

Bibliografía verde de Madre de Dios

Versión 4.1

Compilado y editado por
**Nigel Pitman, Maricarmen Loyola,
Karina Salas, Gabriela Vigo y Dave Lutz**



**Asociación para la Conservación
de la Cuenca Amazónica**



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INTRODUCCIÓN EN CASTELLANO

El presente libro es una lista preliminar de todos los documentos escritos acerca de la biología y conservación del departamento de Madre de Dios, Perú, en el sudoeste amazónico. La lista fue compilada por Nigel Pitman, Maricarmen Loyola, Karina Salas, Gabriela Vigo y Dave Lutz entre septiembre de 2004 y septiembre de 2005. Para elaborar la lista incorporamos referencias de otras bibliografías publicadas y no-publicadas, realizamos búsquedas en bibliotecas peruanas y bases de datos en el internet y consultamos con investigadores con mucha experiencia en Madre de Dios.

Hasta la fecha nuestra búsqueda ha resultado en una lista de 2.255 referencias. La lista no está completa, pero creemos que incluye aproximadamente un 90% del material existente. Desde octubre 2005, gracias al apoyo del Botanical Research Institute of Texas, la bibliografía está disponible en la siguiente página web, la cual permite a los usuarios realizar búsquedas, downloads, correcciones y actualizaciones:

<http://atrium.andesamazon.org/biblio>

También se puede mandar adiciones, correcciones y otros comentarios a Nigel Pitman en npitman@amazonconservation.org.

La lista incluye artículos de revistas profesionales y populares, libros, libros editados, capítulos de libros editados, abstractos y capítulos en resúmenes de conferencias, tesis e informes no publicados. Muchas veces fue difícil definir categorías claras para algunos documentos distribuidos por agencias gubernamentales o ONG's. En algunos casos, esos documentos han sido distribuidos a unas pocas personas como hojas fotocopiadas engrapadas; en otros casos, estos documentos parecen libros impresos profesionalmente y son distribuidos a miles de personas. La regla que se utilizó para distinguir entre libros y lo que se llama *unpublished reports* (informes no publicados) en esta bibliografía es que los libros contienen una página que indica la imprenta, ciudad y año de impresión, mientras los informes no publicados no la contienen. A los informes que carecen de alguna afiliación institucional, los hemos denominado *unpublished reports of unknown provenance* (informes no publicados de origen desconocido).

La lista no incluye manuscritos que se encontraban en revisión o en prensa a partir de agosto 2005, ni artículos de periódico, leyes, informes entregados al INRENA, obras de ficción o poesía, mapas, sitios web, CD's, películas, programas de radio y otras obras multimedia. Una bibliografía comprensiva de la biodiversidad de Madre de Dios debería incluir la descripción taxonómica y las revisiones y tratamientos taxonómicos posteriores, de cada especie de flora y fauna registrada hasta la fecha en la región. Esto no fue posible, ya que representaría un labor de décadas y habría resultado en una bibliografía dominada por publicaciones cuya conexión con Madre de Dios era tenue. Por lo tanto, se decidió solo incluir publicaciones taxonómicas cuando éstas describen nuevas especies de especímenes colectados en Madre de Dios, o cuando sean de una utilidad indiscutible para los investigadores de la región, como *The Palms of the Amazon* de Henderson (1994).

Para restringir la cobertura bibliográfica a temas de biología y conservación –las cuales podrían interpretarse como campos de estudio vastos– se tuvo que emplear unos filtros arbitrarios. Por ejemplo, se decidió incluir documentos acerca de las exploraciones históricas de la región, así como los estudios de geología, suelos y clima, por la razón de que estos representan una tela de fondo histórico y abiótico imprescindible para los biólogos y conservacionistas que trabajan en el departamento. Publicaciones de las industrias madereras y mineras solo fueron incluidos en la bibliografía cuando estos contenían información biológica significativa. La bibliografía no incluye estudios acerca de la agricultura, con la excepción de los que tratan especies cultivadas que son nativas del Madre de Dios, los que tratan de agricultura en áreas protegidas y los que mencionan algún otro aspecto de la biodiversidad nativa del departamento. Solo se incluyeron textos acerca de la salud humana si mencionaran la biología no-humana; por ejemplo, los artículos sobre la uta suelen tener información interesante acerca de las moscas que transmiten la enfermedad. Solo incluimos textos acerca de poblaciones o culturas indígenas si estos trataran de la biología no-humana o de poblaciones adentro de áreas protegidas.

A continuación se presenta una lista de las fuentes que se consultaron durante la elaboración de la bibliografía. Los iniciales en paréntesis corresponden a la persona que trabajó con cada fuente.

Más de 100 referencias:

- Lista de publicaciones de la Estación Biológica Cocha Cashu [NP]
- Lista de publicaciones de la Concesión para Conservación Río Los Amigos [NP]
- Base de datos de la ISI Web of Science, <http://isi4.isiknowledge.com/portal.cgi/wos> [NP]
- Base de datos de la biblioteca del Instituto de Investigaciones de la Amazonía Peruana en Iquitos [NP]
- Lista de publicaciones de Tambopata compilada por ProNaturaleza y Conservación Internacional [NP]
- Wahl Kleiser, L., & K. Rummenhoeller. 1991. La región de Madre de Dios: Bibliografía anotada. Centro de Estudios Regionales Andinos Bartolomé de Las Casas, Cusco. 304 páginas [NP]

20-100 referencias:

- Goulding, M., C. Cañas, R. Barthem, B. Forsberg & H. Ortega. 2003. Amazon Headwaters: Rivers, wildlife, and conservation in southeastern Peru. Amazon Conservation Association y Gráfica Biblos S.A., Lima. 198 páginas [NP]
- Rodríguez, L. O. 2000. El Manu y otras experiencias de investigación y manejo de bosques neotropicales. Proyecto Aprovechamiento y Manejo Sostenible de la Reserva de Biosfera y Parque Nacional del Manu (PRO-MANU), Lima. 308 páginas [NP]
- Leite Pitman, R., N. Pitman & P. Álvarez (eds.). 2003. Alto Purús: Biodiversidad, conservación y manejo. Duke University Center for Tropical Conservation & Impreso Gráfica, Lima. 350 páginas [NP]
- Wilson, D. E., & A. Sandoval (eds.). 1997. Manu: The biodiversity of southeastern Peru. Smithsonian Institution Press, Washington, DC, USA [NP]
- Lista de publicaciones de la Sociedad Zoológica de Frankfurt - Perú [NP]
- Valdez O., U. & A. Tovar (eds.). 1995. Reporte Tambopata: Resúmenes de investigaciones en los alrededores del Explorer's Inn/Abstracts of investigations around Explorer's Inn. Informe no publicado del Centro de Datos para la Conservación (CDC), Universidad Nacional Agraria de La Molina, Conservation International, y la Tambopata Reserve Society, Lima [NP]
- Lista de publicaciones acerca de *Bertholletia excelsa*, compilada por Enrique Ortiz [NP]
- Kalliola, R., M. Puhakka & W. Danjoy (eds.). 1993. Amazonía peruana: Vegetación húmeda tropical en el llano subandino. Proyecto Amazonia of the Universidad de Turku (PAUT), and Oficina Nacional de Evaluación de Recursos Naturales (ONERN), Jyväskylä. 261 páginas [NP]
- Biblioteca del Centro de Estudios Regionales Andinos Bartolomé de las Casas, Cusco [DL]
- Lista de referencias acerca de Tambopata, compilada por la Tambopata Research Society [NP]
- Google Scholar (www.scholar.google.com) [NP]
- Biblioteca de la Universidad Nacional San Antonio Abad del Cusco, sede Puerto Maldonado [KS]
- Biblioteca del Instituto de Investigaciones de la Amazonía Peruana en Puerto Maldonado [KS]
- Biblioteca de CESVI en Puerto Maldonado [KS]
- Biblioteca del Centro de Datos para la Conservación en la Universidad Nacional Agraria La Molina [ML]
- Biblioteca del REDINFOR en la Universidad Nacional Agraria La Molina [ML]
- Foster, R. B., J. L. Carr & A. B. Forsyth (eds.). 1994. The Tambopata-Candamo Reserved Zone of Southeastern Perú: A Biological Assessment. Conservation International, Washington, DC, USA. 184 páginas [NP]
- Lista de publicaciones compilada por Julia Ohl [NP]
- Napravnik Pesce, M. (ed.). 2004. Guía interpretativa para Tambopata Research Center y Posada Amazonas. 11ra Edición 1994-2004. Rainforest Expeditions S. A. C. and INNOVA Arquitectura Integral S. R. L, Lima. 332 páginas [NP]

Otras bibliotecas visitadas:

- Biblioteca de la oficina de FENAMAD en Puerto Maldonado [KS]
- Biblioteca de la oficina de FONDEBOSQUE en Puerto Maldonado [KS]
- Biblioteca del Consejo Municipal de Puerto Maldonado [KS]
- Biblioteca de la oficina de INC en Puerto Maldonado [KS]

- Biblioteca de la oficina del World Wildlife Fund-Perú en Puerto Maldonado [KS]
- Biblioteca de la Dirección de Turismo en Puerto Maldonado [KS]
- Biblioteca de la Dirección de Minería en Puerto Maldonado [KS]
- Biblioteca de la Dirección de Pesquería en Puerto Maldonado [KS]
- Biblioteca del Instituto Superior Pedagógico en Puerto Maldonado [KS]
- Biblioteca del Instituto Superior Tecnológico Jorge Basadre Grohman en Puerto Maldonado [KS]
- Biblioteca de la Universidad Nacional de Madre de Dios en Puerto Maldonado [KS]
- Biblioteca principal de la Universidad Nacional Agraria La Molina en Lima [ML]
- Biblioteca de la oficina de la Asociación para la Conservación de la Cuenca Amazónica en Puerto Maldonado [KS]
- Base de datos de las bibliotecas de Princeton University [NP]
- Base de datos de las bibliotecas de Duke University [NP]
- Biblioteca de la Universidad Andina en Puerto Maldonado [KS]
- Biblioteca de la Asociación de Niños y su Ambiente en Puerto Maldonado [KS]
- Biblioteca de APAKTONE en Puerto Maldonado [KS]
- Biblioteca principal del Instituto Nacional de Recursos Naturales en Lima [GV]
- Biblioteca del Museo de Historia Natural de la Universidad Ricardo Palma [GV]
- Biblioteca del Museo de Historia Natural de la Universidad Nacional Mayor San Marcos [GV]
- Biblioteca de la Facultad de Biología de la Universidad Nacional Mayor de San Marcos [GV]
- Biblioteca principal de la Universidad Peruana Cayetano Heredia [GV]
- Biblioteca de la Facultad de Ciencias y Filosofía de la Universidad Peruana Cayetano Heredia [GV]
- Base de datos de la Biblioteca Nacional del Perú [GV]
- Biblioteca de la Dirección General de Áreas Naturales Protegidas en el Instituto Nacional de Recursos Naturales en Lima [GV]
- Sala Pease de la Biblioteca Nacional del Perú [GV]
- Sala Pastor de la Biblioteca Nacional del Perú [GV]
- Volúmenes completos de la *Revista Peruana de Entomología* [GV]
- Volúmenes completos de la *Revista Peruana de Biología* [GV]
- Volúmenes completos de *Las Memorias del Museo de Historia Natural y Publicaciones del Museo* [GV]

Agradecimientos

Las siguientes personas ayudaron en la compilación de esta bibliografía: Lourdes Aranguena, Magaly Blácido, Lucas Benites, Enrique Gushiken, Victor Miyakawa, Erinn Nanney, Piero Rengifo Cardenas, Mercedes Ruiz, Miles Silman, Antonio Tovar y Pedro Vásquez. Las siguientes personas revisaron copias preliminares de la bibliografía e hicieron adiciones, correcciones u otros comentarios útiles: Miguel Alexiades, Diane Davidson, Louise Emmons, Jessica Groenendijk, John Janovec, Chris Kirkby, Renata Leite Pitman, Peter Murphy, Julia Ohl, Oliver Phillips, Mathias Tobler, Rudolf Von May y Douglas Yu. El proyecto fue financiado por una Beca Semilla de la Amazon Conservation Association y la Asociación para la Conservación de la Cuenca Amazónica. Gracias a Renata Leite Pitman por haber corregido la traducción al portugués de esta introducción.

Nigel Pitman
Estación Biológica Los Amigos
Madre de Dios, Perú
Octubre del 2005

ENGLISH INTRODUCTION

This book is a preliminary list of written documents related to the biology and conservation of Peru's Madre de Dios Department, in southwestern Amazonia. It was compiled by Nigel Pitman, Maricarmen Loyola, Karina Salas, Gabriela Vigo, and Dave Lutz over a one-year period between September 2004 and September 2005. To build the list we consulted existing bibliographies, searched libraries in Peru, searched databases on the internet, and consulted with long-term researchers in Madre de Dios.

To date our search has uncovered 2,255 publications. The list is not complete, but we believe it includes approximately 90% of existing material. Since October 2005, and thanks to support from the Botanical Research Institute of Texas, the bibliography is accessible at the following website as a searchable database that permits visitors to make downloads, corrections, and updates:

<http://atrium.andesamazon.org/biblio>

Additions, corrections, and other comments can also be sent to Nigel Pitman at npitman@amazonconservation.org.

