2012, Salmona *et al.* 2017). Surprisingly, staff at Fanamby – the Malagasy NGO, that manages the Loky-Manambato Protected Area – recently confirmed the presence of several groups of sifakas in the Andrafiarena Andavakoera Protected Area, about 50 km to the west of the closest known populations, therefore extending their known distribution. Threats include habitat loss due to slash-and-burn agriculture and grassland fires, mining, and potentially hunting, all of which are likely to be exacerbated by improvements to the national road that bisects their range (Anania *et al.* 2018, M. Semel *et al.* in review b).

Anania, A., Salmona, J., Rasolondraibe, E., Jan, F., Chikhi, L., Fichtel, F., Kappeler, P.M., Rasoloarison, R. (2018). Taboo adherence and presence of Perrier's sifaka (*Propithecus perrieri*) in Andrafiarena forest. *Madag. Conserv. Dev.* 13(1): 6–14.

Quéméré, E., Champeau, J., Besolo, A., Rasolondraibe, E., Rabarivola, C., Crouau-Roy, B. and Chikhi, L. (2010). Spatial variation in density and total size estimates in fragmented primate populations: the golden-crowned sifaka (*Propithecus tattersalli*). *Am. J. Primatol.* 72: 72–80.

Quéméré, E., Amelot, X., Pierson, J., Crouau-Roy, B. and Chikhi, L. (2012). Genetic data suggest a natural prehuman origin of open habitats in northern Madagascar and question the deforestation narrative in this region. *PNAS* 109(32): 13028–13033.

Salmona, J., Heller, R., Quéméré, E. and Chikhi, L. (2017). Climate change and human colonization triggered habitat loss and fragmentation in Madagascar. *Mol. Ecol.* 26: 5203–5222.

Semel, B.P., Karpanty, S.M., Semel, M.A., Stauffer, D.F., Quéméré, E., Walters, J.R., Andrianiaina, A.F., Rakotonahary, A.N., Ranaivoson, T., Rasolonirina, D.V. and Vololonirina, F.F. (in review a). Highly variable densities and a decline in critically endangered golden-crowned sifaka (*Propithecus tattersalli*) population abundance from 2008–2018.

Semel, M.A., Abernathy, H.N., Semel, B.P., Cherry, M.J., Ratovoson, T.J.C. and Moore, I.T. (in review b). Environmental and anthropogenic influences on movement and foraging in a critically endangered lemur species, *Propithecus tattersalli*: implications for habitat conservation planning.

Vargas, A., Jiménez, I., Palomares, F. and Palacios, M.J. (2002). Distribution, status, and conservation needs of the golden-crowned sifaka (*Propithecus tattersalli*). *Biol. Conserv.* 108: 325–334.

MADAGASCAR – PERRIER'S SIFAKA

***Propithecus perrieri* Lavauden, 1931**

Madagascar
(2000, 2002, 2004, 2014, 2016)

Rio Heriniaina, Hosnah Bezara Hortensia and Jhon Rigobert

Perrier's Sifaka (*Propithecus perrieri*) is Critically Endangered (Ranaivoarisoa *et al.* 2006). The species has a very restricted home range in northern Madagascar that includes the Analamerana Special Reserve and Andrafiarena-Andavakoera Protected Area (Petter *et al.* 1977). It has been estimated that only 100 to 2,000 individuals remain in the wild, with an effective population unlikely to exceed 230 (Bank *et al.* 2007). This species can be found in semi-evergreen forest. Perrier's Sifaka is threatened by hunting, selective logging, habitat destruction to make way for agriculture, heavy fires set to increase pasture for livestock, and charcoal production (Schwitzer *et al.* 2006). More recently, mining has come to be an important threat to this species.

- Banks, M.A., Ellis, E.R., Antonio and Wright, P.C. (2007). Global population size of a critically endangered lemur, Perrier's sifaka. *Anim. Conserv.* 10: 254-262.
- Petter, J.-J., Albignac, R. and Rumpfer, Y. (1977). Mammifères lémuriens (Primates prosimiens). *Faune de Madagascar*. 44: 1-513.
- Ranaivoarisoa, J.F., Ramanamahefa, R., Louis, E.E. Jr. and Brenneman, R.A. (2006). Range extension of Perrier's Sifaka, *Propithecus perrieri*, in the Andrafiarena Classified Forest. *Lemur News* 11: 17-21.
- Schwitzer, C., Arnoult, O. and Rakotosamimanana, B. (2006). An international conservation and research programme for Perrier's sifaka (*Propithecus perrieri* Lavauden, 1931) in northern Madagascar. *Lemur News* 11: 12-14.

AFRICA – KIPUNJI

***Rungwecebus kipunji* (Ehardt, Butynski, Jones & Davenport, 2005)**

Tanzania

(2006, 2008, 2018)

Tim R.B. Davenport

The kipunji (*Rungwecebus kipunji*) was included in *Primates in Peril: The World's 25 Most Endangered Primates 2018–2020* (Davenport 2019), based on its small global population, narrow range and threats. After a decade and a half of conservation in their forest habitat, Davenport *et al.* (2022) reassessed the population size, demography, and distribution of *R. kipunji* across Tanzania's Southern Highlands, employing the identical sweep census methods as of 2007 (Davenport *et al.* 2008). A habituated group was also monitored daily over the same period. A total of 1,866 individuals in 59 groups ($\mu = 31.63 \pm SE 1.2$) were recorded in Livingstone Forest (in Kitulo National Park), Mt Rungwe Nature Reserve, and Madehani Village Forest. This corresponded to a 65% increase in individuals, a 59% increase in group numbers, and a 19% increase in Area of Occupancy since the previous census. The ratio of subadults/juveniles to adult females, a proxy for survival, was good (1.77), but higher in Livingstone (2.61) than Mt Rungwe (1.11). A 121% increase in group size was recorded in the habituated group. Signs of human activity fell by 81%, with a 100% and 98% reduction in the number of charcoal pits and timber felling in Mt Rungwe. Whilst the total remains low by global standards, both temporal and spatial data demonstrated that long-term holistic conservation had led to a significant increase in the numbers of *R. kipunji* (Davenport *et al.* 2022).

Davenport, T.R.B. (2019). Kipunji (*Rungwecebus kipunji*). In: C. Schwitzer *et al.* (eds.), *Primates in Peril: The World's 25 Most Endangered Primates 2018–2020*, pp. 32–36. Washington, D.C., and Bristol, UK: IUCN SSC Primate Specialist Group, International Primatological Society, Global Wildlife Conservation and Bristol Zoological Society.

Davenport, T.R.B., Stanley, W.T., Sargis, E.J., De Luca, D.W., Mpunga, N.E., Machaga, S.J. and Olson, L.E. (2006). A new genus of African monkey, *Rungwecebus*. Morphology, ecology and molecular phylogenetics. *Science* 312: 1378–1381.

Davenport, T.R.B., De Luca, D.W., Jones, T., Mpunga, N.E., Machaga, S.J. and Picton Phillipps, G. (2008). The kipunji *Rungwecebus kipunji* of southern Tanzania: first census and assessments of distribution and conservation status. *Oryx* 42(3): 352–359.

Davenport, T.R.B., Machaga, S.J., Mpunga, N.E., Kimiti, S.P., Mwalwengele, W., Mwaipungu, O. and Makumbule, P.M. (2022). A reassessment of the population size, demography and distribution of Tanzania's endemic kipunji *Rungwecebus kipunji* 13 years on – demonstrating conservation success. *Int. J. Primatol.* doi.org/10.1007/s10764-022-00281-3

AFRICA – WHITE-THIGHED COLOBUS

***Colobus vellerosus* (l. Geoffroy Saint-Hilaire, 1834)**

Benin, Côte d'Ivoire, Ghana, Togo

(2016, 2018)

Reiko Matsuda Goodwin

The White-thighed Colobus (*Colobus vellerosus*) is a Critically Endangered species. Unregulated hunting and destruction, degradation, and fragmentation of its habitats throughout its range have reduced the species' population by more than 80% in the past three decades (Matsuda Goodwin *et al.* 2020). In the absence of hunting, *C. vellerosus* can thrive in a variety of habitats, from lowland rainforests to savannah-forest mosaics, and from high forests to moderately disturbed forests (Wong

and Sicotte 2007, Oates 2011). This species used to be widely distributed from the area between the Sassandra-Bandama rivers in Côte d'Ivoire to southwestern Nigeria, traversing Ghana and Togo, but it has probably been extirpated from Nigeria. It is now distributed in extremely fragmented ranges, occurring only in a few protected areas and community forests in the remaining range countries. Although a lack of systematic surveys precludes us from making a precise estimate, less than 1,500 individuals probably remain in the habitat countries. The two strongholds of this species are the Boabeng-Fiema Monkey Sanctuary (BFMS) in Ghana and Comoé National Park in Côte d'Ivoire. Deforestation, hunting, and mining continue to negatively influence the long-term survival of the species. Additionally, climate change would exacerbate the rate of contraction and fragmentation of the suitable habitat of this species and many other forest-living primates (Korstjens *et al.* 2010, Stewart *et al.* 2020). Robust conservation measures and range-wide systematic surveys are urgently needed to protect this species.

- Korstjens, A.H., Lehmann, J. and Dunbar, R.I.M. (2010). Resting time as an ecological constraint on primate biogeography. *Anim. Behav.* 79(2), 361–374.
- Matsuda Goodwin, R., Gonedélé Bi, S., Nobimè, G., Koné, I., Osei, D., Segniagbeto, G. and Oates, J.F. (2020). *Colobus vellerosus*. The IUCN Red List of Threatened Species 2020: e.T5146A169472127.
- Oates, J.F. (2011). *Primates of West Africa: A Field Guide and Natural History*. Arlington, VA: Conservation International.
- Stewart, B.M., Turner, S.E. and Matthews, H.D. (2020). Climate change impacts on potential future ranges of non-human primate species. *Clim. Change* 162(4): 2301–2318.
- Wong, S.N. and Sicotte, P. (2007). Activity budget and ranging patterns of *Colobus vellerosus* in forest fragments in central Ghana. *Folia Primatol.* 78(4): 245–254.