The list includes journal articles, magazine articles, books, edited volumes, chapters from edited volumes, abstracts and chapters from congress proceedings, theses, and unpublished reports. We often found it hard to define clear categories for documents released by government agencies and non-governmental organizations. In some cases reports are distributed as stapled photocopies to a very few people, while in other cases they are hard to distinguish from professionally published books and are intended for mass distribution. Our rule in distinguishing published books from what we call "unpublished reports" was that published books include a title page indicating the printer, city, and year of publication, while unpublished reports do not. Reports that lacked an institutional affiliation, or whose institutional affiliation was not clear to us, are indicated here as "unpublished reports of unknown provenance."

The list does not include manuscripts that were in review or in press as of August 2005, nor newspaper articles, laws, reports submitted to INRENA by the holders of research permits, works of fiction or poetry, maps, websites, CD's, movies, radio programs, and other multimedia sources. A truly comprehensive bibliography of the region's biodiversity would include the taxonomic description, as well as subsequent revisions and treatments, of every life-form ever registered in Madre de Dios. Because this is a Herculean task, and would lead to a bibliography dominated by publications with a tenuous relationship to southeastern Peru, we have chosen to include only taxonomic publications that describe new species from specimens collected in Madre de Dios, or that are broadly useful for researchers in Madre de Dios, like Henderson's (1994) *The Palms of the Amazon*.

Restricting the bibliography to biology and conservation required some arbitrary decisions. For example, documents on early explorations, geology, soils, and climate were included as useful background texts for biologists and conservationists working in the area, while documents on the logging and mining industries were only included when they included significant biological information. The bibliography does not include documents of a purely agricultural nature (e.g., reports on tomato yields in Laberinto) unless they discuss cultivated species that are native to Madre de Dios, research inside protected areas, or some other aspect of regional biodiversity. Documents on public health, medicine, and human populations were only included if they made some mention of biology, e.g., reports on leishmaniasis often provide information on phlebotomine sand flies, which transmit the disease to humans. Texts on indigenous peoples or cultures were excluded unless they contained significant biological information or dealt with populations inside protected areas.

Below is a list of the various sources that we used to construct the bibliography, in the order that we used them. Bracketed initials indicate the person who worked with each source.

More than 100 references:

- List of publications from the Cocha Cashu Biological Station [NP]
- List of publications from the Los Amigos Conservation Concession [NP]
- ISI Web of Science database, <http://isi4.isiknowledge.com/portal.cgi/wos> [NP]

- Database of the library of the Instituto de Investigaciones de la Amazonía Peruana in Iquitos [NP]
- ProNaturaleza/Conservación Internacional publication database for Tambopata [NP]
- Wahl Kleiser, L., & K. Rummenhoeller. 1991. La región de Madre de Dios: Bibliografía anotada. Centro de Estudios Regionales Andinos Bartolomé de Las Casas, Cusco. 304 pages [NP]

20-100 references:

- Goulding, M., C. Cañas, R. Barthem, B. Forsberg & H. Ortega. 2003. Amazon Headwaters: Rivers, wildlife, and conservation in southeastern Peru. Amazon Conservation Association and Gráfica Biblos S.A., Lima. 198 pages [NP]
- Rodríguez, L. O. 2000. El Manu y otras experiencias de investigación y manejo de bosques neotropicales. Proyecto Aprovechamiento y Manejo Sostenible de la Reserva de Biosfera y Parque Nacional del Manu (PRO-MANU), Lima. 308 pages [NP]
- Leite Pitman, R., N. Pitman & P. Álvarez (eds.). 2003. Alto Purús: Biodiversidad, conservación y manejo. Duke University Center for Tropical Conservation & Impreso Gráfica, Lima. 350 pages [NP]
- Wilson, D. E., & A. Sandoval (eds.). 1997. Manu: The biodiversity of southeastern Peru. Smithsonian Institution Press, Washington, DC, USA [NP]
- Frankfurt Zoological Society Peru publications list [NP]
- Valdez O., U. & A. Tovar (eds.). 1995. Reporte Tambopata: Resúmenes de investigaciones en los alrededores del Explorer's Inn/Abstracts of investigations around Explorer's Inn. Unpublished report by the Centro de Datos para la Conservación (CDC), Universidad Nacional Agraria de La Molina, Conservation International, and Tambopata Reserve Society, Lima [NP]
- List of Brazil nut-related articles maintained by Enrique Ortiz [NP]
- Kalliola, R., M. Puhakka & W. Danjoy (eds.). 1993. Amazonía peruana: Vegetación húmeda tropical en el llano subandino. Proyecto Amazonia of the Universidad de Turku (PAUT), and Oficina Nacional de Evaluación de Recursos Naturales (ONERN), Jyväskylä. 261 pages [NP]
- Library of the Centro de Estudios Regionales Andinos Bartolomé de las Casas, Cusco [DL]
- Bibliography of the Tambopata Research Society [NP]
- Google Scholar (www.scholar.google.com) [NP]
- Library of the Universidad Nacional San Antonio Abad del Cusco in Puerto Maldonado [KS]
- Library of the Instituto de Investigaciones de la Amazonía Peruana in Puerto Maldonado [KS]
- CESVI library in Puerto Maldonado [KS]
- Library of the Centro de Datos para la Conservación at the Universidad Nacional Agraria La Molina [ML]
- Library of REDINFOR at the Universidad Nacional Agraria La Molina [ML]
- Foster, R. B., J. L. Carr & A. B. Forsyth (eds.). 1994. The Tambopata-Candamo Reserved Zone of Southeastern Perú: A Biological Assessment. Conservation International, Washington, DC, USA. 184 pages [NP]
- List of publications compiled by Julia Ohl [NP]
- Napravnik Pesce, M. (ed.). 2004. Guía interpretativa para Tambopata Research Center y Posada Amazonas. 11ra Edición 1994-2004. Rainforest Expeditions S. A. C. and INNOVA Arquitectura Integral S. R. L, Lima. 332 pages [NP]

Other sources investigated:

- Library of FENAMAD office in Puerto Maldonado [KS]
- Library of FONDEBOSQUE office in Puerto Maldonado [KS]
- Library of the Consejo Municipal of Puerto Maldonado [KS]
- Library of INC office in Puerto Maldonado [KS]
- Library of the World Wildlife Fund-Perú in Puerto Maldonado [KS]
- Library of the Dirección de Turismo in Puerto Maldonado [KS]
- Library of the Dirección de Minería in Puerto Maldonado [KS]
- Library of the Dirección de Pesquería en Puerto Maldonado [KS]
- Library of the Instituto Superior Pedagógico in Puerto Maldonado [KS]
- Library of the Biblioteca Instituto Superior Tecnológico Jorge Basadre Grohman in Puerto Maldonado [KS]

- Library of the Universidad Nacional de Madre de Dios in Puerto Maldonado [KS]
- Main library of the Universidad Nacional Agraria La Molina [ML]
- Library of the Asociación para la Conservación de la Cuenca Amazónica in Puerto Maldonado [KS]
- Online database of the Princeton University libraries [NP]
- Online database of the Duke University libraries [NP]
- Library of the Universidad Andina in Puerto Maldonado [KS]
- Library of the Asociación de Niños y su Ambiente in Puerto Maldonado [KS]
- Library of APAKTONE in Puerto Maldonado [KS]
- Main library of the Instituto Nacional de Recursos Naturales office in Lima [GV]
- Library of the Museo de Historia Natural of the Universidad Ricardo Palma [GV]
- Library of the Museo de Historia Natural of the Universidad Nacional Mayor San Marcos [GV]
- Library of the Facultad de Biología of the Universidad Nacional Mayor de San Marcos [GV]
- Main library of the Universidad Peruana Cayetano Heredia [GV]
- Library of the Facultad de Ciencias y Filosofía of the Universidad Peruana Cayetano Heredia [GV]
- Database of the Biblioteca Nacional del Perú [GV]
- Library of the Dirección General de Áreas Naturales Protegidas at the Instituto Nacional de Recursos Naturales office in Lima [GV]
- Sala Pease of the Biblioteca Nacional del Perú [GV]
- Sala Pastor of the Biblioteca Nacional del Perú [GV]
- Entire set of the *Revista Peruana de Entomología* [GV]
- Entire set of the *Revista Peruana de Biología* [GV]
- Entire sets of *Las Memorias del Museo de Historia Natural* and *Publicaciones del Museo* [GV]

Acknowledgments

The following people assisted in the compilation of this bibliography: Lourdes Aranguena, Magaly Blácido, Lucas Benites, Enrique Gushiken, Victor Miyakawa, Erinn Nanney, Piero Rengifo Cardenas, Mercedes Ruiz, Miles Silman, Antonio Tovar, and Pedro Vásquez. The following people reviewed preliminary copies of the bibliography and made additions, corrections, and other helpful comments: Miguel Alexiades, Diane Davidson, Louise Emmons, Jessica Groenendijk, John Janovec, Chris Kirkby, Renata Leite Pitman, Peter Murphy, Julia Ohl, Oliver Phillips, Mathias Tobler, Rudolf Von May, and Douglas Yu. The project was funded by a Seed Grant from the Amazon Conservation Association and the Asociación para la Conservación de la Cuenca Amazónica. Thanks to Renata Leite Pitman for correcting the Portuguese translation of the introduction.

Nigel Pitman
Los Amigos Biological Station
Madre de Dios, Peru
October 2005

INTRODUÇÃO EM PORTUGUÊS

Este livro é uma lista preliminar de documentos relacionados à biologia e a conservação do Departamento de Madre de Dios, Peru, no sudoeste da Amazônia. Foi compilada por Nigel Pitman, Maricarmen Loyola, Karina Salas, Gabriela Vigo y Dave Lutz entre setembro de 2004 e setembro de 2005. Para construir a lista utilizaram-se bibliografias já existentes, realizaram-se buscas em bibliotecas peruanas e bases de dados na internet, e foram consultados científicos com larga experiência em Madre de Dios.

Até agora a busca resultou em uma lista com 2.255 publicações. A lista não é completa, mais acredita-se que inclui aproximadamente um 90% do material existente. Desde outubro de 2005, graças ao apoio do Botanical Research Institute of Texas, a bibliografia está disponível na página web citada logo abaixo, onde os usuários podem realizar buscas, *downloads* e atualizações:

<http://atrium.andesamazon.org/biblio>

Também é possível enviar referências novas, correções e outros comentários para Nigel Pitman em npitman@amazonconservation.org.

A lista inclui artigos de revistas profissionais e populares, livros, livros editados, capítulos de volumes editados, resumos e capítulos de volumes procedentes de conferências, teses e relatórios não publicados. Com frequência foi difícil distinguir categorias para alguns documentos difundidos por agências governamentais ou ONG's. Em alguns casos, esses documentos foram distribuídos para poucas pessoas como fotocópias; em outros casos, livros profissionalmente impressos que foram distribuídos a milhares de pessoas. A regra utilizada para distinguir entre os livros e os relatórios não publicados nesta bibliografia foi que os livros contêm uma página que indica a impressa, cidade e ano de impressão, em quanto os relatórios não publicados não. Os relatórios que não demonstram nenhuma afiliação institucional foram denominados como *unpublished reports of unknown provenance* (relatórios não publicados de origem desconhecida).

A lista não inclui manuscritos que estavam em revisão ou sendo impressos em agosto de 2005, nem artigos de jornal, leis, relatórios entregados ao Instituto Nacional de Recursos Naturales do Peru, obras de ficção ou poesia, mapas, páginas web, CD's, filmes, programas de rádio e outras obras multimídia. Uma bibliografia completa da biodiversidade de Madre de Dios deveria incluir a descrição taxonômica e as revisões e tratamentos taxonômicos posteriores de cada espécie da flora e fauna registrada até agora na região. Isto não foi possível, porque representaria um trabalho de décadas e teria resultado em uma bibliografia dominada por publicações com uma conexão superficial com Madre de Dios. Por enquanto, decidiu-se somente incluir publicações taxonômicas quando estas descrevem espécies novas de espécimens coletados em Madre de Dios, ou quando sejam de utilidade indiscutível para os investigadores da região, como por exemplo *The Palms of the Amazon* de Henderson (1994).

Para restringir a cobertura bibliográfica a temas de biologia e conservação, filtros arbitrários foram aplicados. Por exemplo, decidiu-se incluir documentos sobre as explorações históricas da região, assim como os estudos de geologia, solos e clima, porque estos representam um suporte histórico e abiótico imprescindível para os biólogos e conservacionistas que trabalham na região. Publicações das indústrias madeireiras e mineiras somente foram incluídas na bibliografia quando estas continham informação biológica significativa. A bibliografia não inclui estudos sobre a agricultura, com a exceção das que tratam de espécies cultivadas que são nativas de Madre de Dios, das que tratam da agricultura em áreas protegidas e das que mencionam algum outro aspecto da biodiversidade nativa da região. Somente incluíram-se textos sobre a saúde humana se estos mencionaram a biologia não-humana; por exemplo, alguns artigos sobre a leishmaniose incluem informação interessante sobre as moscas que transmitem a doença. Somente incluíram-se textos sobre populações ou culturas indígenas que tratam de biologia não-humana ou populações dentro de áreas protegidas.

A continuação apresenta-se uma lista das fontes utilizadas durante a compilação da bibliografia, na ordem em que foram utilizadas. As iniciais em parentesis indicam à pessoa quem trabalhou com cada fonte.

Mais de 100 referências:

- Lista de publicações da Estação Biológica Cocha Cashu [NP]
- Lista de publicações da Concessão para Conservação Rio Los Amigos [NP]

- Base de datos da ISI Web of Science, <http://isi4.isiknowledge.com/portal.cgi/wos> [NP]
- Base de datos da biblioteca do Instituto de Investigaciones de la Amazonía Peruana em Iquitos [NP]
- Lista de publicações de Tambopata compilada por ProNaturaleza e Conservação Internacional [NP]
- Wahl Kleiser, L., & K. Rummenhoeller. 1991. La región de Madre de Dios: Bibliografía anotada. Centro de Estudios Regionales Andinos Bartolomé de Las Casas, Cusco. 304 páginas [NP]

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- Avalos Roldán, G. and N. Quispe Gutiérrez. 2002. Condiciones sinópticas de la incursión de una masa de aire frío en Sudamérica: Caso julio 2000 y su impacto en la selva peruana. Unpublished report of the Servicio Nacional de Meteorología e Hidrología (SENAMHI). 9 pages. ABSTRACT: Se realizó un análisis físico de la estructura vertical de la troposfera, antes, durante y después del evento FriaJe, ocurrido entre el 8 y 13 de julio del año 2000, utilizando las salidas del Modelo Global de CPTEC. El evento se inicia con una intensa perturbación meridional en alta atmósfera como consecuencia de la intensificación de la Corriente en Chorro, configurándose una profunda vaguada que advece vorticidad negativa hacia superficie desde dos días previos al día D, generando ciclogénesis. La configuración e intensidad del APS, favoreció la advección fría, canalizando el aire de origen polar hacia el flanco sur-oriental de los Andes. El día D, la cuña sobre continente adquiere una configuración cuasi-omega ($\bar{\omega}$) reforzando la ciclogénesis y al sistema frontal ubicado entre Brasil y Argentina, intensificándose la interacción entre los sistemas de baja y alta atmósfera. El descenso de la temperatura mínima empezó en la selva sur del Perú el día 12 del julio (día "D").
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the Royal Society of London Series B-Biological Sciences 359(1443): 353-365. ABSTRACT: A previous study by Phillips et al. of changes in the biomass of permanent sample plots in Amazonian forests was used to infer the presence of a regional carbon sink. However, these results generated a vigorous debate about sampling and methodological issues. Therefore we present a new analysis of biomass change in old-growth Amazonian forest plots using updated inventory data. We find that across 59 sites, the above-ground dry biomass in trees that are more than 10 cm in diameter (AGB) has increased since plot establishment by 1.22 +/- 0.43 Mg per hectare per year (ha(-1) yr(-1), where 1 ha = 10(4) m(2)), or 0.98 +/- 0.38 Mg ha(-1) yr(-1) if individual plot values are weighted by the number of hectare years of monitoring. This significant increase is neither confounded by spatial or temporal variation in wood specific gravity, nor dependent on the allometric equation used to estimate AGB. The conclusion is also robust to uncertainty about diameter measurements for problematic trees: for 34 plots in western Amazon forests a significant increase in AGB is found even with a conservative assumption of zero growth for all trees where diameter measurements were made using optical methods and/or growth rates needed to be estimated following fieldwork. Overall, our results suggest a slightly greater rate of net stand-level change than was reported by Phillips et al. Considering the spatial and temporal scale of sampling and associated studies showing increases in forest growth and stem turnover, the results presented here suggest that the total biomass of these plots has on average increased and that there has been a regional-scale carbon sink in old-growth Amazonian forests during the previous two decades.

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- Ball, G. E. and D. Shpeley. 1990. Synopsis of the Neotropical genus *Ozaena* Olivier: Classification and reconstructed evolutionary history (Coleoptera: Carabidae: Ozaenini). *Canadian Entomologist* 122(9-10): 779-816. ABSTRACT: Descriptions and illustrations of structural features of adults, a key, and chorological data provide the basis for characterizing the genus *Ozaena* Olivier and classifying the 10 included species, two of which are new: *O. maxi* (type locality: Iracubo, CAYENNE), and *O. manu* (type locality: Manu National Park, Madre de Dios Province, PERU). With a geographical range that extends from ca. 30 degree S to 30 degree N in the New World, all species of *Ozaena* occur in cis-Andean South America, only two ranging farther north: *O. dentipes* Olivier, to Panama; and *O. lemoulti* Banninger to southern Arizona, USA. A reconstructed phylogeny postulates the following: the genus *Platycerozaena* Banninger as the sister-group of *Ozaena*, together these genera comprising the *Ozaena* genus-group; within *Ozaena*, the *O. dentipes* group as sister-taxon of the *O. lemoulti* + *convexa* groups; within the *O. dentipes* group, *O. maxi* as sister-taxon of *O. linearis* Banninger + *dentipes*; within the *O. lemoulti* group, the sequence *O. ecuadorica* Bann. (*O. elavata* Bann. (*O. lemoulti* + *martinezi* Ogueta)); and within the *O. convexa* group, *O. grossa* Bann. as sister-taxon of *O. convexa* Bann. + *manu*. Character evolution involves losses, gains, and shifts, in about equal numbers. Convergence is relatively rare, involving only three of 35 characters. The predominant mode of character evolution is simple, with few examples of sequential changes sustained through several speciation events. Basic modifications in evolution of the groundplan of the *Ozaena* genus-group include reduction or loss (for example, tactile sense organs, antennal cleaner of the fore tibia, and adhesive vestiture of the male fore tarsi), and enhancement or gain (for example, scale-like sensilla basiconica on pronotum and elytra, concentration of sensilla basiconica in groups on the antennomeres, particularly antennomere 11). Within *Ozaena*, many modifications to the antennae and mouthparts indicate the importance of these organs to evolution of the group. Based on phylogenetic relationships and the distribution pattern of the extant species, a reconstructed geographical

history of *Ozaena* postulates the following: first, a vicariance event in South America separating the ancestral stock of *Ozaena* into a northern vicar that gave rise to the *O. dentipes* group, and a southern vicar that gave rise to the *O. lemoulti* and *convexa* groups; followed by cycles of range expansion and contraction that allowed for differentiation of successive stocks of species. The temporal range for these speciation events is estimated to extend over a period of about 12 million years, or from the latter part of the Miocene epoch to the Recent. The most recent speciation events are estimated to be of Pliocene age. Based on lack of differentiation of South American and Middle American representatives of *O. dentipes* and *O. lemoulti* respectively, and extent of range in Middle America, these two species are postulated to be relatively recent invaders of the latter area with *O. dentipes* being the more recent to arrive.

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- Beck, H., M. S. Gaines, J. E. Hines and J. D. Nichols. 2004. Comparative dynamics of small mammal populations in treefall gaps and surrounding understorey within Amazonian rainforest. *Oikos* 106(1): 27. ABSTRACT: Variation in food resource availability can have profound effects on habitat selection and dynamics of populations. Previous studies reported higher food resource availability and fruit removal in treefall gaps than in the understorey. Therefore, gaps have been considered "keystone habitat" for Neotropical frugivore birds. Here we test if this prediction would also hold for terrestrial small mammals. In the Amazon, we quantified food resource availability in eleven treefall gaps and paired understorey habitats and used feeding experiments to test if two common terrestrial rodents (*Oryzomys megacephalus* and *Proechimys* spp.) would perceive differences between habitats. We live-trapped small mammals in eleven gaps and understorey sites for two years, and compared abundance, fitness components (survival and per capita recruitment) and dispersal of these two rodent species across gaps and understorey and seasons (rainy and dry). Our data indicated no differences in resource availability and consumption rate between habitats. Treefall gaps may represent a sink habitat for *Oryzomys* where individuals had lower fitness, apparently because of habitat-specific ant predation on early life stages, than in the understorey, the source habitat. Conversely, gaps may be source habitat for *Proechimys* where individuals had higher fitness, than in the understorey, the sink habitat. Our results suggest the presence of source-sink dynamics in a tropical gap-understorey landscape, where two rodent species perceive habitats differently. This may be a mechanism for their coexistence in a heterogeneous and species-diverse system.
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uses were found for studies carried out at Peru, Mexico, Brazil and Thailand. A low diversity was found for Tonga, and island biogeography theory is used to discuss these results. Sampling effort is evaluated through rarefaction curves. The estimation of the diversity of resources used by native populations may be useful when planning conservation areas and their management.

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- Blundell, A. G. 2004. A review of the CITES listing of big-leaf mahogany. *Oryx* 38(1): 84-90. ABSTRACT: Big-leaf mahogany *Swietenia macrophylla* King (Meliaceae) is the premier timber species of Latin America. A lack of

law enforcement allows widespread illegal logging, and its unsustainable harvest depletes local stocks, necessitating a shift in sources of supply. To better control this exploitation, parties to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) recently elected to list mahogany on Appendix II. This listing requires exporting countries to verify that each shipment was legally acquired and its harvest was non-detrimental to the survival of mahogany. The CITES listing poses considerable challenges: 1) there is no precedent, as mahogany is the first commonly traded timber species listed on Appendix II, and 2) given current, unsustainable logging practices, CITES regulations will be difficult to implement. This paper synthesizes information on the conservation and management of mahogany that informed the listing decision, and provides recommendations for implementation, including timber tracking to ensure legality.

- Blundell, A. G. and R. E. Gullison. 2003. Poor regulatory capacity limits the ability of science to influence the management of mahogany. *Forest Policy and Economics* 5(4): 395-405. ABSTRACT: Decades of research have had virtually no impact on harvesting rates or harvesting practices for mahogany (*Swietenia* spp.), among the most valuable timber species of Latin America. Despite the existence of science-based regulations, mahogany is rapidly and often illegally harvested to the point where its density is so depleted that logging is no longer commercially viable. The lack of influence of science on forest management is not a result of scientific deficiency; rather, it is a political and economic failure to implement existing forest management policies. Until political will and regulatory capacity for enforcement exist or until buyers insist on meaningful verification that shipments were legally obtained, there is little incentive for reform and policies regulating the use of mahogany will not be implemented. Thus, under present conditions, there is little opportunity for science to influence the fate of mahogany. The case study of mahogany provides an excellent example not only of the difficulty for research to inform forest management, but also of demonstrating the key elements necessary for effective implementation of any forest policy. (C) 2003 Elsevier B.V. All rights reserved.
- Blundell, A. G. and B. D. Rodan. 2003. Mahogany and CITES: Moving beyond the veneer of legality. *Oryx* 37(1): 85-90. ABSTRACT: The genuine mahoganies (*Swietenia* spp., Meliaceae) are the most valuable timber species in Latin America. Only one species, bigleaf mahogany *S. macrophylla*, is still traded. Because of concerns regarding logging it is regulated under Appendix III of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). We analyze implementation of CITES regulations by the USA, which is the major importer, comparing CITES statistics with data from US Customs to determine if shipments entering the USA have proper CITES documentation. Based on summary data for 1997-1999 (the most recent available), US Customs reports substantially more mahogany imports than CITES, although > 90% of imports were accompanied by the proper CITES documents. The discrepancies resulted from (1) changes in shipment volume made after permits were issued, (2) data transcription and unit conversion errors, (3) mistaken inclusion of other species in Customs data, and (4) imports that might or might not have been accompanied by the appropriate CITES documents. The analysis demonstrates that the USA is properly implementing CITES requirements. However, mahogany may be smuggled under different species names. Furthermore, the numerous credible reports of widespread illegal mahogany logging suggest that a substantial proportion of US imports might have been obtained in a manner inconsistent with the domestic laws of the exporting countries. Thus illegally obtained mahogany might have been 'legalized' through the CITES process, with Appendix III providing a veneer of legality to what is otherwise illegal wood.
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- Boinski, S. and C. L. Mitchell. 1992. Ecological and social factors affecting the vocal behavior of adult female squirrel monkeys. *Ethology* 92(4): 316-330. ABSTRACT: Focal recordings of the vocalizations of squirrel monkeys, *Saimiri sciureus*, occupying an undisturbed Peruvian habitat were collected to evaluate the importance of both the ecological and social functions of female vocal behavior. The rates and sequences of six call types were examined by context: single, double, and multiple chuck, peep, tweet, and tweet-chuck. In contrast to laboratory studies, our findings emphasize the primacy of ecological functions in the wild, where calling permits females to operate as a convoy of spatially separated individuals in an arboreal habitat where visual contact is limited. Chuck calls are probably best interpreted as contact calls. The rate of chucks and tweet-chucks increased when the nearest adult female was >5 m away. However, call production did not predict a change in the spatial separation between a female and her nearest adult female. During travel, the rate of single and double chucks was greater and the rate of multiple chucks was reduced. No direct relationship was found between foraging activities and vocal behavior. Although secondary, social factors did have a subtle effect on vocal behavior: the larger the social alliance of a female, the lower the rate and repetitiveness of her chuck vocalizations. We also consider the role of variations in vocalization rates among primates and the differing conclusions of field and captive studies of squirrel monkey vocal behavior.
- Boinski, S. and C. L. Mitchell. 1995. Wild squirrel monkey (*Saimiri sciureus*) "caregiver" calls: Contexts and acoustic structure. *American Journal of Primatology* 35(2): 129-137. ABSTRACT: A field study of the vocal behavior of 22 wild adult female squirrel monkeys (*Saimiri sciureus*) in Parque Nacional del Manu, Peru, found that 21% of vocalizations were "caregiver" calls. Caregiver calls are brief, low frequency calls, often with numerous harmonics, that are addressed by caregivers to their own infants in three contexts: 1) prenurse, signalling the caregiver's location and willingness to nurse; 2) nurse, while nursing; and 3) end nurse, indicating the end of the nursing bout. Three measures (start, end, and peak frequency) of the acoustic structure of the fundamental frequency of the caregiver calls significantly differed across the contexts. Duration of caregiver calls, however, was not distinguished by context. Compared to other primate taxa, the specificity and importance of caregiver calls in squirrel monkey vocal behavior appears unusual, if not unique. That *S. sciureus* caregiver calls are highly developed and employed so extensively probably follows from an unusual combination of ecological and life history factors. These factors include delayed weaning and large infant body size, high levels of indirect foraging competition which encourages spatial separation, susceptibility to predation, and specialization on a densely foliated, branch-end microhabitat in which visual contact is often impeded.
- Boinski, S. and C. L. Mitchell. 1997. Chuck vocalizations of wild female squirrel monkeys (*Saimiri sciureus*) contain information on caller identity and foraging activity. *International Journal of Primatology* 18(6): 975-993. ABSTRACT: Analysis of the acoustic signal of the chuck vocalizations of adult female squirrel monkeys (*Saimiri sciureus*) in Parque Nacional de Manu, Peru, revealed consistent differences within and between individuals. We quantified four peak frequency parameters: (a) the peak frequency of single chucks, (b) the first and (c) the second peak frequencies of double chuck, and (d) the peak difference: the difference between the first and the second double chuck peaks. One-way ANOVAs and a posteriori comparisons of these variables revealed that each distinguished more than 70% of all possible pairs of females. When all double chuck measures were included in a discriminant analysis, 57% of double chuck were correctly assigned to the caller. Another category of information potentially encoded in the acoustic structure of chuck vocalizations is foraging activity. When the chuck of squirrel monkeys during foraging and nonforaging activities were compared, the single chuck peak frequency, and the first peak frequency and the peak difference of double chucks, were significantly reduced during foraging contexts. Previously Boinski and Mitchell (1992) concluded that chuck facilitate group cohesion among widely dispersed troop members by providing information of the location of callers; the rate of chuck produced by an adult female increases as she becomes more spatially and visually separated from other adult females. The additional information potentially conveyed by chucks on caller identity and foraging activity documented in these new analyses further emphasizes the role chuck serve to enhance group coordination and cohesion.
- Boinski, S., K. Sughrue, L. Selvaggi, R. Quatrone, M. Henry and S. Cropp. 2002. An expanded test of the ecological model of primate social evolution: Competitive regimes and female bonding in three species of squirrel monkeys (*Saimiri oerstedii*, *S. boliviensis*, and *S. sciureus*). *Behaviour* 139: 227-261. ABSTRACT: Two critical premises underlie prevalent interpretations of the ecological basis of variation among female primate social behavior. The first is that food distribution affects competitive regimes for food experienced by females. This leads, in turn, to the second premise that these competitive regimes generate predictable patterns of female social relationships and residence. Long-term field studies of *S. oerstedii* at Corcovado, Costa Rica and *S. boliviensis* at Manu, Peru (Mitchell et al., 1991) provide what is widely considered as the most powerful