AFRICA – CROSS RIVER GORILLA

***Gorilla gorilla diehli* Matschie, 1904**

Cameroon, Nigeria

(2000, 2002, 2004, 2006, 2008)

Inaoyom Imong, Andrew Dunn and Richard Bergl

The Cross River Gorilla (*Gorilla gorilla diehli*) is endemic to the hilly rainforest region along the Nigeria-Cameroon border and Critically Endangered (Bergl *et al.* 2016). The population is small and fragmented, estimated to number fewer than 300 individuals (Dunn *et al.* 2014) concentrated in about 15 small hilly areas interspersed among large areas of unoccupied but suitable habitat (Imong *et al.* 2014) across a landscape of approximately 12,000 km² spanning the Afi Mountain Wildlife Sanctuary in the west to the Kagwene Gorilla Sanctuary in the east, with an isolated outlying locality in the Tofala Hills (Dunn *et al.* 2014), of which approximately 8,000 km² is tropical forest (Bergl *et al.* 2012). The population is threatened by hunting and habitat loss from agriculture, illegal logging, and road construction. Although hunting of Cross River Gorillas has declined very considerably over the last two decades, they are still occasionally killed by hunters as snare by-catch. While much of the species' population lives in protected areas, a number of subpopulations exist on community land with no formal protection (Dunn *et al.* 2014). Insecurity resulting from the ongoing political and armed conflict in the Southwest and Northwest regions of Cameroon prevents the implementation of conservation activities in the Cameroon side of the landscape. The presence of refugees in and around key habitat areas in Nigeria are an additional threat to this population.

- Bergl, R.A., Warren, Y., Nicholas, A., Dunn, A., Imong, I., Sunderland-Groves, J.L. and Oates, J.F. (2012). Remote sensing analysis reveals habitat, dispersal corridors and expanded distribution for the Critically Endangered Cross River gorilla, *Gorilla gorilla diehli*. *Oryx* 46: 278–289.
- Bergl, R.A., Dunn, A., Fowler, A., Imong, I., Ndeloh, D., Nicholas, A. and Oates, J.F. (2016). *Gorilla gorilla* ssp. *diehli* (errata version published in 2016). The IUCN Red List of Threatened Species 2016: e.T39998A102326240.
- Dunn, A., Bergl, R., Byler, D., Eben-Ebai, S., Etiendem, D.N., Fotso, R., Ikfuingei, R., Imong, I., Jameson, C., Macfie, L., Morgan, B., Nchanji, A., Nicholas, A., Nkembi, L., Omeni, F., Oates, J., Pokempner, A., Sawyer, S. and Williamson, E.A. (2014). Revised Regional Action Plan for the Conservation of the Cross River Gorilla (*Gorilla gorilla diehli*): 2014–2019. New York, NY: IUCN/SSC Primate Specialist Group and Wildlife Conservation Society.
- Imong, I., Robbins, M.M., Mundry, R., Bergl, R. and Kühl, H.S. (2014). Distinguishing ecological constraints from human activity in species range fragmentation: the case of Cross River gorillas. *Anim. Conserv.* 17: 323–331. doi.10.1111/acv.12100

AFRICA – WESTERN CHIMPANZEE

***Pan troglodytes verus* Schwarz, 1934**

Côte d'Ivoire, Ghana, Guine, Guinea-Bissau, Liberia, Mali, Senegal, Sierra Leone
(2018)

Information summarized by the editors from the IUCN Red List (Humble et al. 2016)

The Western Chimpanzee (*Pan troglodytes verus*) is Critically Endangered due to high levels of poaching and habitat loss and degradation. It is suspected that the population has declined at an average annual rate of 6.53% between 1990 and 2014, with a total population of 18,000 to 56,000 remaining in the wild (Sop et al. in prep., cited in Humble et al. 2016). The population is considered almost certainly extinct in Benin, Burkina Faso, and Togo (Ginn et al. 2013, Campbell and Hounbedji 2015) and has seen a decline of 90% in its population in Côte d'Ivoire (Campbell et al. 2008). Although it can be found in several protected areas, most of the population is found in areas that remain unprotected. Conservation actions and research gaps are detailed in the IUCN Red List profile (Humble et al. 2016).

Campbell, G. and Hounbedji, M. (2015). Conservation Status of the West African Chimpanzee (*Pan troglodytes verus*) in Togo and Benin. Arlington, VA: Primate Action Fund.

Campbell, G., Kühl, H., N'Goran Kouamé, P. and Boesch, C. (2008). Alarming decline of West African chimpanzees in Côte d'Ivoire. *Curr. Biol.* 18: R903–R904.

Ginn, L.P., Robison, J., Redmond, I. and Nekaris, K.A.I. (2013). Strong evidence that the West African chimpanzee is extirpated from Burkina Faso. *Oryx* 47: 323–327.

Humble, T., Boesch, C., Campbell, G., Junker, J., Koops, K., Kuehl, H. and Sop, T. (2016). *Pan troglodytes* ssp. *verus* (errata version published in 2016). The IUCN Red List of Threatened Species 2016: e.T15935A102327574.

ASIA – JAVAN SURILI

***Presbytis comata* Desmarest, 1822**

Indonesia (Java)

Never included on the Top 25 List

Arif Setiawan and Vincent Nijman

The Javan Surili (*Presbytis comata*) is listed as Endangered on the IUCN Red List of Threatened Species and is endemic to the western part of the island of Java (Nijman 1997, Nijman and Setiawan 2020), an area it shares with some 70 million humans, who are living at a population density of over 1,500 people per km². With the Javan Surili confined to forest, there is considerable pressure on the remaining areas where the species is still found, and the cumulative effect of small amounts of forest loss is a clear impediment to its survival (Supartono et al. 2016). With the recognition by IUCN of the Rekrekan (*P. fredericae*) from central Java as a distinct species (formerly considered *P. comata*), there is considerable confusion about the exact distribution of two species, as individuals from the intervening area show morphological affinities of them both. Further research (morphological, behavioral and molecular) is urgently needed to clarify their taxonomic arrangement and also their range distribution. The surili is largely known from well-trodden volcanoes where it is found mostly in the lower montane or montane zone (up to 2,500 m asl) but where lowland forest remains it can occur down to sea-level. It is found in a number of protected areas, including the Ujung Kulon, Gunung Halimun-Salak, and Gunung Gede-Pangrango national parks. The total population of *Presbytis comata* in Ujung Kulon, Rawa Danau, Mts Halimun-Salak, Mt Gede-Pangrango, Kawah Kamojang, Mt Patuha, Ciremay-Kuningan-Pemabarisan is estimated at 7,500–10,200 individuals. Potentially sizeable populations, such as at Sanggabuana, Masigit-Kareumbi, Mt Tangkuban Perahu-Burangrang, and Cibanteng-Cikepuh (Supriatna et al. 1994) were last surveyed more than two decades ago and therefore need renewed attention. Densities differ somewhat by altitude, from 0.4–2.4 groups/km² in the lowlands below 1,000 m asl to 0.1–5.8 groups/km² in montane forests. Group sizes are negatively correlated with altitude – in the lowlands averaging around eight individuals and in the mountains around six individuals (Nijman 2017).

- Nijman, V. (1997). Occurrence and distribution of grizzled leaf monkey *Presbytis comata* (Desmarest, 1822) (Mammalia: Primates: Cercopithecidae) in Java, Indonesia. *Contrib. Zool.* 66: 247–256.
- Nijman, V. (2017). Group composition and monandry in grizzled langurs, *Presbytis comata*, on Java. *Folia Primatol.* 88(2): 237–254.
- Nijman, V. and Setiawan, A. (2020). *Presbytis comata*. The IUCN Red List of Threatened Species 2020: e.T18125A17955175.
- Supriatna, J., Tilson, R.L. Gurmaya, K.J., Manansang, J., Wardoyo, W., Sriyanto, A., Teare, A., Castle, K. and Seal, U.S. (eds.). (1994). *Javan Gibbon and Javan Langur: Population and Habitat Viability Analysis Report*. Apple Valley, Minnesota: IUCN/SSC Conservation Breeding Specialist Group (CBSG).
- Supartono, T.T., Prasetyo, L.B., Hikmat, A. and Kartono, A.G. (2016). Spatial distribution and habitat use of Javan Langur (*Presbytis comata*): case study in District of Kuningan. *Procedia Environ. Sci.* 33: 340–353.

ASIA – BORNEAN BANDED LANGUR

***Presbytis chrysomelas* Müller, 1838**

Brunei Darussalam, Indonesia (Kalimantan), Malaysia (Sarawak)

Never included on the Top 25 List

Andie Ang, Chien Lee, Erik Meijaard, Vincent Nijman and Noel Rowe

The Bornean Banded Langur or Cross-marked Langur (*Presbytis chrysomelas*) is endemic to the northwestern corner of Borneo and is Critically Endangered (Nijman *et al.* 2020). Two subspecies are recognized: *P. c. chrysomelas* and *P. c. cruciger*. In the past it could be found in protected areas such as the Tanjung Datu, Maludam, Similajau and Niah national parks, and the Lanjak Entimau and Samunsam wildlife sanctuaries, all in Sarawak, and the Danau Sentarum Wildlife Sanctuary in West Kalimantan (Groves 2013, Phillipps and Phillipps 2018). However, the most recent records of their occurrence in all but the first two parks date back more than a decade. While Nijman *et al.* (2008) conservatively estimated that 200–500 individuals remained, more recent research suggests this might have been an underestimate. However, their habitat is declining, partially because of cash crop plantations and forest fires. Hunting is a continuing threat in their habitat, and even in the protected areas.

- Groves, C.P. (2013). Cross-marked langur *Presbytis chrysomelas*. In: R.A. Mittermeier, A.B. Rylands and D.E. Wilson (eds.), *Handbook of the Mammals of the World. Volume 3. Primates*, p. 716. Barcelona: Lynx Edicions.
- Nijman, V., Cheyne, S., Traeholt, C. and Setiawan, A. (2020). *Presbytis chrysomelas*. The IUCN Red List of Threatened Species 2020: e.T39803A17955321.
- Nijman, V., Hon, J. and Richardson, M. (2008). *Presbytis chrysomelas*. The IUCN Red List of Threatened Species 2008: e.T39803A10268236.
- Phillipps, Q. and Phillipps, K. (2018). *Phillipps' Field Guide to the Mammals of Borneo and Their Ecology*. 2nd edition. Oxford, UK: John Beaufoy Publishing.