support to date for such an ecological model. The data from these two squirrel monkey field studies are entirely consistent with the various incarnations of the van Schaik (1989) and associates' models linking a cascade of predictions on within- and between-sex social bonds and dispersal patterns to the presence or absence of significant within-group contest competition for food. A key premise of these models is that females tolerate the significant costs of within-group food competition because of the advantages group living affords in reduction of predation risk. In the current study, comparable ecological and behavioral data from long-term field observations of known individuals of *S. sciureus* at Raleighvallen, Suriname are used to expand the test of ecological models to three species. In all three sites female within-group direct competition regimes clearly follow from the distribution of fruit patches. In Suriname, however, *S. sciureus* females exhibit weak social bonds and rarely form coalitions with other females despite frequent, intense, even vicious within-group direct food competition. Although all males appear to emigrate from their natal troops, some females do as well, probably exceeding about 10% of the female group membership annually. Yet the lack of consistency with the expectations of the ecological model is only superficial. In fact, *S. sciureus* is the exception that corroborates the general robustness of predictions made in the ecological model. The fruit patches defended by *S. sciureus*, although small, are usually dense, extremely rewarding and easily defended by the individual with the greatest resource holding potential. Female coalitions to defend fruit patches would not be stable, as one female call ultimately prevail in monopolizing the resource. The lack of reliable foraging benefits to females who form coalitions and the consequent lack of strong female social bonds among female *S. sciureus* are completely concordant with the logical rationale underlying the ecological model.

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- Boul, K. E. 2003. *Call variation and correlated vocal production mechanisms: Intraspecific and interspecific comparisons from the Physalaemus pustulosus species group*. Master's thesis. University of Texas at Austin, Austin, USA. pages. ABSTRACT: Surveys have shown that Physalaemus pustulosus and its sister species, P. petersi, are the only species within the P. pustulosus species group that produce complex calls, or calls with two components. This thesis reveals substantial call variation both within and between populations of P. petersi along a north-south transect. Not only do some populations lack complex calls, but also the variation in the majority of call variables corresponds to a north-south difference, consistent with the species separation of P. petersi and P. freibergi. The details of the variation of the advertisement call and the implications for evolution are discussed within the second chapter. Understanding the evolution of advertisement calls can be aided through understanding the mechanisms associated with call production. Studies have shown that a structure in the larynx, the fibrous mass (FM1), is correlated with complex call production. With the hypothesis that the advertisement call variation mirrors laryngeal variation, the third chapter examines calls and larynges of P. petersi in the western extent of its range and the evolutionary pathways that might have occurred. Additionally, the results of P. petersi were compared with P. pustulosus and a closely related congeneric, P. coloradorum, a species that does not produce complex calls. The FM1 is significantly larger in populations of P. petersi that produce complex calls than those that do not. Even more interesting is the finding that the FM1 sizes of populations of P. petersi were more similar to other species with the same call type than they were to populations of their own species with a different call type. Evolutionary pathways of call complexity and potential mechanisms of how the FM1 may contribute to call complexity are discussed.
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- Brightsmith, D. J. 2000. Use of arboreal termitaria by nesting birds in the Peruvian Amazon. *Condor* 102(3): 529-538. ABSTRACT: I documented the use by nesting birds and availability of arboreal termite nests (termitaria) in the Peruvian Amazon. Birds occupy about 1% of the termitaria annually, suggesting that termitarium availability does not limit reproductive output. Birds choose termitaria that are larger and higher than average, and the three most common termitarium-nesting species differ in their use of termitaria. Two species of *Brotogeris* parakeets use termitaria with similar characteristics, but Tui Parakeets (*B. sanctithomae*) nest in young forests and edge habitats whereas Cobalt-winged Parakeets (*B. cyanoptera*) use mature forests. Termitaria used by Black-tailed Trogons (*Trogon melanurus*) are larger and lower than those used by the two *Brotogeris* species. The contention that birds usually nest in termitaria still occupied by termites was upheld, but the presence or absence of termites did not explain a significant proportion of the difference between used and available termitaria after removing the effects of height, volume, and substrate type. Birds choose to nest in termitaria inhabited by both termites and aggressive biting ants (*Dolichoderus* sp.). These ants may be protecting the birds' nests by attacking predators or by providing a sort of "olfactory camouflage."
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- Brightsmith, D. J. 2004. Effects of weather on avian geophagy in Tambopata, Peru. *Wilson Bulletin* 116: 134-145. ABSTRACT: Geophagy is widespread and well documented for mammals, but avian geophagy has only

recently become the subject of serious scientific investigation. I analyzed data from 606 mornings of observations at a large avian geophagy site or “clay lick” in the southwestern Amazon Basin to examine the effects of weather on bird lick use. Birds used the clay lick on 94% of the mornings without precipitation or fog. Parrots dominated the site in both numbers of species (17) and individuals (.99%). Weather conditions were significantly correlated with total lick use: there was greater use on sunny mornings and less on rainy mornings. Fog and overnight rain were correlated with low lick use. Sun, rain, fog, and overnight rain were recorded on 47, 25, 20, and 8% of the mornings, respectively. I estimated that inclement weather caused an annual 29% reduction in geophagy for all bird species combined. When early morning rain prevented species from using the lick, they did not return later in the day nor did they compensate for rainy mornings by increasing lick use on subsequent days. The timing of lick use and the lack of compensation suggest that neutralization of toxins could be driving lick use in this system.

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- Burnham, R. J. 1993. Reconstructing richness in the plant fossil record. *Palaeos* 8(4): 376-384. ABSTRACT: A comparison of species richness of leaf litter samples derived from a variety of modern forest types provides a means for estimating diversity of source forests in the fossil record. Single samples of temperate forest litter relatively consistently record about three-quarters of the source tree species larger than 10 cm diameter at breast height within the surrounding hectare. Tropical and subtropical samples, in contrast, contain a very small proportion of leaves of the tree species in the surrounding hectare of source forest, and demonstrate that

the forest sampled by a single collection is about 0.1 to 0.125 hectare. Five combined samples from a tropical forest hectare with about 25-m intervals between adjacent samples can be used to extrapolate to hectare-based richness estimates, provided that sufficient specimens are recovered from each site. The major differences in methods needed for reconstruction of source forest richness from forests in different climatic zones indicates that a climatic filter should be applied to estimates of plant diversity in the past.

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- Bush, M. B. and M. R. Silman. 2004. Observations on Late Pleistocene cooling and precipitation in the lowland Neotropics. *Journal of Quaternary Science* 19(7): 677-684. ABSTRACT: Although accurate reconstructions of Amazonian palaeoclimates are central to understanding the distribution and history of Neotropical biodiversity, current reconstructions based on proxy data are discordant and Subject to intense debate. We review some Current thinking in Amazonian climatology and incorporate some new ideas in an attempt to explain the apparently contradictory records of palaeoprecipitation from across the Amazon Basin. We suggest that palaeoecologists need to recognise that organised convective radiation, the process that induces most wet season rainfall in Amazonia, should be treated as a phenomenon related to, but separate from, the passage of the inter-tropical convergence zone (ITCZ). Decoupling ITCZ migration from larger convective activity provides a mechanism to account for observed palaeoclimatic heterogeneity. Patterns of observed precipitation change are consistent with the long-term persistence of closed forest across Much of Amazonia, indicating that the greatest changes in precipitation during the last glacial maximum came during the wet season, which would have little negative impact on forest extent. Neotropical cooling at the last glacial maximum (LGM) is widely accepted, although the estimates of that cooling range between 1degreesC and >5degreesC. In answering the basic question 'What is meant by cooling?' we observe that interhemispheric ice mass asymmetry may have caused cooling to be manifested differently according to location. A terrestrial cooling of ca. 5degreesC, as well as radiative cooling and event-based cooling combined to induce vegetation change. Probably, both absolute temperature and mean monthly minima were reduced by polar air incursions in the northern Neotropics. However, in the southern Neotropics, mean monthly minima were reduced by more frequent incursions of Patagonian air masses, but absolute minima may have been largely unchanged. Copyright (C) 2004 John Wiley Sons, Ltd.
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Peruana de Entomología 38: 23-28. ABSTRACT: Se hace especial referencia a dos especies de insectos comprobados como vectores de la *Leishmanias cutanea andina* o "uta" (*Lutzomia ayacuchensis* y *Lutzomia peruensis*) y a tres considerados como vectores potenciales (*L. tejedori*, *L. verrucarum* y *L. pescei*).

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- Cadle, J., J. Icochea, J. Pérez Zúñiga, A. Portilla and C. Rivera. 2002. La herpetofauna encontrada en el Refugio Juliaca y en el Puesto de Vigilancia Enahuipa del Santuario Nacional Pampas del Heath. Pages 52-57 in J. R. Montambault (ed.), *Informes de las evaluaciones biológicas Pampas del Heath, Perú; Alto Madidi, Bolivia; y Pando, Bolivia*. Conservation International Bulletin of Biological Assessment 24, Washington, DC, USA.
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than when groupmates were visible, even when the quantity of food was very small, and hence not 'sharable'. These results suggest that red-bellied tamarin food calls are not entirely governed by opportunities or inclinations to share food, nor are they solely a function of arousal in the presence of large amounts of preferred food. Red-bellied tamarin food calls may be functionally analogous to those of house sparrows, *Passer domesticus*, which recruit flockmates to the vicinity of the caller. To the extent that a species is dependent on intra-group cohesion for critical daily activities and protection, food calls may benefit the caller by drawing its allies near, even if calling increases feeding competition. (C) 1995 The Association for the Study of Animal Behaviour