ASIA – NATUNA ISLAND SURILI

***Presbytis natunae* (Thomas & Hartet, 1894)**

Indonesia (Sumatra)

(2002)

Arif Setiawan and Vincent Nijman

The Natuna Island Surili (*Presbytis natunae*) is confined to Bunguran, the largest island in the Natuna archipelago, halfway between northwestern Borneo and the Thai-Malay Peninsula. The species has been the subject of very few studies; in 86 years only four field surveys were conducted (Indrawan and Rangkuti 2001, Lammertink *et al.* 2003, Firman Aldi 2007 [unpubl. report], Handayani *et al.* 2021). In 2001, Lammertink *et al.* (2003) conducted the first systematic population survey which found that the species had a preference for primary lowland forest and avoided logged forest. There were 2.3 groups per km², and groups comprised only three to four individuals on average, probably because of reduced predator pressure on the island. The population was estimated at 4,500–12,500 individuals. Setiandari (2018) obtained data on the status of the Natuna Island Surili from 30 informants, who noted a steady decline in numbers and identified poaching, deforestation, an increase in human population size, and a lack of effective conservation management as the main reasons for this apparent decline.

In 2020, research suggested that the total remaining habitat for the Natuna Island Surili is about 48,274 ha or 29.83% of the island (K. Latifiana, K. Putri Handayani and E. Yuni Agustin), with forest cover having declined by 17.93% from 2001 to 2020. The species is found in a wide range of habitats, from lowland and montane forest to heath forest, mixed forest gardens and rubber plantations. While a substantial part of the island is still forested, more and more is affected by logging, fragmentation and conversion to other land uses, and the largest area of relatively untouched forest is found on Mt Bedung. Conflict with humans is greatest near the coast where most of the villages are situated. There are no forest areas that are formally protected on Bunguran. Populations are likely to be experiencing continued decline due to habitat loss and capture for pets. Data are lacking for strengthening conservation measures.

- Handayani, K.P., Latifiana, K., and Agustin, I.Y. (2021). Conservation Status of Natuna Leaf Monkey (*Presbytis natunae*). Final report (no. 1667). Charlestown, RI, USA: Primate Conservation Inc.
- Indrawan, M. and Rangkuti, F. (2001). Development, biodiversity and the conservation status of banded langur in Natuna Islands, Indonesia. *Trop. Biodiv.* 7: 151–163.
- Lammertink, M., Nijman, V. and Setiorini, U. (2003). Population size, Red List status and conservation of the Natuna leaf monkey *Presbytis natunae* endemic to the island of Bunguran, Indonesia. *Oryx* 37(4): 472–479.
- Setiandari, Y.C. (2018). Studi tingkat penurunan populasi hewan endemik Kekah Natuna (*Presbytis natunae*) di desa Ceruk, kabupaten Natuna ditinjau dari penyebabnya. BSc thesis, Universitas Pasundan Bandung, Indonesia.

ASIA – EAST SUMATRAN BANDED LANGUR

***Presbytis percura* Lyon, 1908**

Indonesia (Sumatra)

Never included on the Top 25 List

Rizaldi and Andie Ang

Presbytis percura is found in just a few isolated and unprotected lowland areas in Riau Province, Sumatra, and faces extinction in the wild due to forest loss on a large scale (Rizaldi *et al.* 2019, Ang *et al.* 2020). Riau experienced the highest rate of deforestation in Sumatra, and 63% of the natural forest was lost between 1985 and 2008 (Uryu *et al.* 2010). Additionally, forest fires linked to the ENSO events, and open burning of forest land for agricultural purposes destroy millions of hectares of land in Indonesia every year, and Riau is often one of the worst impacted areas, owing in part to its high concentration of peatland (World Bank 2016). A preliminary survey in 2018 found *P. percura* only in rubber plantations, subsisting on rubber leaves and seeds (Rizaldi *et al.* 2019). The scattered forest remnants and agroforests where *P. percura* were found might no longer remain without conservation action on the ground. Individuals of this species are also killed by local communities when they feed on fruit crops of such as rambutans and durians. Manpower and financial support are urgently needed for the research and protection of not only this species, but also other poorly studied langurs (*P. bicolor* and *P. siamensis cana*) and their remaining habitats in Riau Province in Sumatra.

- Ang, A., Roesma, D.I., Nijman, V., Meier, R., Srivathsan, A. and Rizaldi. (2020). Faecal DNA to the rescue: shotgun sequencing of non-invasive samples reveals two subspecies of Southeast Asian primates to be Critically Endangered species. *Sci. Rep.* 10: 9396.
- Rizaldi, Ilham, K., Prasetyo, I., Lee, Z.H., Jabbar, S. and Ang, A. (2019). Preliminary study on the distribution and conservation status of the East Sumatran banded langur (*Presbytis femoralis percura*) in Riau Province, Sumatra, Indonesia. *Asian Primates J.* 8(1): 25–36.
- Uryu, Y., Purastuti, E., Laumonier, Y., Sunarto, S.B.Y.S.A., Hadian, O., Kosasih, D.A. and Stüwe, M. (2010). *Sumatra's Forests, Their Wildlife and the Climate, Windows in Time: 1985, 1990, 2000, and 2009*. Technical Report. Jakarta, Indonesia: WWF–Indonesia.
- World Bank (2016). *The Cost of Fire: An Economic Analysis of Indonesia's 2015 Fire Crisis*. Indonesia Sustainable Landscapes Knowledge Note 1. Washington, D.C.: The World Bank.

ASIA – TONKIN SNUB-NOSED MONKEY

***Rhinopithecus avunculus* Dollman, 1912**

Vietnam
(2000–2018)

Tilo Nadler

The Tonkin Snub-nosed Monkey, *Rhinopithecus avunculus*, is a Critically Endangered species endemic to Vietnam (Quyet *et al.* 2020). It is now confined to only two areas of the far northwest (Nadler *et al.* 2003, Nadler and Brockman 2014). Its distribution has been drastically reduced in recent decades due to massive deforestation and intensive hunting. As a result, the population has become severely fragmented. The species was thought to be extinct until its rediscovery near the town of Na Hang, Tuyen Quang Province in 1989. Conservation activities there were unsuccessful, and it is most likely now extirpated. A population of 20 to 40 individuals was estimated for the Cham Chu Nature Reserve, Tuyen Quang Province in 1992, but subsequent surveys provided no sightings, and the population is also most likely extirpated. In 2001, a population was discovered in Khau Ca, close to Du Gia Nature Reserve, Ha Giang Province. A census in 2015 confirmed 125–130 individuals. The area was subsequently declared as the Tonkin Snub-nosed Monkey Species/Habitat Conservation Area. Based on recent surveys the population is estimated to comprise about 160 individuals. During a survey in March 2022, two groups were observed, one group with 84 and another with 11 individuals. It is the only population that is not immediately threatened. In 2007, a population of about 20 Tonkin Snub-nosed Monkeys was discovered in Tung Vai, Ha Giang Province, close to the border with China (Le Khac Quyet and Covert 2010). This population is threatened by hunting and habitat loss and through intensive cardamom cultivation, besides other human activities. The total population of the Tonkin Snub-nosed Monkey is currently believed to be fewer than 200 individuals.

Le Khac Quyet and Covert, H.H. (2010). Another population of the Tonkin snub-nosed monkey (*Rhinopithecus avunculus*) discovered in Ha Giang Province, Vietnam. *Vietnam. J. Primatol.* 1(4): 19–25.

Quyet, L.K., Rawson, B.M., Duc, H., Nadler, T., Covert, H. and Ang, A. 2020. *Rhinopithecus avunculus*. The IUCN Red List of Threatened Species. 2020: e.T19594A17944213.

Nadler, T., Momberg, F., Nguyen Xuan Dang, and Lormee, N. (2003). *Vietnam Primate Conservation Status Review 2002. Part 2: Leaf Monkeys*. Hanoi, Vietnam, Frankfurt, Germany: Fauna & Flora International–Vietnam Program and Frankfurt Zoological Society.

Nadler, T. and Brockman, D. (2014). *Primates of Vietnam*. Vietnam: Endangered Primate Rescue Center.

ASIA – GOLDEN LANGUR

***Trachypithecus geei* Khajuria, 1956**

(2016, 2018)
Bhutan, India (Assam)

Dilip Chetry

The Golden Langur (*Trachypithecus geei*) is endemic to India and Bhutan. Its range in India covers more than 2,500 km² and in Bhutan 4,782 km². Wet evergreen and tropical semi-evergreen forests are its primary habitats in India. In Bhutan, it is found in both warm broadleaf and tropical forests. The Assamese Macaque, Rhesus Macaque and Bengal Slow Loris are its cohabitants in these forests. It spends 99% of its active time in trees and primarily exploits the top and middle strata of the forest. It lives in diverse social settings, including uni-male:multi-female, bi-male:multi-female and multi-male:multi-female groups, besides all male bands and lone males. Annually, Golden Langurs spend 12.8–33% of time in feeding, 40–63.1% in resting, 6.3–19% in locomotion, 5–11.5% in monitoring, 2–3.7% in playing and 0.3–6% in grooming. They eat green leaves, their staple food, and other food items from more than 200 plant species. They spend their nights in tall trees of a few selected species. Leopard, wild dogs and python are the prominent predators. Domestic and feral dogs attack Golden Langurs in fringe villages. It is categorized as Endangered on the IUCN Red List of Threatened Species (Das *et al.* 2020), and is listed as a Schedule-I species in the Wildlife (Protection) Act of India, 1972,

and the Forest and Nature Conservation Act of Bhutan, 1995. It is an Appendix-I species in CITES. Along with habitat loss, habitat fragmentation and shrinkage, recent hybridization between Golden Langurs and Capped Langurs (*Trachypithecus pileatus*) across the suspension bridges constructed over the Chamkhar River has emerged as the severest threat (Wangchuk et al. 2003). Electrocutation, roadkill, and dog predation are also serious threats. Conservation challenges are likely to increase in the coming years despite current conservation initiatives. More effective landscape conservation and management, such as reforestation and corridors (both forested and artificial), are vital for the survival of this species (Ghosh 2009, Chetry et al. 2010).

Chetry, D., Chetry, R., Ghosh, K., and Bhattacharjee, P.C. (2010). Status and conservation of Golden Langur in Chakrashila Wildlife Sanctuary, Assam, India. *Primate Conserv.* 25: 81–86.

Das, J., Chetry, D., Medhi, R. and Choudhury, A. (2020). *Trachypithecus geei*. The IUCN Red List of Threatened Species 2020: e.T22037A17960997.

Ghosh, S. (2009). Report on the Distribution and Population Status of Golden Langur (*Trachypithecus geei*) in Bodoland. Territorial Council, Guwahati: Assam, India.

Wangchuk, T., Inouye, D.W. and Hare, M.P. (2003). A new subspecies of Golden Langur (*Trachypithecus geei*) from Bhutan. *Folia Primatol.* 74(2): 104–108.

NEOTROPICS – BUFFY-TUFTED-EAR MARMOSET

***Callithrix aurita* (É. Geoffroy in Humboldt, 1812)**

Brazil (Rio de Janeiro, São Paulo, Minas Gerais)
(2018)

Rodrigo Salles de Carvalho, Fabiano R. de Melo, Mônica Mafra Valença-Montenegro, Claudia Igayara-Souza, Marcio Port-Carvalho and Leandro Jerusalinsky

The Buffy-tufted-ear Marmoset (*Callithrix aurita*) is endemic to the montane Atlantic Forest of southeastern Brazil, in the southern part of the state of Minas Gerais, the state of Rio de Janeiro, and the east and northeast of the state of São Paulo. The historically widespread destruction of forests in its range has resulted in extremely reduced and severely fragmented remnant habitats, with diminished and isolated populations (Melo et al. 2018, 2021). Even as these factors persist as a major threat to the species, the anthropogenic introduction of congeneric species has led to invasive populations and ecological competition, and genetic erosion is now an alarming threat to the survival of this species (Carvalho et al. 2018, 2019, Malukiewicz et al. 2021). Although yet to be confirmed, it is suspected that a recent yellow fever outbreak has also impacted the species' populations. The cumulative and synergistic effects of these threats led to the species being categorized as Critically Endangered on the IUCN Red List of Threatened Species (Melo et al. 2021). Since 2014, the Mountain Marmosets Conservation Program (MMCP) has been developing measures for the implementation of conservation strategies, as established by the *National Action Plan for the Conservation of the Atlantic Forest Primates and the Maned Sloth* (Brazil, ICMBio 2018). They include research and management in small fragments as well as important protected areas where the species occurs (the Serra dos Órgãos, Itatiaia, and Serra da Bocaina national parks) and an *ex situ* management program coordinated by the Brazilian Association of Zoos and Aquaria (AZAB) and the National Center for Research and Conservation of Brazilian Primates (ICMBio/CPB), involving the Guarulhos Zoo and the Mountain Marmosets Conservation Center at the Federal University of Viçosa (CCSS-UFV) in Minas Gerais, Brazil.

Brazil, ICMBio. (2018). Aprova o Plano de Ação Nacional para a Conservação dos Primatas da Mata Atlântica e da Preguiça-de-Coleira. Portaria nº 702, de 07 de agosto de 2018 – Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio). *Diário Oficial da União*, Seção 1, número 153: 57.

Carvalho, R.S. et al. (2018). *Callithrix aurita*: a marmoset species on its way to extinction in the Brazilian Atlantic Forest. *Neotrop. Primates* 24(1): 1–8.

Carvalho, R.S. et al. (2019). Buffy-tufted-ear marmoset – *Callithrix aurita* É. Geoffroy Saint-Hilaire, 1812. In: C. Schwitzer et al. (eds.), *Primates in Peril: The World's 25 Most Endangered Primates 2018–2020*, pp. 78–81. Washington, DC, Bristol, UK: IUCN SSC Primate Specialist Group, International Primatological Society, Global Wildlife Conservation, Bristol Zoological Society.

- Malukiewicz, J. et al. (2021). An introduction to the *Callithrix* genus and overview of recent advances in marmoset research. *ILAR Journal* 61(2–3): 110–138. doi.org/10.1093/ilar/ilab027
- Melo, F.R., Hilário, R.R., Ferraz, D.S., Pereira, D.G., Bicca-Marques, J.C., Jerusalinsky, L., Mittermeier, R.A., Ruiz-Miranda, C.R., Oliveira, L. and Valença-Montenegro, M.M. (2021). *Callithrix flaviceps* (amended version of 2020 assessment). The IUCN Red List of Threatened Species 2021: e.T3571A191700879.

NEOTROPICS – PIED TAMARIN

Saguinus bicolor Spix, 1823

Brazil (Amazonas)
(2018)

Marcelo Gordo, Diogo Lagroteria, Renata Azevedo and Leandro Jerusalinsky

The Pied Tamarin is a small callitrichid (450–550g; 66–74cm) endemic to the Central Amazon, in the vicinity of Manaus, Brazil (Gordo et al. 2017). Groups are extremely territorial, and range from 2 to 13 individuals. Population densities are low throughout their range (1–2 groups/km²) (Gordo 2012, Gordo et al. 2017). Recent research estimates its geographic distribution at about 8,000 km², from Itacoatiara, Rio Urubu to the Rio Cuieiras, north of Manaus (Lagroteria and Gordo, in prep.). Expansion of the city of Manaus and the increasing occupation of rural areas has caused a severe loss and fragmentation of its habitat. Adding to habitat loss, are roadkill, electrical shocks, and predation by dogs (Gordo et al. 2013, 2021), and its already tiny range is contracting, giving way to the invasive *Saguinus midas* with evidence of hybridization (Gordo et al. 2017). *Saguinus bicolor* is classified as Critically Endangered on the IUCN Red List of Threatened Species (Gordo et al. 2021) and the Brazilian Official National List of Threatened Species (Brazil, MMA 2014, Vidal et al. 2018) due to a projected population reduction of 80% or more in the next 18 years (three generations) resulting from the threats described above. More studies are needed on the interactions between the two tamarins. Strategies for the species' conservation were established in the *National Action Plan for the Conservation of the Pied Tamarin*, including as goals: a) reduction of habitat loss; b) creation of protected areas, and the maintenance and adequate management of those already existing; c) maintenance and expansion of habitat connectivity both in urban and rural areas; d) reduction of the loss of individuals due to electrocution, roadkill, and attacks by domestic animals; e) restoration of areas to improve habitat quality; f) an understanding of the distribution of *Saguinus bicolor* and its potential relationship with *Saguinus midas*; g) strengthening environmental education for the conservation of the species; and h) promotion of adequate population management for the species' conservation (Jerusalinsky et al. 2017, Brazil, ICMBio 2018). The Brazilian Association of Zoos and Aquaria (AZAB) and the National Center for Research and Conservation of Brazilian Primates (ICMBio/CPB) are coordinating an *ex situ* management program.

- Brazil, ICMBio. (2018). Aprova o 2º ciclo do Plano de Ação Nacional para a Conservação do Sauim-de-coleira. Portaria nº 281, de 4 de abril de 2018. Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio), Ministério de Meio Ambiente (MMA). *Diário Oficial da União*, Seção 1, número 66: 70.
- Brazil, MMA. (2014). Lista Nacional Oficial de Espécies da Fauna Ameaçadas de Extinção. Portaria nº 444, de 17 de dezembro de 2014. Ministério do Meio Ambiente (MMA). *Diário Oficial da União*, Seção 1, número 245: 121–126.
- Gordo, M. (2012). Ecologia e Conservação do Sauim-de-Coleira, *Saguinus bicolor* (Primates, Callitrichidae). Doctoral thesis, Museu Paraense Emílio Goeldi, Universidade Federal do Pará (UFPA), Belém, Brazil.
- Gordo, M., Calleia, F.O., Vasconcelos, S.A., Leite, J.J.F. and Ferrari, S.F. (2013). The challenges of survival in a concrete jungle: conservation of the pied tamarin (*Saguinus bicolor*) in the urban landscape of Manaus, Brazil. In: L.K. Marsh and C.A. Chapman (eds.), *Primates in Fragments: Complexity and Resilience*, pp. 357–370. New York, NY: Springer.
- Gordo, M., Subirá, R.J., Vidal, M.D., Röhe, F., Spironello, W.R., Valente, L.M., Oliveira, J.B., Pissinatti, A., Wormell, D. and Jerusalinsky, L. (2017). Contextualização do sauim-de-coleira. In: L. Jerusalinsky, R.B. Azevedo and M. Gordo (eds.), *Plano de Ação Nacional para a Conservação do Sauim-de-Coleira*, Série Espécies Ameaçadas 29: 25–44. Brasília, Brazil: Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio), Ministério de Meio Ambiente (MMA).
- Gordo, M., Röhe, F., Vidal, M.D., Subirá, R., Boubli, J.P., Mittermeier, R.A. and Jerusalinsky, L. (2021). *Saguinus bicolor* (amended version of 2019 assessment). The IUCN Red List of Threatened Species 2021: e.T40644A192551696.
- Jerusalinsky, L., Azevedo, R.B. and Gordo, M. (eds.). (2017). *Plano de Ação Nacional para a Conservação do Sauim-de-Coleira*. Série Espécies Ameaçadas (29). Brasília, Brazil: Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio), Ministério de Meio Ambiente (MMA).

Vidal, M.D., Gordo, M. and Röhe, F. (2018). *Saguinus bicolor* (Spix, 1823). In: Instituto Chico Mendes de Conservação da Biodiversidade (ed.), *Livro Vermelho da Fauna Brasileira Ameaçada de Extinção*, 1st edition. Volume 2, pp. 44–49. Brasília, Brazil: Instituto Chico Mendes de Conservação da Biodiversidade (ICMbio).