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- Cangialosi, K. R. 1990. Social spider defense against kleptoparasitism. *Behavioral Ecology and Sociobiology* 27(1): 49-54. ABSTRACT: Because of the large amount of webbing they provide, social spider colonies often host other satellite spider species referred to as kleptoparasites or food stealers. Such kleptoparasites may take advantage of increased prey capture rates associated with larger spider aggregates. This study investigates the relationship between a cooperatively social spider species, *Anelosimus eximius* (Araneae: Theridiidae), which lives in the undergrowth of tropical rainforest in Peru and its kleptoparasite *Argyrodes ululans* (Araneae: Theridiidae) which specializes in foraging in *An. eximius* webs. Although large aggregates of spiders may be more attractive to kleptoparasites, the benefits of group defense may offset this cost. The aim was to determine whether kleptoparasite success is affected by the number of social spiders that are available for defense. Prey was less likely to be stolen when a greater number of host *An. eximius* spiders were involved in prey capture. When host detected a kleptoparasite earlier and chased it more often, prey was more likely to be successfully defended. *Ar. ululans* was more successful in stealing small prey items in all colonies and gave up more readily on very large prey (>11mm). It is possible to conclude that communal living and group defense in *An. eximius* confer protection from this kleptoparasite.
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- Cangialosi, K. R. 1991. Attack strategies of a spider kleptoparasite: Effects of prey availability and host colony size. *Animal Behaviour* 41: 639-647. ABSTRACT: *Argyrodes ululans*, a kleptoparasitic spider that specializes in stealing prey from the social spider, *Anelosimus eximius*, faces a variety of foraging situations depending upon the number of host spiders involved in prey capture and defense and prey availability. The ability of *Ar. ululans* to modify its mode of attack may therefore be essential to ensure its success in obtaining food. Kleptoparasite hunger level, host colony size and prey size were manipulated and detailed observations of behavior were made to determine whether *Ar. ululans* modifies its stealing strategy in response to these changing conditions. *Ar. ululans* initiated an attack based on its hunger state and the size of the prey captured and altered the relative frequencies of its component stealing behavior patterns according to the number of host spiders that responded to prey capture. These adjustments in stealing tactics allow *Ar. ululans* to maximize its success in acquiring prey and to conserve energy used for foraging.
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zona de Pakitza es comparada con la diversidad de palmeras de Cocha Cashu, utilizando como referencia el Checklist de Plantas del Parque Nacional del Manu elaborado por Robin Foster (1987). Los resultados muestran 26 especies en 16 géneros para Pakitza y 25 especies para Cocha Cashu. También se describe la distribución geográfica, habitat y usos más comunes de todas las especies de palmeras del PNM. La familia de Arecaceas cuenta con aproximadamente 2779 especies (Moore, 1973) que se encuentran distribuidas en todos los trópicos y subtropicos. Para América se calculan alrededor de 800 especies en 71 géneros, todos ellos endémicos, a excepción de *Elaeis* con una especie en Africa Occidental y *Raphia* con una especie en el Nuevo Mundo y otras en Africa (Henderson, 1990). La flora de Arecaceas del Perú fue reactualizada (Kahn et al., 1992), los datos registran 2897 especímenes de herbario, pertenecientes a 35 géneros, de los cuales 33 son nativos y dos introducidos. El 73% de estos está identificado a nivel específico con un total de 152 especies. El 82% de las muestras proviene de departamentos amazónicos, mientras que los departamentos andinos circundantes a la Cuenca Amazónica han sido poco colectados. La familia Arecaceae es la tercera familia con mayor representación dentro de los bosques de Cocha Cashu, PNM (Gentry, 1990). Alrededor de 35 especies, pertenecientes a 22 géneros, fueron colectadas en varios puntos del PNM, de los cuales poco más de 20 crecen en suelos aluviales de reciente formación (Foster, 1987, 1990). Entre éstas se encuentran algunas especies de *Scheelea* y *Astrocaryum*, los cuales juegan un rol de gran importancia para la vida silvestre, como recurso alimenticio durante la época seca (Terborgh, 1983). La información etnobotánica referente a la familia todavía es desconocida para esta zona, a pesar de que la Institución AMETRA (Aplicación de Medicinas Tradicionales), trabajó con algunas comunidades nativas del PNM, la información obtenida por ellos todavía no está disponible.

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- Cintra, R. 1997. A test of the Janzen-Connell model with two common tree species in Amazonian forest. *Journal of Tropical Ecology* 13(5): 641-658. ABSTRACT: Field experiments and survival analysis were used to test whether the Janzen-Connell model operated for two common Amazonian tree species in Peru: the midstorey palm, *Astrocaryum murumuru*, and the canopy-emergent legume, *Dipteryx micrantha*. Seed and seedling survival patterns of these species partially supported the model, depending on tree species, type of predator, spatial scale and the particular year. At a small scale of a 2.5-ha plot, *Astrocaryum* seed predation by insects

and mammals was density-dependent. At a larger scale of 100 ha, *Dipteryx* seed survival increased with distance from conspecific adults, but for *Astrocaryum* seeds there was no distance dependence. At the scale of 200-400 ha *Dipteryx* seed survival was negatively related to the number of individuals present in groups of conspecific adult trees. In 1992 a higher proportion of *Astrocaryum* seedlings survived far from, compared with close to, conspecific adult trees, whilst in 1993 more *Dipteryx* seedlings survived beneath conspecific adult trees than farther away.

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principally on arboreal carton-ant nests. These "ant gardens" (AGs) were most often inhabited by parabiotic ants, *Camponotus femoratus* and *Crematogaster cf. limata parabiotica*, whose polygynous and polydomous colonies fissioned to form extensive AG aggregations. AGs tended by polydomous but probably monogynous *Azteca cf. traili* occurred on average in smaller isolates. All three ant species enriched nest gardens with vertebrate feces, but frequencies of occurrence of most AG epiphytes were lower on the less organic carton of *Azteca* AGs. Interspecific differences in epiphyte abundance and distribution were related to light requirements of plants and to colonizing abilities, as influenced by differences in allocational preference and life history. AG aggregations occupied 16-39% of five forest habitat types present and were especially common in frequently flooded habitats and areas of high light intensity. Patchy distribution was explained partly by overrepresentation on resource trees, such as *Inga* and *Calytranthes* (parabiotic ants) and *Cordia nodosa* (*Azteca*). Habitat associations did not result from reduction of the terrestrial ant fauna in flooded forests. Other arboreal ants, but not terrestrial ants, were markedly lower in AG aggregations than in areas that lacked AGs, perhaps due to competition from aggressive and dominant AG ants. AGs formed principally by directed dispersal of epiphyte seeds to ant nests, where larvae fed on seed attachments without damaging seeds. AG ants also recognized and retrieved seeds of at least one AG epiphyte from feces of vertebrate fruit dispersers. The preference ranking of epiphyte seeds by *Ca. femoratus* was not correlated with either obvious differences in quality of seed appendages or long-term resource potential of plants. Seeds of AG epiphytes were rejected by three ants that do not tend AGs but were collected by a fourth such species. Seed attractiveness may depend in part on nonnutritional cues. Preadaptations of plants and ants appear to have been very important to the origin of AGs. Evidence for evolutionary specialization and coadaptation is circumstantial but suggestive.

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all ants combined. and with carnivory in large-bodied ants only. Exceptional taxa included small-bodied and predaceous *Wasmannia*, with high % N despite high ER, and *Linepithema*, with the lowest % N despite high $\delta^{15}\text{N}$. Patterns in C:N stoichiometry are explained largely at the genus level and above by elemental composition of alarm/defensive/offensive chemical weaponry and, perhaps in some cases, by reduced N investment in cuticle in taxa with high surface:volume ratios. Several consequences of C:N stoichiometry identify *Azteca*. and possibly *Crematogaster*. as taxa preadapted for their roles as prominent associates of myrmecophytes. C:N stoichiometry of ants should be incorporated into models of strategic colony design and examined in a phylogenetic context as opportunities permit.

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- Del Aguila, A. and J. M. Zapater. 1987. Utilización de suelos orgánicos de pantano, "Huertos Amazónicos" en la Zona de Tambopata, Madre de Dios. Pages 51-60 in E. Malpartida and H. Poupon (eds.), *Sistemas agrarios en el Perú*. UNALM/ORSTOM, Lima. ABSTRACT: Este estudio realizado en la ZRT fue motivado por la necesidad de buscar alternativas agrícolas dirigidas a conocer los recursos naturales de selva, para evitar la práctica actual de agricultura migratoria y por lo tanto manejos inadecuados de suelos y bajo rendimiento en las cosechas. Teniendo en cuenta que la mayoría de suelos en selva son ácidos, arcillosos no aptos para la agricultura, se investigó sobre una agricultura que se adaptara a estas condiciones y que sin alterar el ecosistema, permitiera mejorar la producción y así mejorar la alimentación del poblador de la zona. Se investigó para mejorar la fertilidad del suelo mediante la preparación de mezclas de suelos orgánicos aplicados a parcelas pequeñas. Se sembraron cultivos de maíz, maní, tomate, frijoles y otros, en macetas a fin de analizar las mezclas de suelos, posteriormente se sembraron en parcelas para evaluar el rendimiento en comparación del de suelos aluviales. Se encontró que los mejores resultados de mezcla de suelo corresponden a la mezcla de 40% de tierra orgánica de pantano con 60% de suelo del lugar. Las parcelas con suelo orgánico de pantano tuvieron un mayor rendimiento. Se demuestra que existen alternativas viables para la agricultura sin que estas afecten el ecosistema permitiendo obtener buenas cosechas y que la utilización de suelos orgánicos de la zona permite revalorar el potencial productivo del suelo.
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pobladores acostumbrados a una alimentación por muchos años no pueden variar de manera inmediata, sus costumbres. Los suelos son muy diferentes a aquellos que por siempre cultivaron, razón por la cual, el presente estudio trato de buscar una alternativa ecológica de manejo de suelo adecuado, a fin de que al tiempo de mejorar su fertilidad mediante la incorporación de "suelos orgánicos de pantano" y evaluando cultivos hortícolas "Huertos amazónicos", puedan proporcionar al colono una dieta más compleja. Con la implementación de estos huertos familiares se han obtenido resultados tan espectaculares que es imprescindible continuar dichas investigaciones a fin de corroborar que el éxito no sea sólo de la primera observación, sino que la fertilidad demostrada pueda ser mantenida o aun mejorada en forma sostenida.

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- Doan, T. M. 2003. Which methods are most effective for surveying rain forest herpetofauna? *Journal of Herpetology* 37(1): 72-81. ABSTRACT: Although several investigators have discussed different herpetofaunal sampling methodologies and their effectiveness, few have quantitatively examined which methods are superior for inventorying reptiles and amphibians in rain forest habitats. I examined two years of data from Tambopata, southeastern Peru, to compare and contrast visual encounter survey (VES) and quadrat methodologies and to determine which method yields the highest number of individuals and species per sampling effort. Four separate questions were posed concerning the number of captures for short-term surveys, long-term surveys,

arboreal versus terrestrial amphibian surveys, and particular taxonomic group surveys. Over most of the analyses, more individuals and species of amphibians and reptiles were captured using VES than quadrats. In addition, more unique species were recorded with VES. However, particular microhabitats and taxonomic groups were better sampled with quadrats. In long-term surveys, the methods were equivalent with respect to number of individuals and species captured. This study provides quantitative data on the efficacy of the two methods and describes, for the first time, the particular instances in which the different methods are best suited for sampling rain forest herpetofauna.

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Running likely serves to distribute a pheromone, since the information flow between "runners" and "recruits" can be disrupted by eliminating air exchange, while leaving other potential means of communication intact. In addition, nectar stores in the nest may be monitored continuously. A sudden influx of nectar into the nest also causes measurable increases in forager activity. The implications of bumblebee recruitment behavior for the evolution of communication in bees are discussed.

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- Dyrce, A. 1987. Observations at a nest of Pale-legged Hornero in southeastern Peru. *Journal of Field Ornithology* 58(4): 428-431. ABSTRACT: A nest of a pale-legged hornero (*Furnarius leucopus*) was discovered in a floodplain forest close to the La Torre river in the TRZ; and the activity of a couple of this species was registered. The mud-made nest, was built on a branch of a *Cecropia* tree near the edge of an oxbow lake. The nest was approximately 50% built when it was found. Then, the birds laid probably two eggs and after 16-17 days they hatched two young birds. The nestling period lasted 26-33 days (one of the nestlings left the nest first), this could be because of the safety of the nest which seems to be inaccessible to predators. Adults feeding their young birds were also observed and the frequency of this activity was registered, finding that the young birds were fed infrequently.
- Dyrce, A. 1987. Fat deposits and molt of birds mist-netted in southeastern Peru. *Journal of Field Ornithology* 58(3): 306-310. ABSTRACT: In the middle of the rainy season (November-February), in the TRZ, 600 individuals of 111 bird species were captured using mist-nets. Fat deposits occurred in 251 individuals of 67 species and 20 families. These deposits never reach the maximum found in previous studies on migratory birds of the temperate zone. The highest percentage of individuals with fat deposits fell in the Pipridae family. The percentage was also high in the Dendrocolaptidae, Turdidae, Formicariidae and Thraupidae families; and low in Trochilidae, Ramphastidae and Furnariidae. Near 50% of the birds examined were molting. There was an increase in the proportion of molting birds near February. Fat deposition was negatively correlated with molt. The data confirm that tropical birds and those of temperate zones have similar quantities of fat deposits. This suggests that even though the tropical birds have lower energy demands than those of the temperate zones, they store reserves; since molting and breeding require energy as well as when the seasonal changes of the environment affect the availability of resources.
- Dyrce, A. 1990. Understorey bird assemblages in various types of lowland tropical forest in Tambopata Reserve, SE Peru (with faunistic notes). *Acta Zoologica Cracoviana* 33(11): 215-233. ABSTRACT: Understorey bird assemblages were studied at TRZ during the first half of the rainy season (Nov. 1985 - Feb. 1986). The evaluation was done in four types of forests: lower floodplain forest, upper floodplain forest, upland forest type 1 and upland forest type 2, which represent a vegetation gradient. The abundance of birds and relative wing length decreased, whereas species diversity and the degree of sedentariness increased along this gradient. The ant-followers were more common in upper forests, whereas hummingbirds and manakins were more abundant in floodplain forest. The birds were mist-netted, identified, color-banded and released. 127 species were captured, which in comparison to other places (Panamá, Costa Rica) represents an unusual species richness. The data suggest that there is a considerable overlap of more numerous species between three of the studied forest types. A list of birds is also presented, with notes concerning biometry and breeding.
- Dyrce, A. 1991. Observations on nesting and nestling growth in the Rusty-margined Flycatcher *Myiozetetes cayanensis* in southeastern Peru. *Bulletin of the British Ornithological Club* 111(1): 33-35. ABSTRACT: New data on the breeding of rusty-margined flycatcher (*Myiozetetes cayanensis*) is presented, which contributes to add information on the biology of this species. The study was made at the ends of 1985 at TRZ, where two nests were found at the edge of an oxbow lake, they were situated on small bushes growing in the water. The first nest had two eggs and only one hatched; and this nestling development was observed. Biometry data were taken and behavior observations were made. The second nest had three eggs, but they disappeared, the couple

tried to make a new nest but the water level in the river increased and the whole area was flooded. Additionally, a growth curve of this species is described.