NEOTROPICS – OLALLA BROTHERS' TITI MONKEY

***Plecturocebus olallae* Lönnberg, 1939**

Bolivia
(2018)

Jesus Martinez and Robert Wallace

The Olalla Brothers' Titi Monkey (*Plecturocebus olallae*) is endemic to Bolivia and Critically Endangered (Martinez and Wallace 2021a). Its range is restricted to an area of naturally fragmented forests, and the latest assessment reported a population of 2,855 individuals in an area of 383.4 km² (Martinez and Wallace 2021b). Although this represents some increase in both abundance and distribution (previously 2,000 individuals across 267 km²), the high forest fragmentation levels in the region – less than half of the range is suitable forest (Wallace *et al.* 2013) – is an important spatial limitation for these primates. The improvement of a major road will promote new human settlements and potentially increase intensive agriculture and livestock management in the area, which, together, represent the main risks for *P. olallae* populations (Martinez and Wallace 2021a, 2021b). Two municipal protected areas, Rhukanrhuka and Pampas del Yacuma, include most of the range of *P. olallae* (70%) and research and outreach there are important to raise awareness with local people about these endemic primates (Martinez *et al.* 2015). Current work is focused on consolidating the management of these conservation areas to minimize the impacts of the threats to *P. olallae* populations, and to develop monitoring programs for these range-restricted primates.

Martinez, J., Wallace, R.B., Arnez, A., Barreta, J., Carvajal-Bacarreza, P., Domic, E., Turdera, C.F., Jurado, C., Lopez, L., Lopez-Strauss, H., Morrison, L., Porcel, Z.R., Reinaga, A. and Siles Lazzo, T.M. (2015). Línea base para la conservación de los monos lucachi de Bolivia: *Callicebus olallae* y *C. modestus*. *Agrocienc. Amazonia* 5: 1–11.

Martinez, J. and Wallace, R. (2021a). *Plecturocebus olallae*. The IUCN Red List of Threatened Species 2021: e.T3554A17975516.

Martinez, J. and Wallace, R.B. (2021b). An update on the distribution and abundance of the endemic and threatened Olalla's titi monkey (*Plecturocebus olallae*). *Primate Conserv.* (35): 13–20.

Wallace, R.B., Martinez, J., López-Strauss, H., Barreta, J., Reinaga, A. and López, L. (2013). Conservation challenges facing two threatened endemic titi monkeys in a naturally fragmented Bolivian forest. In: L.K. Marsh and C.A. Chapman (eds.), *Primates in Fragments: Complexity and Resilience*, pp. 493–501. New York, NY: Springer.

NEOTROPICS – CAATINGA TITI MONKEY

***Callicebus barbarabrownae* Hershkovitz 1990**

Brazil (Bahia, Sergipe)
(2010)

André C. Alonso, Hamilton F. Barreto, Eduardo Marques, Mônica M. Valença-Montenegro, Raone Beltrão-Mendes, Sidney Gouveia, Stephen F. Ferrari and Leandro Jerusalinsky

The Caatinga (or Blond) Titi Monkey (*Callicebus barbarabrownae*) is the only endemic primate of the Caatinga (dry forest and xerophilic scrub) in northeastern Brazil, occurring in the states of Bahia and Sergipe (Printes *et al.* 2018, 2021). As for all titi monkeys, it lives in small family groups, with a monogamous reproductive couple and its offspring, occupying a territory of 20–30 ha defended daily by duet vocalizations. The species' range has suffered widespread deforestation resulting in habitat reduction and fragmentation, with scarce, diminished, and isolated remnant populations exposed to synergistic genetic and demographic risks. Cattle ranching, agriculture, and continuing urbanization are the main threats, besides rapid infrastructure development facilitated by an extensive network of highways and power lines (Printes *et al.* 2018, 2021). The extent of hunting needs investigation, although it is probably moderate due to their small size, and few individuals are kept as pets (Printes *et al.* 2013, 2018, 2021). The combination of these threats, however, has resulted in the species being

assessed as Critically Endangered (Brazil, MMA 2014, Printes *et al.* 2018, 2021). A new survey method using standardized vocalization playbacks suggests that the species abundance may be higher than previously thought (Coelho *et al.* 2020). Also, a recent reassessment of the species distribution, ten years after its first evaluation (Estrela *et al.* 2011, Printes *et al.* 2011), revealed more areas and individuals than were previously known (Alonso *et al.* 2022). On the other hand, species distribution modelling combined with population viability analysis under different climate change scenarios and simulated forest loss, predicted a reduction of one-third of the currently suitable area for *C. barbarabrownae* (Barreto *et al.* 2022). These models also indicate that viable populations in large forest remnants represent only a quarter of all known populations, with a decline in climatic suitability, and that smaller populations may be extirpated regardless of the level of forest recovery (Barreto *et al.* 2022). This situation highlights the need to effectively implement the *National Action Plan for the Conservation of the Northeastern Primates* (Brazil, ICMBio 2018).

- Alonso, A.C. *et al.* (2022). On the occurrence of the Critically Endangered blond titi (*Callicebus barbarabrownae*): reassessment of occupied areas and minimum population size. *Int. J. Primatol.* doi.org/10.1007/s10764-021-00269-5
- Barreto, H.F. *et al.* (2022). Viability meets suitability: distribution of the extinction risk of an imperiled titi monkey (*Callicebus barbarabrownae*) under multiple threats. *Int. J. Primatol.* 43, 114–132. doi.org/10.1007/s10764-021-00259-7
- Brazil, ICMBio. (2018). Aprova o Plano de Ação Nacional para a Conservação dos Primatas do Nordeste. Portaria n° 242, de 27 de março de 2018 – Instituto Chico Mendes de Conservação da Biodiversidade. *Diário Oficial da União*, Seção 1, número 61: 252.
- Brazil, MMA. (2014). Lista Nacional Oficial de Espécies da Fauna Ameaçadas de Extinção. Portaria n° 444, de 17 de dezembro de 2014. Ministério do Meio Ambiente. *Diário Oficial da União*, Seção 1, número 245: 121–126.
- Coelho, I.P., Collins, S.J., Santos Junior, E.M., Valença-Montenegro, M.M., Jerusalinsky, L. and Alonso, A.C. (2020). Playbackpoint counts and N-mixture models suggest higher than expected abundance of the critically endangered blond titi monkey in Northeastern Brazil. *Am. J. Primatol.* 82(5): e23126.
- Estrela, A.R., Nogueira, E.M.S. and Porfírio, S. (2011). *Callicebus barbarabrownae* (Hershkovitz, 1990) (Primates: Pitheciidae) de Lamarão/BA: resultados preliminares. In: F.R. Melo and I. Mourthé (eds.), *A Primatologia no Brasil – 11*, pp. 93–102. Jataí, GO, Brazil: Sociedade Brasileira de Primatologia, Universidade de Goiás.
- Printes, R.C., Rylands, A.B. and Bicca-Marques, J.C. (2011). Distribution and status of the Critically Endangered blond titi monkey *Callicebus barbarabrownae* of north-east Brazil. *Oryx* 45: 439–443.
- Printes, R.C., Jerusalinsky, L., Cardoso de Sousa, M. and Rodrigues, L.R.R. and Hirsch, A. (2013). Zoogeography, genetic variation and conservation of the *Callicebus personatus* Group. In: A.A. Barnett, L.M. Veiga, S.F. Ferrari and M.A. Norconk (eds.), *Evolutionary Biology and Conservation of Titis, Sakis and Uacaris*, pp. 43–49. Cambridge, UK: Cambridge University Press.
- Printes, R.C., Alonso, A.C. and Jerusalinsky, L. (2018). *Callicebus barbarabrownae* Hershkovitz, 1991. In: ICMBio, MMA (ed.) *Livro Vermelho da Fauna Brasileira Ameaçada de Extinção: Volume II – Mamíferos*, pp. 283–287. Brasília, Brasil: Instituto Chico Mendes de Conservação da Biodiversidade.
- Printes, R.C., Jerusalinsky, L., Alonso, A.C. and Mittermeier, R.A. (2021). *Callicebus barbarabrownae* (amended version of 2020 assessment). The IUCN Red List of Threatened Species 2021: e.T39929A191703041.

NEOTROPICS – WHITE-CHEEKED SPIDER MONKEY

***Ateles marginatus* (É. Geoffroy Saint-Hilaire, 1809)**

Brazil (Mato Grosso, Pará)

Never included on the Top 25 List

Gustavo R. Canale, André L. Ravetta, Gerson Buss and Leandro Jerusalinsky

The White-cheeked Spider Monkey (*Ateles marginatus*) is endemic to the eastern Brazilian Amazon, south of the Rio Amazonas, with its southernmost populations occupying the transition zone with the Brazilian Cerrado, between the right bank of the Rio Tapajós and its tributary, the Rio Teles Pires, and the left bank of the Rio Xingu (Ravetta *et al.* 2018, Lazari *et al.* 2020, Lima-Silva *et al.* 2022). Most of its Extent of Occurrence lies in the Amazonian ‘arc of deforestation’, where forest loss is at the highest rates of the entire tropics (Garcia *et al.* 2019, Lazari *et al.* 2020). The species is categorized as Endangered on the IUCN Red List of Threatened Species (Ravetta *et al.* 2021) due to suspected population reduction upwards of 50% over the last 45 years (three generations), which is due to habitat declines and hunting in protected and unprotected areas (Brazil, MMA 2014, Ravetta *et al.* 2018, 2021). Its range is cut by major highways – the Transamazônica (BR 230) and Cuiabá-Santarém (BR 163) – and a new railway (Ferrogrão) is projected to cross the species range accelerating the deforestation and

promoting the expansion of soybean plantations, cattle ranching, and urbanization. The construction plans for the Tapajós Hydroelectric Complex, which includes a number of dams in the range of *Ateles marginatus* (Ravetta 2008, Buss *et al.* 2017), might lead to the isolation of populations inhabiting riparian forests. Moreover, highways and human settlement expansion facilitate hunting, which is likely to have already extirpated the species in parts of its range (Ravetta and Ferrari 2009). Late maturation (4–5 years of age) and long inter-birth intervals (up to 30 months) make it difficult for this species to recover from hunting and other threats. The savannization of the Amazonian forests due to climate change is predicted to be sooner and more intense in the region occupied by the White-cheeked Spider Monkeys, one of the least-studied species of the genus. Species conservation strategies, as outlined by the *National Action Plan for the Conservation of the Amazonian Primates*, include the following goals: a) improve territorial planning; b) mitigate and compensate the impacts of development projects; c) reduce hunting pressure; d) assess and mitigate the impacts of epizootics; and e) minimize the effects of climate change (Brazil, ICMBio 2017). As part of the implementation of this plan, the Brazilian Association of Zoos and Aquaria (AZAB) and the National Center for Research and Conservation of Brazilian Primates (ICMBio/CPB) are coordinating an *ex situ* management program.

- Brazil, ICMBio. (2017). Aprova o Plano de Ação Nacional para a Conservação dos Primatas Amazônicos. Portaria n° 792, de 1° de dezembro de 2017 – Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio). *Diário Oficial da União* Seção 1, número 232: 24.
- Brazil, MMA. (2014). Lista Nacional Oficial de Espécies da Fauna Ameaçadas de Extinção. Portaria n° 444, de 17 de dezembro de 2014. Ministério do Meio Ambiente (MMA), *Diário Oficial da União* Seção 1, número 245: 121–126.
- Buss, G., Ravetta, A.L., Fialho, M.S., Rossato, R.S., Sampaio, R., Printes, R.C., Pinto, L.P. and Jerusalinsky, L. and. (2017). Primatas do Parque Nacional do Jamanxim/PA: riqueza, distribuição e ameaças. *Biodiv. Brasil*. 7(2): 34–46.
- Garcia, A.S., Vilela, V.M., Rizzo, R., West, P., Gerber, J.S., Engstrom, P.M. and Ballester, M.V. (2019). Assessing land use/cover dynamics and exploring drivers in the Amazon's arc of deforestation through a hierarchical, multi-scale and multi-temporal classification approach. *Remote Sens. Appl.: Soc. Environ.* 15: 100233.
- Lazari, P.R., Martins Oliveira, A.T., Sandmann, P.H.D., Miguel, B.V., Fontes, M.C., Filho, N.R.A., Guirau, G.V.F., Henicka, T.S., da Silva, L.F., Canale, G.R. and Bernardo, C.S.S. (2020). Parâmetros demográficos de populações de duas espécies ameaçadas de macacos-aranha, *Ateles chamek* e *Ateles marginatus*, no ecótono Cerrado-Amazônia. *Neotrop. Primates* 26: 97–103.
- Lima-Silva, L.G., de Mendonça, R.F.B., da Silva Dutra, L. and Rossi, R.V. (2022). New records and geographic distribution extension of two primate species in the Amazonia-Cerrado transition area, Brazil. *Mammalia* doi.org/10.1515/mammalia-2021-0034
- Ravetta, A.L. (2008). *Ateles marginatus* (É Geoffroy, 1809). In: Instituto Chico Mendes de Conservação da Biodiversidade (ed.), *Livro Vermelho da Fauna Brasileira Ameaçada de Extinção*. 1st edition, Volume 2: 728–730. Brasília: Instituto Chico Mendes de Conservação da Biodiversidade.M
- Ravetta, A.L. and Ferrari, S.F. (2009). Geographic distribution and population characteristics of the endangered white-fronted spider monkey (*Ateles marginatus*) on the lower Tapajós River in central Brazilian Amazonia. *Primates* 50(3): 261–268.
- Ravetta, A.L., Buss, G. and Rylands, A.B. (2018). *Ateles marginatus* (É. Geoffroy Saint-Hilaire, 1809). In: Instituto Chico Mendes de Conservação da Biodiversidade (ed.), *Livro Vermelho da Fauna Brasileira Ameaçada de Extinção*. 2nd edition. Volume 2: 182–185. Brasília: Instituto Chico Mendes de Conservação da Biodiversidade.
- Ravetta, A.L., Buss, G. and Mittermeier, R.A. (2021). *Ateles marginatus* (amended version of 2019 assessment). The IUCN Red List of Threatened Species 2021: e.T2282A191689524.

NEOTROPICS – PERUVIAN YELLOW-TAILED WOOLLY MONKEY

***Lagothrix flavicauda* (Humboldt, 1812)**

Peru

(2000, 2006, 2008, 2010)

Sam Shanee

The Yellow-tailed Woolly Monkey, *Lagothrix flavicauda*, is endemic to Peru and Critically Endangered (Shanee *et al.* 2021). It is found largely in the northern Peruvian departments of Amazonas and San Martín, but also in small areas of neighboring departments, as well as in a newly discovered isolated population in the department of Junin (Shanee 2011, Aquino *et al.* 2016a, 2016b, McHugh *et al.* 2019). It has suffered massive habitat loss and fragmentation throughout almost all of its range in the last decades, leaving many populations isolated (Shanee 2016, Shanee *et al.* 2021). The species is also

hunted for the illegal pet trade and for food throughout its range, and it is generally difficult to find near human settlements (Shanee, N. 2012). It was thought to be extinct until its rediscovery in the 1970's (Mittermeier *et al.* 1975). There are no precise estimates regarding the number of individuals remaining, but the species is declining rapidly across its range, with an estimated population reduction of 93% since the early 1980s (Shanee, N. and Shanee 2014). A number of conservation initiatives now exist for the species, including the creation of new state protected areas, and rapid growth in private and communal reserves (Shanee *et al.* 2017, 2018). In one community area, in Yambrasbamba, Amazonas, community-based conservation efforts have resulted in a significant increase in the population of Yellow-tailed Woolly Monkeys there (Shanee and Shanee 2015).

- Aquino, R., Charpentier, E., García, G. and López, L. (2016a). First record of *Lagothrix flavicauda* on the eastern side of the Río Huallaga: an expansion of its known geographic distribution. *Primate Conserv.* (30): 15–20.
- Aquino, R, Garcia, G. and Charpentier, E. 2016b. Distribution and current status of the Peruvian yellow-tailed woolly monkey (*Lagothrix flavicauda*) in montane forests of the Región Huánuco, Peru. *Primate Conserv.* (30): 31–37.
- McHugh, S.M., Cornejo, F.M., McKibben, J., Zarate, M., Tello, C., Jiménez, C.F. and Schmitt, C.A. (2019). First record of the Peruvian yellow-tailed woolly monkey *Lagothrix flavicauda* in the Región Junín, Peru. *Oryx* 54(6): 814–818.
- Mittermeier, R.A., de Macedo-Ruiz, H. and Luscombe, A. 1975. A woolly monkey rediscovered in Peru. *Oryx* 13(1): 41–46.
- Shanee, N. (2012). Trends in local wildlife hunting, trade and control in the Tropical Andes Hotspot, northeastern Peru. *Endang. Species Res.* 19(2): 177–186.
- Shanee, N. and Shanee, S. (2014). Yellow-tailed woolly monkey (*Lagothrix flavicauda*): conservation status, anthropogenic threats, and conservation initiatives. In: T.R. Defler and P.R. Stevenson (eds.), *The Woolly Monkey*, pp. 283–299. New York, NY: Springer.
- Shanee, S. (2011). Distribution survey and threat assessment of the yellow-tailed woolly monkey (*Oreonax flavicauda* Humboldt 1812), northeastern Peru. *Int. J. Primatol.* 32(3): 691–707.
- Shanee, S. (2016). Predicting future effects of multiple drivers of extinction risk in Peru's endemic primate fauna. In: T.M. Waller (ed.), *Ethnoprimatology: Primate Conservation in the 21st Century*, pp. 315–349. Cham, Switzerland: Springer International Publishing.
- Shanee, S. and Shanee, N. (2015). Measuring success in a community conservation project: local population increase in a critically endangered primate, the yellow-tailed woolly monkey (*Lagothrix flavicauda*) at la Esperanza, northeastern Peru. *Trop. Conserv. Sci.* 8(1): 169–186.
- Shanee, S., Shanee, N., Monteferri, B., Allgas, N., Alarcon Pardo, A. and Horwich, R.H. (2017). Protected area coverage of threatened vertebrates and ecoregions in Peru: comparison of communal, private and state reserves. *J. Environ. Manag.* 202(1): 12–20.
- Shanee, S., Allgas, N. and Shanee, N. (2018). Community conservation as a tool for primate conservation in Peru. In: Romens, D. and Pulido Mata, J. (eds.), *Primatology, Biocultural Diversity and Sustainable Development in Tropical Forests*, pp. 320–329. Mexico: UNESCO.
- Shanee, S., Cornejo, F.M., Aquino, R., Mittermeier, R.A. and Vermeer, J. (2021). *Lagothrix flavicauda*. amended version of 2019 assessment). The IUCN Red List of Threatened Species 2021: e.T39924A192307818.

AFFILIATIONS

EDITORS

Mittermeier, Russell A.

Re:wild
Austin, TX, USA

Reuter, Kim E.

Lemur Love
San Diego, CA, USA

Rylands, Anthony B.

Re:wild
Austin, TX, USA

Jerusalinsky, Leandro

Centro Nacional de Pesquisa e Conservação de Primatas Brasileiros
Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio/CPB)
Cabedelo, PB, Brazil

Schwitzer, Christoph

Dublin Zoo
Dublin, Ireland

Strier, Karen B.

Department of Anthropology
University of Wisconsin-Madison
Madison, WI, USA

Ratsimbazafy, Jonah

Groupe d'étude et de recherche sur les primates (Gerp)
Antananarivo, Madagascar

Humle, Tatyana

Durrell Institute of Conservation and Ecology
School of Anthropology and Conservation
University of Kent
Canterbury, Kent, UK

CONTRIBUTORS

Abwe, Ekwoge

Ebo Forest Research Project
San Diego Zoo Wildlife Alliance
Cameroon

Alfonso-Cortes, Felipe

Grupo de Estudio de Primates del Ecuador (GEPE)
Proyecto Washu
Fundación Naturaleza y Arte
Ecuador

Alonso, André C.

Independent Researcher
Cabedelo, PB, Brazil

Alzamora, Mónica

Fundación Yunkawasi
Lima, Peru

Andriajaona, Aubin

Montange des Français
Madagascar Biodiversity Partnership
Madagascar

Andrianandrasana, Herizo T.

Durrell Wildlife Conservation Trust
Antananarivo, Madagascar

Andrianarimisa, Aristide

Zoology and Animal Biodiversity
University of Antananarivo
Antananarivo, Madagascar

Ang, Andie

Mandai Nature
Singapore

Assis Jardim, Márcia M.