- Easley, S. P. 1984. Diet and territory in *Callicebus torquatus*. *American Journal of Physical Anthropology* 63(2): 154-155.
- Easley, S. P. and W. G. Kinzey. 1981. Territorial shift in *Callicebus torquatus*. *American Journal of Physical Anthropology* 54(2): 216-216.
- Easley, S. P. and W. G. Kinzey. 1986. Territorial shift in the yellow-handed titi monkey (*Callicebus torquatus*). *American Journal of Primatology* 11(4): 307-318.
- Eason, P. 1989. Harpy Eagle attempts predation on adult howler monkey. *Condor* 91(2): 469-470.
- Eason, P. 1992. Optimization of territory shape in heterogeneous habitats: A field study of the red-capped cardinal (*Paroaria gularis*). *Journal of Animal Ecology* 61(2): 411-424. ABSTRACT: Models were developed to examine two factors that may influence optional territory shape in heterogeneous habitats, resource availability and defence costs. These models were tested in a study of a population of red-capped cardinals (*Paroaria gularis*, L.) in Manu National Park, south-eastern Peru. Cardinals defend territories along the shores of oxbow lakes and rivers, with each territory containing two short stretches of shore that are on opposite sides of the water. Analysis of samples of arthropod prey showed no differences between the two shores, allowing the foraging model to be rejected and indicating that resource distributions do not determine the shape of the cardinals' territories. The probability of detecting an intruder on the same shore decreased with increasing distance from the territory owner. Intruders on the shore opposite the territorial pair were more likely to be detected immediately than were intruders on the same shore. Intruders detected immediately were easier to evict than intruders that were not detected immediately, and intruders tended to avoid the shore opposite the territorial pair. The data supported the defence model: reduction in defence costs due to increased intruder detectability appears to be that factor that favours the inclusion of two shores in each cardinal territory. I suggest that in patchy habitats, the effects of defence costs may result in territories that are suboptimally shaped for foraging, and that defense considerations should be included in future studies of territory shape.
- Eason, P. K. 1991. *The effect of habitat structure and visibility on territory shape and space use: Theoretical and empirical studies*. Dissertation. University of California-Davis, Davis, USA. pages.
- Eason, P. K. and P. T. Sherman. 1995. Dominance status, mating strategies and copulation success in cooperatively polyandrous White-winged Trumpeters, *Psophia leucoptera* (Aves, Psophiidae). *Animal Behaviour* 49(3): 725-736. ABSTRACT: In groups of white-winged trumpeters, dominant and subordinate males used different strategies to obtain copulations with the dominant, breeding female. The dominant male initiated copulation attempts slowly and often copulated when subordinate males were standing nearby; in contrast, subordinate males tended to copulate rapidly and surreptitiously, taking advantage of moments when the dominant male was relatively far from the female or engaged in an activity that made it difficult for him to watch the female. The dominant male usually interrupted subordinates' copulation attempts aggressively and always interrupted alone. Subordinate males, however, generally interrupted the dominant simply by approaching him, and collaborated in 19% of their interruptions. Although the dominant male obtained significantly more successful copulations than did subordinate males during the breeding female's fertile period, subordinate males still accounted for one-third of the successful copulations during this period. While relatively few birds or other vertebrates have been reported to breed polyandrously, it is suggested that the frequency with which multiple males sire offspring within a group may be underestimated because of the difficulty of observing copulations by subordinate males in many multi-male groups.
- Eckhardt, K., C. Rodríguez, D. Rodríguez, M. Rivera, M. Espinoza, A. M. Torres, E. Fischer and J. Carilla. 2004. Abundancia y riqueza de ácaros asociados a flores de seis especies de plantas visitadas por colibríes. Pages 91-94 in Servat, G., D. Cadena, K. Balta, and C. García-Robledo (eds.), unpublished compendium of student projects from the OTS course "Ecología de ecosistemas amazónicos 2004-13," sponsored by the Universidad Nacional de la Amazonía Peruana, Centro Amazónico de Educación Ambiental e Investigación & the Organization for Tropical Studies.
- Egido, J. M., J. A. De Diego and P. Penin. 2001. The prevalence of enteropathy due to strongyloidiasis in Puerto Maldonado (Peruvian Amazon). *The Brazilian Journal of Infectious Diseases* 5(3): 119-123. ABSTRACT: Human strongyloidiasis is an important health problem in the southeast region of Peruvian Amazon, due to its prevalence and long term morbidity. An epidemiological study was conducted in the Peruvian Amazon area of Puerto Maldonado to determine the prevalence of strongyloidiasis in the population. Stool samples were collected from 1,133 patients at the outpatient department of our clinic. Strongyloidiasis affected 221

examined patients (20%). Prevalence was highest in males, mostly in children and elderly men. People living in urban and marginal urban areas, those coming from outside the region, and Andean people, showed the highest prevalences. Pre-school children were more likely to be parasitized than older children. The most common symptoms were diarrhea (55%), abdominal pain (32%) and cough (53%). One in seven (13%) affected patients presented with moderate or severe symptoms, including life-threatening complications. Other intestinal parasites were found frequently in patients diagnosed with strongyloidiasis. Improved human waste disposal services are considered to be the main requirement to reduce the high prevalence of this disease.

Ellison, K. 2003. Renting: The conservation concessions approach. *Conservation Biology in Practice* 4(4): 20-29.

Elorrieta, T. 1938. Los machiguenga y los animales domésticos. *Misiones Dominicanas del Perú* 20(107): 151-153.

Emmons, L. and M. Romo. 1994. Mammals of the upper Tambopata/Távora. Pages 46-47, 140-143 in R. B. Foster, J. L. Carr and A. B. Forsyth (eds.), *The Tambopata-Candamo Reserved Zone of southeastern Peru: A biological assessment*. Conservation International, Washington, DC, USA.

Emmons, L. H. 1981. Morphological, ecological, and behavioral adaptations for arboreal browsing in *Dactylopsilus dactylinus* (Rodentia, Echimyidae). *Journal of Mammalogy* 62(1): 183-189. ABSTRACT: The few available data on the bamboo rat (*Dactylopsilus dactylinus*) have been limited to scarce collections, reports on its calls and the stomach contents of a single specimen. In this contribution, a set of characteristics which seems to be specific adaptations to its completely arboreal browsing habits is offered. The call behavior of this species was monitored at TRZ (December 1979). Previous data were obtained at Limoncocha, Ecuador (Sept.-Dec. 1977) and Cocha Cashu, Manu National Park, Peru (Jul.-Aug. 1978). The species' morphology shows some external features, being the most remarkable the primatelike feet but with some particularities. Musk glands are also present, which distinctive odor can be often smelled where bamboo rats were common. Other internal features such as enlarged larynx in males and digestive tract are described. Some differences on the habitats of the studied localities were found, although in all three cases individuals were registered in waterside and floodplain zones. The call behavior of *D. dactylinus* was also studied and sonograms were obtained in all three localities. *D. dactylinus* is one of the smallest neotropical arboreal folivores and to cover its energy requirements, has to process its digestive contents at rapid rates and for this reason eats only those plants that can be digested quickly (it has a highly selective diet). In conclusion, this features converge with those of arboreal browsing genera from at least four other mammalian orders, suggesting strong adaptive constraints on the mammals of this feeding guild.

Emmons, L. H. 1982. Ecology of *Proechimys* (Rodentia, Echimyidae) in southeastern Peru. *Tropical Ecology* 23(2): 280-290. ABSTRACT: Aspects of the ecology of *Proechimys brevicauda*, *P. longicaudatus* and *P. hendeei* in southeastern Peru were studied by means of trapping, radiotelemetry, censuses by transect and analysis of feces. These species are associated with mature forest with dense understory. The density of *Proechimys* varied over the range 0-4.2 individuals per hectare. The home range of *Proechimys brevicauda* and *P. hendeei* are completely superimposed on one another. The adjacent home ranges of five adult females of *P. brevicauda* were mutually exclusive; the home range of the males are superimposed on those of the females, but too few males were captured to determine their distribution relative to one another. The animals spend the day in thickets and do not burrow. Their diet includes palm nuts, mycorrhizal fungi and seeds of climbing plants with aerial distribution. It has been proposed that small home ranges and high population densities (and also the absence of species in marginal habitats) correlate with the concentration of food, mainly seeds and fungi. This investigation was carried out mainly in Manu National Park, in the vicinity of the Biological Station of Cocha Cashu (*Proechimys hendeei* and *P. brevicauda*), but it has been complemented with information from TRZ (*Proechimys hendeei* and *P. longicaudatus*): its results include information on habitats, densities and biomass, nocturnal movements, seasonal home ranges, situation of hiding places and alimentary habits. In spite of the fact that more information is required, especially from other localities, the hypothesis that explains the distribution of *Proechimys* as a function of ecological determinants (resource and habitat availability) seems justified so far.

Emmons, L. H. 1984. Geographic variation in densities and diversities of non-flying mammals in Amazonia. *Biotropica* 16(3): 210-222. ABSTRACT: The results of the evaluation of non-flying mammals at seven localities of Ecuador, Brazil and Peru (Cocha Cashu, Yanamono, Mishana and Tambopata) are presented. Trapping and transect census were made during day and night, in localities of mature ever green tropical forest. The objective was to compare the relative number of individuals and species of mammals of the studied localities. The relative number of individuals from small species varies substantially from one locality to another, while the large species remain constant. The variation pattern of the number of species observed is reflected in the differences of species richness between the western Amazonia and the Guiana Shield region of Brazil, suggesting that similar environmental facts will regulate the number of species and of individuals in one locality. Soil fertility and undergrowth density are positively correlated with the density and species richness of

mammals in a locality, but pattern of rainfall does not seem to account for any of the observed differences. Competition, home range size and diet are discussed as possible causes of differential reduction in density and species richness of small, compared to large species in unfavorable habitats. It is also observed that in the studied localities, hunting has exterminated or severely reduced populations of large mammals, especially primates.

- Emmons, L. H. 1987. Comparative feeding ecology of felids in a Neotropical rainforest. *Behavioral Ecology and Sociobiology* 20(4): 271-283.
- Emmons, L. H. 1987. Jungle cruisers. *Animal Kingdom* 90: 22-30.
- Emmons, L. H. 1988. A field-study of ocelots (*Felis pardalis*) in Peru. *Terre et Vie* 43(2): 133-157.
- Emmons, L. H. 1989. Jaguar predation on chelonians. *Journal of Herpetology* 23(3): 311-314.
- Emmons, L. H. 2001. Mammals of Los Amigos. Unpublished report for the Asociación para la Conservación de la Cuenca Amazónica.
- Emmons, L. H., C. Ascorra and M. Romo. 1994. Mammals of the Río Heath and Peruvian pampas. Pages 69-71, 146-149 in R. B. Foster, J. L. Carr and A. B. Forsyth (eds.), *The Tambopata-Candamo Reserved Zone of southeastern Peru: A biological assessment*. Conservation International, Washington, DC, USA.
- Emmons, L. H. and M. A. Dubois. 2003. Leaf-area index change across river-beach successional transects in south-eastern Peru. *Journal of Tropical Ecology* 19: 473-477.
- Emmons, L. H. and A. H. Gentry. 1983. Tropical forest structure and the distribution of gliding and prehensile-tailed vertebrates. *The American Naturalist* 121(4): 513-524. ABSTRACT: Prehensile tails and gliding have arisen only in certain taxonomic groups which could occur only on certain continents as a result of biogeographic history, e.g., no marsupials in Africa or flying squirrels in the Neotropics. The simultaneous occurrence of these adaptations in a number of unrelated vertebrate families in some regions but not in others, even when the same families are present, and the parallel appearance of the same characters in ecological equivalents belonging to different orders or families (e.g., Manis and Tamandua; Potos and Arctictis and Anomalurus, Petaurista, Schoinobates and Cynocephalus) suggests that the biogeographic patterns of these adaptations are the result of more than chance. Different forest structures in different parts of the world are correlated with different modes of locomotion by arboreal vertebrates. Scarcity of lianas in tropical Asia favors the long distance strategy of gliding; high liana frequency in tropical Africa correlates with a lack of specialized locomotory adaptations for inter-tree movement; many palms, an intermediate number of lianas and perhaps generally more fragile branches in the Neotropics are associated with prevalence of prehensile tails.
- Emmons, L. H., P. Sherman, D. C. Bolster, A. W. Goldizen and J. Terborgh. 1989. Ocelot behavior in moonlight. *Advances in Neotropical Mammology* 1989: 233-242.
- Emmons, L. H. and N. M. Stark. 1979. Elemental composition of a natural mineral lick in Amazonia. *Biotropica* 11(4): 311-313.
- Encarnación C., F. and E. W. Heymann. 1998. Body mass of wild *Callimico goeldii*. *Folia Primatologica* 69(6): 368-371.
- Encarnación, F. 1985. Introducción a la flora y vegetación de la Amazonía peruana: Estado actual de los estudios, medio natural y ensayo de claves de determinación de las formaciones vegetales en la llanura amazónica. *Candollea* 40(1): 237-252.
- Encarnación, F. 1990. Informe preliminar sobre censo de primates no humanos en el Sur Oriente Peruano: Iberia e Iñapari (Departamento de Madre de Dios), Mayo 15 - Junio 14, 1978. Pages 57-67 in N. E. Castro-Rodríguez (ed.), *La primatología en el Perú: Investigaciones primatológicas (1973-1985)*. Proyecto Peruano de Primatología "Manuel Moro Sommo", Lima.
- Encarnación, F. 1993. El bosque y las formaciones vegetales en la llanura amazónica del Perú. *Alma Mater* 6: 95-114.
- Enriquez, L. and P. Morante. 2002. *Impacto de la actividad turística en la Zona Reservada del Parque Nacional del Manu*. Licenciatura thesis. Facultad de Turismo, Universidad San Antonio Abad del Cusco, Cusco. pages.
- Ericsson, S. 1936. La conexión entre los ferrocarriles del sur y los ríos navegables del oriente por carretera. *Boletín de*

la Sociedad Geográfica de Lima 53(2-3): 140-163.

- Ernst, C. H. 1983. Geographic variation in the Neotropical Turtle, *Platemys platicephala*. *Journal of Herpetology* 17(4): 345-355.
- Ernst, C. H. and J. E. Lovich. 1986. Morphometry in the chelid turtle, *Platemys platycephala*. *Herpetological Journal* 1(2): 66-70.
- Erwin, T. 1983. Tropical forest canopies: The last biotic frontier. *Bulletin of the Entomological Society of America* 29(1): 14-19.
- Erwin, T. 1991. Establishing a tropical species co-occurrence database. Part 1: A plan for developing consistent biotic inventories in temperate and tropical habitats. *Memorias del Museo de Historia Natural Javier Prado* 20: 1-16.
- Erwin, T. and M. Kabel. 1991. Establishing a tropical species co-occurrence database. Part 2: An automated system for mapping dominant vegetation. *Memorias del Museo de Historia Natural Javier Prado* 20: 17-36.
- Erwin, T. and D. L. Pearson. 1991. Establishing a tropical species co-occurrence database. Part 3: An integrated approach toward understanding biological diversity. *Memorias del Museo de Historia Natural Javier Prado* 20: 37-45.
- Erwin, T. L. 1982. *Agra*, arboreal beetles of Neotropical forests: *Agra platyscelis* group systematics (Carabidae). *Systematic Entomology* 7(2): 185-210. ABSTRACT: This paper is the second in a series covering taxonomically all species-groups of *Agra*, whose cumulative ranges extend from southernmost Texas (USA) to northernmost Argentina. A clear understanding of their phylogeny and distribution may provide good data with which to test recently proposed hypotheses of tropical species richness and endemism, particularly the forest refugium and flood-zone hypothesis. New methods of description are used in the series to cover the several hundred species in less time and space, to provide a consistent numerical data base for those who choose to use it and to use more efficiently and effectively the descriptive process. Four new combinations are made: *A. baccii* (Straneo), *A. platyscelis* (Chaudoir), *A. guyanensis* (Chaudoir) and *A. semiviridis* (Straneo). All these species were originally placed in *Agridia*. One synonymy was detected; *A. clangoris* Liebke is a junior synonym of *A. guyanensis* (Chaudoir). Sixteen new species of *Agra* are described from the following type-localities: *A. howdenorum* (Simla, 5.0 miles north of Arima, Trinidad, West Indies), *A. ecaligis* (Rio Bobonanza, Mentalva, Ecuador), *A. yodella* (Gourdonville, French Guiana), *A. limulus* (Tarapoto, Peru), *A. tumatumari* (Rio Potaro, Tumatumari, Guyana), *A. varzeicola* (Parana Costa da Ilha de Curari (Rio Solimoes), Amazonas, Brazil), *A. ariasi* (Reserva Ducke, 26.0 km northeast of Manaus, Amazonas, Brazil), *A. olivencana* (Sao Paulo d'Olivencia, Amazonas, Brazil), *A. iquitosana* (Iquitos, Peru), *A. tarapotoana* (Tarapoto, Peru), *A. titan* (type area: French Guiana), *A. seabrae* (Mangabeira, near Mocajuba, Para, Brazil), *A. caliga* (Barro Colorado Island, Canal Zone, Panama) *A. yeti* (Rosario Oeste, Minas Gerais, Brazil), *A. sasquatch* (Belem, Para, Brazil) *A. azureipennis* (type are: northern Venezuela). Three subgroups containing 21 spp. are fully discussed. Their cumulative range extends from Panama south to Bolivia, east to the mouth of the Amazon River and north along the coast of the Guyanas; most species are very locally distributed. A dot map illustrates the range of each taxon. Distribution and relationships are discussed in general, but detailed cladistic analysis is deferred until taxonomy of the five groups of section *Erythropus* is completed. Species distributions correspond to Pleistocene refuges suggested by other authors based on other classes of organisms.
- Erwin, T. L. 1984. Small terrestrial ground beetles of the Amazon Basin (Coleoptera: Bembidiini: *Tachyina* and *Anillina*). *Amazoniana* 8(4): 511-518. ABSTRACT: Five new species and one new genus are described for the purpose of providing names for species in ecology studies of small terrestrial ground-beetles in Amazonian Brazil and Peru. The taxa are as follows: MOIRAINPA amazona gen. et sp. nov., Brazil, Amazonas, Manaus vcn., Rio Solimoes, Curari Island 03 degree 15'S to 59 degree 49'W; the new species *Polyderis moira*, *P. ucavali* and *P. nympha*, Peru, Huanuco, Panguana Biological Station, Rio Yuyapichis, 09 degree 37'S to 74 degree 56'W; *P. terra*, Brazil, Para, Utinga tract near Belem, 01 degree 27'S to 48 degree 29'W. A key is provided for their identification and distributions of the taxa summarized.
- Erwin, T. L. 1985. Tambopata Reserved Zone, Madre de Dios, Peru: History and description of the reserve. *Revista Peruana de Entomología* 27: 1-8.
- Erwin, T. L. 1988. The tropical forest canopy: The heart of biotic diversity. Pages 123-129 in E. O. Wilson (ed.), *Biodiversity*. National Academy Press, Washington, DC.
- Erwin, T. L. 1989. Canopy arthropod biodiversity: A chronology of sampling techniques and results. *Revista Peruana de Entomología* 32: 71-77.

- Erwin, T. L. 1991. Natural history of the carabid beetles at the BIOLAT Biological Station, Rio Manu, Pakitza, Peru. *Revista Peruana de Entomología* 33: 1-85.
- Erwin, T. L. 1994. Arboreal beetles of tropical forest: The Xystosomi group, subtribe Xystosomina (Coleoptera: Carabidae: Bembidiini): Part I. Character analysis, taxonomy, and distribution. *Canadian Entomologist* 126(3): 549-666. ABSTRACT: A group of subarboreal tropical beetles, the Xystosomi of subtribe Xystosomina new subtribe, is revised and reclassified based on a reevaluation of structural characters. Xystosomi are found in tropical Australia (Queensland) and tropical/subtropical America (Guerrero, Mexico, to Aguas Blancas, Argentina). The largest concentration of species occurs near the equator in the Amazon Basin, but a significant radiation of flightless forms was recently discovered in the northern Andes of Colombia, Ecuador, and Venezuela. Xystosomina also includes the Mioptachyi, which at present is composed of the genera Mioptachys and Inpa. Seventy-six species of Neotropical and Australian Xystosomi are described or redescribed, illustrated, or keyed. This assemblage includes 12 classic species, 24 species described in the last three decades, and 40 new species, a six-fold increase since the time of Henry Walter Bates, the last 19th-century entomologist to study this remarkable lineage of carabid beetles. The Xystosomi are now arrayed in five genera: Philipis gen. nov. (type: Tachys trunci Darlington, Australia), Geballusa gen. nov. (type: Xystosomus microtretus Erwin, Costa Rica), Gouleta gen. nov. (type: Bembidion cayennense Dejean, Brazil), Batesiana gen. nov. (type: Xystosomus gruti Bates, Brazil), and Xystosomus Schaum (type: Xystosomus inflatus Schaum, Brazil). The following specific taxa are described as new (type-locality in parentheses): Geballusa rex (Brazil: 06 degree 02'N 050 degree 17'W), oligotreta (Panama: 08 degree 40'N 079 degree 56'W), nannotreta (Brazil: 02 degree 54'S 059 degree 57'W), Gouleta gentryi (Peru: 12 degree 50'S 069 degree 20'W), Batesiana para (Brazil: 01 degree 22'S 048 degree 20'W), angustia (Peru: 05 degree 08'S 074 degree 45'W), samiria (Peru: 05 degree 08'S 074 degree 45'W), esheje (Peru: 05 degree 08'S 074 degree 45'W), crassa (Peru: 03 degree 15'S 072 degree 55'W), notesheje (Peru: 03 degree 15'S 072 degree 55'W), manusculptilis (Peru: 12 degree 07'S 070 degree 58'W), parapara (Brazil: 02 degree 28'S 046 degree 26'W), am (Peru: 05 degree 08'S 074 degree 45'W), indetecticostis (Ecuador: 00 degree 57'S 077 degree 48'W), nox (Ecuador: 00 degree 57'S 077 degree 48'W), parkeri (Peru: 03 degree 15'S 072 degree 55'W), hamatilis (Ecuador: 01 degree 02'S 077 degree 40'W), notparkeri (Colombia: 00 degree 08'N 075 degree 51'W), pfunorum (Peru: 03 degree 15'S 072 degree 55'W), quadrata (Peru: 03 degree 15'S 072 degree 55'W), protosculptilis (Peru: 12 degree 50'S 069 degree 20'W), misahualli (Ecuador: 01 degree 02'S 077 degree 40'W), depressisculptilis (Ecuador: 01 degree 02'S 077 degree 40'W), irisculptilis (Ecuador: 00 degree 24'S 076 degree 37'W), foveosculptilis (Brazil: 02 degree 28'S 046 degree 26'W), punctisculptilis (Peru: 03 degree 15'S 072 degree 55'W), eugeneae (Peru: 11 degree 56'47"S 071 degree 17'00W), anchicaya (Colombia: 03 degree 43'N 076 degree 57'W), jefe (Panama: 09 degree 12'N 079 degree 21'W), exigupunctata (Peru: 05 degree 08'S 074 degree 45'W), rosebudae (Ecuador: 00 degree 57'S 077 degree 48'W), equanegrei (Ecuador: 00 degree 57'S 077 degree 48'W), henryi (Ecuador: 00 degree 28'S 077 degree 53'W), baeza (Ecuador: 00 degree 57'S 077 degree 48'W), huacamayas (Ecuador: 00 degree 28'S 077 degree 53'W), dannyi (Ecuador: 00 degree 57'S 077 degree 48'W), alticola (Colombia: 04 degree 21'S 074 degree 22'W), jacupiranga (Brazil: 24 degree 42'S 048 degree 00'W), chiriboga (Ecuador: 00 degree 15'S 078 degree 44'W), wygo (Colombia: 04 degree 53'N 074 degree 31'W). The following names are resurrected from synonymy for good species: hilaris Bates and belti Bates. Several names combinations were changed as a result of the generic reorganization: Philipis trunci (Darlington), Geballusa microtreta (Erwin), G. polytreta (Erwin), Gouleta notiophiloides (Erwin), G. spangleri (Erwin), G. cayennense (Dejean), Batesiana bisulcifrons (Erwin), B. negrei (Erwin), B. hilaris (Bates), B. belti (Bates), B. ampliata (Bates), B. strigosa (Bates), B. gruti (Bates), B. nigripalpis (Erwin), B. villiersi (Peffault), B. apicisulc
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1, 04 degrees 30'S, 74 degrees 18'W); *A. conhornigas* new species, (PERU, Madre de Dios, 30 air km SW Puerto Maldonado, Rio Tambopata Res., 12 degrees 50'S, 69 degrees 20'W); *A. lilu* new species, (BRAZIL, Amazonas, Humaita, 07 degrees 32'S 63 degrees 02'W); *A. lindae* new species, (PERU, Madre de Dios, 30 air km SW Puerto Maldonado, Rio Tambopata Res., 12 degrees 50'S. 69 degrees 20'W); *A. rondonia* new species, (BRAZIL, Rondonia, Ariquemes, 9 degrees 56'S, 63 degrees 03'W); *A. ner* new species, (BRAZIL. Amazonas. 2km N Itacoatiara-Manaus Highway, 11 hn, W of Itacoatiara, Canadian Fathers' Pool, 03 degrees 08'S, 58 degrees 28'W); *A. manu* new species, (PERU, Madre de Dios, Manu Biosphere Res., Pakitza, 11 degrees 56'S, 71 degrees 17'W); *A. dnr* new species, (PANAMA, Canal Zone, Barro Colorado Is., 09 degrees 10'N, 79 degrees 50'W). The females of *A. iquitosana* Erwin and *A. sasquatch* Erwin, and the male of *A. varzeicola* Erwin are described and illustrated for the first time. A revised key and checklist are provided and distributions of all 33 species are dot-mapped. A general discussion for each of the new species, as well as for 12 additional species for which new locality records were found (*A. klugii* Brulle, *A. limulus* Erwin, *A. varzeicola*, *A. iquitosana*, *A. tarapotana* Erwin, *A. titan* Erwin, *A. platyscelis* (Chaudoir), *A. caliga* Erwin, *A. feti* Erwin, *A. semiviridis* (Straneo), *A. sasquatch* Erwin, and *A. azureipennis* Erwin) is included. Remarks on systematics and biogeography based on the newly described specimens are provided.