Museu de Ciências Naturais do Rio Grande do Sul
Secretaria do Meio Ambiente e Infraestrutura
Porto Alegre, RS, Brazil

Azevedo, Renata B.

Centro Nacional de Pesquisa e Conservação de Primatas Brasileiros
Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio/CPB)
Cabedelo, PB, Brazil

Bailey, Carolyn A.

Omaha's Henry Doorly Zoo and Aquarium
Omaha, NE, USA

Barreto, Hamilton F.

Programa de Pós-graduação em Ecologia e Conservação
Universidade Federal de Sergipe
São Cristóvão, SE, Brazil

Beltrão-Mendes, Raone

Programa de Pós-graduação em Ecologia e Conservação
Universidade Federal de Sergipe
São Cristóvão, SE, Brasil

Bergl, Richard

North Carolina Zoological Park
Asheboro, North Carolina, USA

Bezara Hortensia, Hosnah

Parc Andrafiarena Andavakoera
Madagascar

Bicca-Marques, Júlio César

Laboratório de Primatologia
Escola de Ciências da Saúde e da Vida
Pontifícia Universidade Católica do Rio Grande do Sul,
Porto Alegre, RS, Brazil

Boubli, Jean P.

School of Science, Engineering and the Environment
University of Salford
Salford, UK

Buss, Gerson

Centro Nacional de Pesquisa e Conservação de Primatas
Brasileiros
Instituto Chico Mendes de Conservação da Biodiversidade
(ICMBio/CPB)
Cabedelo, PB, Brazil

Butynski, Thomas M.

Eastern Africa Primate Diversity and Conservation Program
Nanyuki, Kenya

Canale, Gustavo Rodrigues

Centre of Biodiversity Studies of the Southern Amazon
(NEBAM)
Federal University of Mato Grosso (UFMT)
Sinop, MT, Brazil

Cardoso, Tatiane dos Santos

Museu Paraense Emilio Goeldi
Belém, PA, Brazil.

Carvalho, Rodrigo Salles

Programa de Educação Ambiental - PREA
Juiz de Fora, MG, Brazil

Cervera, Laura

Grupo de Estudio de Primates del Ecuador (GEPE)
Asociación Ecuatoriana de Mastozoología AEM
Quito, Ecuador

Chaves, Óscar M.

Universidad de Costa Rica (UCR)
San José, Costa Rica

Cheyne, Susan M.

Oxford Brookes University
Oxford, UK, and
Borneo Nature Foundation
Central Kalimantan, Indonesia

Chikhi, Lounès

Laboratoire Évolution and Diversité Biologique - UMR5174
French National Centre for Scientific Research - IRD – UPS
Toulouse, France, and Instituto Gulbenkian de Ciência,
Oeiras, Portugal

Cornejo, Fanny

Fundación Yunkawasi
Lima, Peru

Cotton, Sam

Bristol Zoological Society
Bristol Zoo Gardens
Bristol, UK

Davenport, Tim R.B.

Re:wild
USA/Tanzania

De Jong, Yvonne A.

Eastern Africa Primate Diversity and Conservation
Program
Nanyuki, Kenya

de la Torre, Stella

Grupo de Estudio de Primates del Ecuador (GEPE)
Universidad San Francisco de Quito
Colegio de Ciencias Biológicas y Ambientales Ecuador

Dempsey, Andrea

West African Primate Conservation Action
Zoological Society of Hertfordshire
Broxbourne, UK

Dinsmore, Mary P.

School of Environmental Sustainability
Loyola University Chicago
Chicago, IL, USA

do Carmo, Sarisha Trindade

Centro de Conservação dos Saguis-da-Serra, Vila
Universidade Federal de Viçosa
Viçosa, MG, Brasil

Doumbé, Osiris

Sekakoh Association
Ntui, Cameroon

Dunn, Andrew

Wildlife Conservation Society
Calabar, Nigeria

Dutton, Paul

Independent researcher
Waikato, New Zealand

Eppley, Timothy M.

Conservation Science and Wildlife Health
San Diego Zoo Wildlife Alliance
Escondido, CA, USA, and
Department of Anthropology
Portland State University
Portland, OR, USA

Fernanda Solórzano, María

Grupo de Estudio de Primates del Ecuador (GEPE)
Asociación Ecuatoriana de Mastozoología AEM
Quito, Ecuador

Ferrari, Stephen F.

Department of Ecology
Universidade Federal de Sergipe
Aracaju, SE, Brazil

Fotang, Chefor

Brandenburg University of Technology
Cottbus-Senftenberg, Germany

Frasier, Cynthia L.

Omaha's Henry Doorly Zoo and Aquarium
Omaha, NE, USA

Fuentes, Nathalia

Grupo de Estudio de Primates del Ecuador (GEPE)
Proyecto Washu / Fundación Naturaleza y Arte
Ecuador

Garber, Paul A.

Department of Anthropology, Program in Ecology,
Evolution, and Conservation Biology
University of Illinois
Urbana, IL, USA

Gonder, Mary Katherine

Bioko Biodiversity Protection Programme
College of Arts and Sciences
Drexel University
Philadelphia, PA, USA

Gonedelé Bi, Sery

UFR Biosciences
Université Félix Houphouët-Boigny
Abidjan, Côte d'Ivoire

Gordo, Marcelo

Laboratório Biologia da Conservação Departamento de
Biologia/ICB, Universidade Federal do Amazonas
Manaus, AM, Brazil

Gouveia, Sidney

Department of Ecology
Federal University of Sergipe
São Cristóvão, SE, Brazil

Gutiérrez-Pineda, Karol M.

Fundación Pro-Conservación de los Primates Panameños
(FCPP)
Panama City, Panama

Hadisiswoyo, Panut

Orangutan Information Centre
Sumatra Utara, Indonesia

Hanlan, Fei

College of Life Science
China West Normal University
Nanchong, China

Hart, John A.

FZS-ICCN Lomami National Park Project
Kinshasa, Democratic Republic of the Congo

Heriniaina, Rio

Primate Biology, Behaviour and Conservation
University of Roehampton
London, UK

Hending, Daniel

School of Biological Sciences
University of Bristol
Bristol, UK

Hernández-Jaramillo, Alma

Neotropical Primate Conservation
Bogotá, Colombia

Hirano, Zelinda B.

Biological Research Center (CEPESBI)
Fundação Universidade Regional de Blumenau (FURB)
Indaial, SC, Brazil

Igayara-Souza, Claudia

Guarulhos Zoo
Guarulhos, SP, Brazil

Ikemeh, Rachel Ashegbofe

SW/Niger Delta Forest Project
New Garki, Abuja, Nigeria

Imong, Inaoyom

Wildlife Conservation Society
Calabar, Nigeria

Jabbar, Sabrina

Mandai Nature
Singapore

Jerusalinsky, Leandro

Centro Nacional de Pesquisa e Conservação de Primatas
Brasileiros
Instituto Chico Mendes de Conservação da Biodiversidade
(ICMBio/CPB)
Cabedelo, PB, Brazil

Kamgang, Serge A.

Waza National Park
Far North Region, Cameroon

Kappeler, Peter M.

German Primate Center
Göttingen, Germany

Koné, Inza

Centre Suisse de Recherche Scientifiques en Côte d'Ivoire
(CSRS)
Abidjan, Côte d'Ivoire

Kowalewski, Martin

Estación Biológica Corrientes (EBCo)
Museo Argentino de Ciencias Naturales BR CONICET
Consejo Nacional de Investigaciones Científicas y Técnicas
Corrientes, Argentina

Kuswanda, Wanda

Life Sciences and Environment Research Organization
National Research and Innovation Agency (BRIN) Central
Jakarta, Indonesia

Lagroteria, Diogo

Centro Nacional de Pesquisa e Conservação da
Biodiversidade Amazônica
Instituto Chico Mendes de Conservação da Biodiversidade
(ICMBio/CEPAM)
Manaus, AM, Brazil

Lee, Chien

Sarawak, Borneo

Lee, Zan Hui

Universiti Sains Malaysia
Pulau Pinang, Malaysia

Leonard, Neahga

Cat Ba Langur Conservation Project
Ca Ba National Park
Cat Ba Island, Cat Ba District
Hai Phong Province, Vietnam

Lewis, Richard

Durrell Wildlife Conservation Trust
Antananarivo, Madagascar

Louis, Jr., Edward E.

Omaha's Henry Doorly Zoo and Aquarium
Omaha, NE, USA

Lu, Zhang

School of Life Sciences
Sun Yat-Sen University
Guangzhou, Guangdong, China

Markolf, Matthias

University of Göttingen
Göttingen, Germany

Marques, Eduardo

Instituto Chico Mendes de Conservação da Biodiversidade
Cabedelo, PB, Brazil

Martinez, Jesus

Wildlife Conservation Society
La Paz, Bolivia

Matsuda Goodwin, Reiko

Department of Sociology and Anthropology
Fordham University
New York, USA

McGraw, W. Scott

The Ohio State University
Department of Anthropology
Columbus, OH, USA

McLester, Edward

Department for the Ecology of Animal Societies
Max Planck Institute of Animal Behavior
Konstanz, Germany

Melo, Fabiano R. de

Forestry Engineering Department
Viçosa Federal University
Viçosa, MG, Brazil

Mendes, Sérgio Lucena

Instituto Nacional da Mata Atlântica (INMA) and
Universidade Federal do Espírito Santo (UFES), Vitória, ES,
Brazil

Mendes-Oliveira, Ana Cristina

Laboratório de Ecologia e Zoologia de Vertebrados
Instituto de Ciências Biológicas
Universidade Federal do Pará
Belém, PA, Brazil

Meijaard, Erik

Borneo Futures
Brunei

Méndez-Carvajal, Pedro G.

Fundación Pro-Conservación de los Primates Panameños
(FCPP)
Panama City, Panama

Montilla, Sebastián

Departamento de Ciencias Biológicas
Universidad de Los Andes y Fundación Proyecto Primates
Bogotá, Colombia

Morales-Jiménez, Alba Lucía

Fundación Biodiversa Colombia
Bogotá, Colombia

Morelos-Juárez, Citlalli

Fundación Reserva Tesoro Escondido
Ecuador

Morgan, Bethan Jane

Ebo Forest Research Project
Messa, Cameroon, and
Institute for Conservation Research
San Diego Zoo Global
Escondido, CA, USA

Myers Thompson, Jo A.

Lukuru Wildlife Research Foundation
Marion, OH, USA

Nadler, Tilo

Three Monkeys Wildlife Conservancy
Cuc Phuong Commune, Nho Quan District
Ninh Binh Province, Vietnam

Nekaris, K. Anna I.

Nocturnal Primate Research Group
Oxford Brookes University
Oxford, UK

Neves, Leonardo G.

Instituto de Estudos Socioambientais do Sul da Bahia (IESB)
Universidade Estadual de Santa Cruz (UESC)
Ilhéus, BA, Brazil

Nijman, Vincent

Oxford Brookes University
Oxford, UK

Ngouh, Amadou

Université de Dschang
Cameroon

Oates, John F.

Dept of Anthropology
Hunter College CUNY
New York, NY, USA

Oklander, Luciana I.

Grupo de Investigación en Genética Aplicada
IBS Consejo Nacional de Investigaciones Científicas y Técnicas
Universidad Nacional de Misiones
Argentina

Passaro, Richard L.

Previously associated with the Cat Ba Langur Conservation Project
Vietnam

Pengfei, Fan

School of Life Sciences
Sun Yat-Sen University
Guangzhou, Guangdong, China

Perkin, Andrew

Independent Researcher
Tanzania

Perry, George (PJ)

Departments of Anthropology and Biology Pennsylvania State University
University Park, PA, USA

Pinel Ramos, Eduardo J.

Instituto de Neuroetología
Universidad Veracruzana
Honduras

Pollensio, Herinandrasana

Département des Sciences de la Nature et de l'Environnement
Université d'Antsiranana
Antsiranana, Madagascar

Port-Carvalho, Márcio

Environmental Research Institute, Conservation and Biodiversity Nucleus
Infrastructure and Environment Secretariat of São Paulo, SP, Brazil, and
National School of Tropical Botany
Rio de Janeiro Botanical Garden
Rio de Janeiro, RJ, Brazil

Pozo-Montuy, Gilberto

Facultad Maya de Estados Agropecuarios
Universidad Autónoma de Chiapas
México

Prasetyo, Didik

Yayasan Orangutan Tapanuli Indonesia (YOTI)
Jakarta, Indonesia

Queiroz, Helder

Mamirauá Institute for Sustainable Development
Tefé, AM, Brazil

Raffel, Martina

Allwetter Zoo, Germany

Raharivololona, Brigitte M.

Mention Zoologie et Biodiversité Animale
Ecole Doctorale Sciences de la Vie et de l'Environnement
Université d'Antananarivo
Antananarivo, Madagascar

Rakotoarisoa, Gilbert

Parc Botanique et Zoologique de Tsimbazaza
Antananarivo, Madagascar

Rakotondraparany, Felix

Département de Zoologie et Biodiversité Animale
Université d'Antananarivo
Antananarivo, Madagascar

Rakotomalala, Valérie F.

Faculté des Sciences, de Technologie et de l'Environnement
Université de Mahajanga
Mahajanga, Madagascar

Rakotondrazandry, Jeannin Nicolas

Ecole Doctorale des Ecosystèmes Naturels
Université de Mahajanga
Mahajanga, Madagascar

Rakotondrina, Romeo

Mention Zoologie et Biodiversité Animale
Université d'Antananarivo
Antananarivo, Madagascar

Ralainasolo, Fidy

Durrell Wildlife Conservation Trust
Antananarivo, Madagascar

Randimbiharirinina, Doménico R.

Groupe d'Etude et de Recherche sur les Primates de Madagascar (GERP)
Antananarivo, Madagascar

Randriatahina, Guy H.

Association Européenne pour l'Étude et la Conservation des Lémuriens (AEECL)
Madagascar

Rasoanaivo, Noa E.

Département Zoologie et Biodiversité Animale Faculté des Sciences
Université d'Antananarivo
Antananarivo, Madagascar

Rasoamazava, Lucile

Faculté des Sciences, de Technologies et de l'Environnement
Université de Mahajanga
Mahajanga, Madagascar

Rasoloharijaona, Solofonirina

Faculté des Sciences, de Technologies et de l'Environnement
Université de Mahajanga
Mahajanga, Madagascar

Ratsimbazafy, Jonah

Groupe d'Etude et de Recherche sur les Primates de Madagascar (GERP)
Antsakaviro, Antananarivo, Madagascar

Raveloarimalala, Lucile Mialisoa

Madagascar Wildlife Conservation
Atsimondrova
Ambatondrazaka
Madagascar

Ravelomandrato, Franky

Mention Zoologie et Biodiversité Animale
Université d'Antananarivo
Antananarivo, Madagascar

Raveloson, Herimalala

Ecole Doctorale des Ecosystèmes Naturels
Université de Mahajanga
Mahajanga, Madagascar

Ravetta, André Luis

Programa de Capacitação Institucional
Museu Paraense Emílio Goeldi (PCI-MPEG)
Belém, PA, Brazil

Ren, Baoping

Ministry of Education Key Laboratory for Ecology of Tropical Islands
College of Life Sciences
Hainan Normal University
Haikou, China

Rigobert, Jhon

University of Antsiranana
Antsiranana, Madagascar

Rivera, Esteban

Grupo de Estudio de Primates del Ecuador (GEPE)
Proyecto Washu / Fundación Naturaleza y Arte
Ecuador

Rizaldi

Andalas University
Padang City, West Sumatra, Indonesia

Rodríguez-Menjívar, Melissa E.

Asociación Territorios Vivos El Salvador (ATVES)
El Salvador

Rowe, Noel

Primate Conservation Inc.
Charlestown, RI, USA

Rudran, Rasanayagam

Smithsonian's Conservation Biology Institute
Front Royal, VA, USA

Ruppert, Nadine

School of Biological Sciences
Universiti Sains Malaysia
Pulau Pinang, Malaysia

Rylands, Anthony B.

Re:wild
Austin, TX, USA

Sánchez-Porras, Ronald

Universidad de Costa Rica
San José, Costa Rica

Salmona, Jordi

Laboratoire Évolution and Diversité Biologique - UMR5174
Université Toulouse III Paul Sabatier - IRD - CNRS
Toulouse, France

Schäffler, Livia

Leibniz Institute for the Analysis of Biodiversity Change (LIB)
Museum Koenig, and
Centre for Biodiversity Monitoring and Conservation
Science
Section Conservation Ecology
Bonn, Germany

Schrudde, Daniela

Previously associated with the Cat Ba Langur Conservation Project
Vietnam

Schwitzer, Christoph

Dublin Zoo
Dublin, Ireland

Sefczek, Timothy M.

Omaha's Henry Doorly Zoo and Aquarium
Omaha, NE, USA

Seibokuro, Tukuru

Apoi Community Conservation Association
Nigeria

Semedo, Thiago B.F.

Instituto Nacional de Pesquisa do Pantanal (INPP) Museu
Paraense Emílio Goeldi (MPEG), and
Programa de Capacitação Institucional
Cuiabá, MT, Brazil

Semel, Brandon

Fish and Wildlife Sciences
Virginia Tech University
Blacksburg, VA, USA

Semel, Meredith

Biological Sciences
Virginia Tech University
Blacksburg, VA, USA

Setiawan, Arif

SwaraOwa
Yogyakarta, Indonesia

Shanee, Sam

Neotropical Primate Conservation
Moyobamba, San Martín, Peru

Shekelle, Myron

Biology Department
Western Washington University
Bellingham, WA, USA

Spaan, Denise

Universidad Veracruzana de México
Xalapa, México

Steffens, Travis S.

Department of Sociology and Anthropology
University of Guelph
Guelph, ON, Canada, and
Planet Madagascar
Guelph, ON, Canada

Stenke, Roswitha

Previously associated with the Cat Ba Langur Conservation
Project
Vietnam

Supriatna, Jatna

Department of Biology, FMIPA
University of Indonesia
Indonesia, and
Tapanuli Orangutan Foundation
Indonesia

Thuc, Phan Duy

Previously worked on the Golden-headed Langur

Tinsman, Jen

Conservation Genetics Department
Omaha's Henry Doorly Zoo and Aquarium
Omaha, NE, USA

Tirira, Diego G.

Grupo de Estudio de Primates del Ecuador (GEPE)
Fundación Mamíferos y Conservación
Capelo, Rumiñahui, Ecuador

Valença-Montenegro, Mônica M.

Centro Nacional de Pesquisa e Conservação de Primatas
Brasileiros
Instituto Chico Mendes de Conservação da Biodiversidade
(ICMBio/CPB)
Cabedelo, PB, Brazil

Vital, Orlando

Programa de Pós-Graduação em Ecologia
Centro de Conservação dos Saguis-da-Serra Universidade
Federal de Viçosa
Viçosa, MG, Brazil

Volampeno, Sylviane

Mikajy Natiora
Madagascar

Waeber, Patrick O.

ETH Zurich, Ecosystems Management, Forest Management
and Development Group
Zurich, Switzerland

Wallace, Robert

Wildlife Conservation Society
La Paz, Bolivia

Wich, Serge

Liverpool John Moores University
Liverpool, UK

Wilmet, Leslie

Durrell Wildlife Conservation Trust
Antananarivo, Madagascar

Zaldaña-Orantes, Karla P.

Asociación Territorios Vivos El Salvador (ATVES)
San Salvador, El Salvador

Zaonarivelo, John

Département des Sciences de la Nature et de
l'Environnement
Université d'Antsiranana
Antsiranana, Madagascar

Zhou, Jiang

School of Karst Science
Guizhou Normal University
Guiyang, China

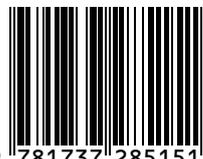
Back cover photo: The Ka'apor Capuchin Monkey, *Cebus kaapori*, in the Gurupi Biological Reserve, Maranhão, Brazil. Photograph by Fabiano R. de Melo.



PRIMATES IN PERIL

The World's 25 Most Endangered Primates
2022–2023

ISBN 978-1-7372851-5-1



90000>



9 781737 285151