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- Flores, C. F. 2001. Cuando las áreas naturales protegidas no guardan recursos para el mañana, sino para hoy: El caso del cedro rojo ribereño (*Cedrela odorata* L.) en el Manu. Pages 100-100 in L. O. Rodríguez (ed.), *El Manu y otras experiencias de investigación y manejo de bosques neotropicales*. Proyecto Aprovechamiento y Manejo Sostenible de la Reserva de Biosfera y Parque Nacional del Manu (PRO-MANU), Lima.
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Influencia de la iluminación de copas. *Revista Forestal del Perú* 20(1): 63-74. ABSTRACT: Mediante el empleo de mínimos cuadrados, se ha construido un modelo de regeneración para explicar el comportamiento del incremento diamétrico, en función del tamaño y la iluminación de copas. La iluminación de copas, al ser incluidas en el modelo, explica mejor la variabilidad observada en el incremento diamétrico. Sin embargo, el modelo construido no explica una fracción importante de la variabilidad total de dicho incremento ($R^2 = 0,464$). Se especula que la variabilidad no explicada se debe a la influencia de los factores genéticos y a la edad que está inadecuadamente expresada en el tamaño.

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Flores N., C. and J. Díaz G. 1995. Especies maderables seleccionadas en el ámbito de la Reserva de Biósfera del Manu. *Revista Forestal del Perú* 22(1-2): 75-82. ABSTRACT: En base a los sistemas selectivos de manejo forestal sugeridos por De Graff (1986) y Hutchinson (1987b), se presentan cuatro grupos de especies según el valor actual y/o potencial de ellas en el mercado. Las especies de valor que han sido seleccionadas suman 43, mientras que actualmente se emplean solo alrededor de 20.

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Flores Negrón, C. F. 1990. *Caracterización de brinzales de Cedrela odorata L. en las áreas inundables cercanas a Cocha Cashu, río Manu*. Thesis for the degree of Ingeniero Forestal. Universidad Nacional Agraria La Molina, Lima. 140 pages.

Flores Negrón, C. F. 1998. Distribución y suelos asociados a *Cedrela odorata L.* y *Cedrela fissilis Vell.* en el Parque Nacional del Manu: Informe de trabajo para el año 1997. Unpublished report of unknown provenance. 12 pages.

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Flores, W. B. C., H. Noda and C. R. Clement. 1990. Genetic/phenotypic studies on spines in Pejibaye (*Bactris gasipaes* H.B.K. palmae). *Revista Brasileira de Genética* 13(2): 305-312. ABSTRACT: The pejibaye, an Amazonian palm widely used for food, is starting to be genetically improved. Twenty-eight open pollinated plants were randomly sampled from a spineless stemmed sub-population from Yurimaguas, Peru, and their progeny were evaluated in a randomized block design with 4 repetitions. The character "petiole/rachis spines" showed high hereditabilities, both narrow sense (0.36) and wide sense (0.77), while the characters "leaflet edge spines" showed medium (0.26 and 0.60, respectively) and "leaflet nerve spines" showed low (0.14 and 0.41, respectively) hereditabilities. The magnitudes of the additive genetic variances were low, as were the genetic coefficients of variation and Vencovsky's "b" index (ratio of genetic C.V. to environmental C.V.). Statistically significant phenotypic correlations were observed between "petiole spines" and "leaflet edge spines" ($r = 0.82$) and between "leaflet nerve spines" and "edge spines" ($r = 0.58$) in the progenies, but not in the parent plants, suggesting the existence of endogenous factors that modify the expression of these characters during their development, which was confirmed for "petiole/rachis spines" in the field.

Folgarait, P. J. and D. W. Davidson. 1994. Antiherbivore defenses of myrmecophytic *Cecropia* under different light regimes. *Oikos* 71(2): 305-320. ABSTRACT: In a greenhouse experiment, we compared presumed biotic, chemical, physical and phenological defenses of six myrmecophytic Peruvian *Cecropia* species under high and low light regimes. For all species, increased light intensity enhanced both dry mass production of glycogen-rich Mullerian bodies (MBs) and levels of condensed tannins and total phenolics. The production of lipid-rich pearl bodies (PBs), the leaf toughness, and the expansion rate of new leaves were not enhanced consistently by higher light intensity. The six species were comprised of three pairs of close congeners; each pair consisted of a "pioneer" of riverine and stream edges or land-slips, and a "gap" species from treefall openings in primary forest. Each gap species grew more slowly than did its pioneer counterpart and allocated proportionally more resources to MBs. Gap species produced a greater dry mass of MBs per unit of leaf area, and initiated their production earlier in seedling ontogeny. In comparison with pioneer relatives, gap species also possessed somewhat longer-lived and tougher leaves. Both PB production and leaf expansion rates were greater in pioneers than in closely related gap species. Disparities in the behaviors of MBs and PBs in interspecific comparisons probably reflect differences in the initial construction costs versus continuing or maintenance costs of these two types of ant rewards. Interspecific differences in the production of carbon-based secondary compounds by pioneers and gap species are pair specific and appear to be related to the degree of morphological differentiation within pairs, and, possibly, to time since divergence. We relate our results to current theories of plant defense.

- Folgarait, P. J. and D. W. Davidson. 1995. Myrmecophytic *Cecropia*: Antiherbivore defenses under different nutrient treatments. *Oecologia* 104(2): 189-206. ABSTRACT: In greenhouse experiments, we compared putative biotic, chemical, physical and phenological defenses of six myrmecophytic *Cecropia* species cultivated under high and low nutrient regimes. We tested the intraspecific predictions of the C:N balance hypothesis for a broader range of defenses than included in other studies to date. Treatment effects on defenses appear to depend on the nutrient constituents of those defenses. Only strictly carbon-based defenses such as tannins and phenolics reached higher concentrations at the lower nutrient level. The production of glycogen-rich and membrane-bound Mullerian body ant rewards (MBs) increased with greater levels of both nutrients (this study) and light (Folgarait and Davidson 1994). In contrast, lipid- and amino acid-rich pearl body food rewards (PBs) were produced in greater numbers under conditions of high nutrient levels (this study) and low light (Folgarait and Davidson 1994), both of which should have contributed to a relative excess of nitrogen. Nutrient effects on toughness and leaf expansion rates (perhaps serving as phenological defenses) were inconsistent with the predictions of the C:N balance hypothesis. Mature leaves are protected principally by chemical and physical defenses, and new leaves, by biotic defenses. As in a previous study, interspecific comparisons agreed with the resource availability theory of plant defense. Plant investment in immobile defenses (tannins and phenolics, and leaf toughness), and in a defense with high initial construction costs (trichilia differentiated to produce MBs) were greater in each of three comparatively slow-growing "gap" *Cecropia* typical of small openings in primary forest, than in closely related and fast-growing "pioneer" species of large-scale disturbances (riparian edge and land slips). In contrast, both production of PBs (with negligible initial construction costs) and leaf expansion rates were greater in pioneers than in gap species. Rapid onset of biotic defenses during new leaf development (earlier in pioneers) may reduce new leaf herbivory in all species.
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western edge of the Amazon Basin, in southeastern Peru, is here described. It is close to *N. mockfordi* and it is the second species of the genus known from both sexes; the male of the new species can be separated from the male of *N. gamma* on details of terminalia, particularly of the epiproct, clunium and phallosome. The types are deposited in the Smithsonian Institution, Washington, D.C.

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seasonal changes in food availability, yet no study published to date has both correlated birth seasonality with food availability, and shown that the physical conditions of individuals decline during annual periods of food scarcity. (2) We document the following observations in a population of saddle-back tamarins (*Saguinus fuscicollis* Spix, Callitrichidae) at the Cocha Cashu Biological Station in Peru's Manu National Park. (3) The availability of both fruits and insects was substantially lower during the annual 4-month dry season (May-September) than at other times of the year. (4) Individual tamarins lost an average of 5% of their weight over this period. (5) Three-quarters of twenty-two *S. fuscicollis* births at this site occurred between November and February, and none occurred between mid-March and mid-August. (6) We suggest that tamarin births at Cocha Cashu are timed such that lactation and weaning occur when food is abundant, because during the period of low food availability, there would be insufficient food to meet the demands of lactation and to serve as easily obtainable weaning foods. In this sort of seasonal environment, tamarins appear to be constrained, by the seasonality of their food supply, from breeding as frequently as they do in captivity.

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site. In three of the four sites (with the exception of BCI, where there are no typical young secondary forests), distance to secondary forests was correlated with at least one axis of the PCA ($P < 0.06$). Other significant correlations included soil variables (CC and KM41), gap size (KM41), and forest type (secondary vs. primary; BCI). Overall, the results provide some support for the hypothesis that at the spatial scale of this study, distance to young secondary forests (both natural and anthropogenic) influences treefall gap composition at a level comparable to endogenous and exogenous microenvironmental factors.

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water content (0-10 cm) was significantly lower in B+ plots. On average, over four times as many seedlings and saplings were classified as having stem damage in B+ plots as compared with B- plots. Saplings of a given dbh were on average 29% taller in B- plots than those in B+ plots. We propose that the occurrence of bamboo-dominated forests can be explained by an interplay between mechanical properties of soils, wind disturbance, and elevated rates of tree mortality in the presence of bamboo. (C) 2002 Elsevier Science B.V. All rights reserved.

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correlated with small sapling density at fine (1 m²) quadrat) and coarse spatial scales (among forests), although across forests the effect of palms was due entirely to the difference between LS and the other three forests. These results provide cross-site support for the hypothesis that understory cover by palms decreases the density of small saplings that comprise the advance regeneration of the forest.

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- Kiltie, R. A. and J. Terborgh. 1983. Observations on the behavior of rain forest peccaries in Peru: Why do white-lipped peccaries form herds? *Zeitschrift für Tierpsychologie* 62(3): 241-255. ABSTRACT: The ecology and behavior of *Tayassu tajacu* and *T. pecari* were studied for 16 mo. in the years 1975-1978 in the Manu National Park in southeastern Peru. From 132 sightings of *T. tajacu* at the study site, and from reports from other regions, groups of this species in rain forest usually contain fewer than 12 individuals. *T. tajacu* repeatedly used wallows in the forest. Individuals of this species were relatively sedentary. Herds of *T. pecari* were encountered on 60 occasions. Five counts indicated that there were over 100 individuals in the herds. This species was encountered at practically random intervals, more frequently in the dry season than in the rainy season. Adults of both species are prey primarily of large cats and humans. Both species feed on green plant parts, fruits, nuts and seeds, but *T. pecari* feeds on more resistant seeds and nuts than *T. tajacu*. The hardest palm nuts that only *T. pecari* can consume are distributed in a patchy manner. Cracking these nuts between the teeth causes the animals to be heard more than 50 m away. The patchy distribution of the hard nuts and seeds prevent *T. pecari* from being sedentary. Group formation has several individual benefits for foraging efficiency and defense against predators; avoidance of searching for food in places recently visited by others, benefiting from the knowledge of experienced foragers, reducing the per capita probability of detection by predators, reducing the probability of being captured after group detection by predators, increasing the ability to counterattack as a group, increasing the probability of detecting the predator before it can attack and confusing the predator through escape behavior. *T. tajacu* seems to live in small groups because its typical foods are distributed more evenly and because consumption of these foods does not cause individuals to be so noticeable to predators.
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- Kirkby, C. 2002. Optimización de la tarifa de entrada para la Reserva Nacional Tambopata y el Parque Nacional Bahuaja Sonene, Madre de Dios, Perú. Unpublished report for the Instituto Nacional de Recursos Naturales (INRENA) and World Wildlife Fund-Perú. Puerto Maldonado. 31 pages. ABSTRACT: Este reporte examina el tema del uso de tarifas de entrada como fuentes de financiamiento para Áreas Naturales Protegidas (ANP) en países en vías de desarrollo, centrándose en los métodos económicos comúnmente utilizados para optimizarlas, como son el Análisis del Mercado; el Costo de Viaje (CV); y la valorización de la experiencia turística basada en la Disponibilidad de Pago (DP) de los turistas. Se presenta los detalles y resultados de un estudio realizado durante los meses de febrero a mayo del 2002 que utilizó dichos métodos para identificar las tarifas óptimas para cuatro zonas en la Reserva Nacional Tambopata (RNTAMB) y el Parque Nacional Bahuaja Sonene (PNBS), dos ANP ubicadas en el bosque húmedo sub-tropical del departamento de Madre de Dios en el sur-este del Perú. El promedio de la DP de 525 turistas extranjeros encuestados era mucho mayor que las tarifas existentes para las zonas de interés, y equivalente al 5% del promedio del CV a dichas zonas. Asimismo, las tarifas actuales son bajas en comparación con otras ANP similares. Estas pistas indican que existe amplio potencial para incrementar la recaudación turística en estas ANP. Las tarifas óptimas propuestas, calculadas para las cuatro zonas de interés, es decir Sandoval, Medio Tambopata, Alto Tambopata, y PNBS, respectivamente, varían entre el 59-79% de la DP, equivalente al 3.0-3.6% del CV, dependiendo de la zona. Las tarifas óptimas también son competitivas en términos de los cobros vigentes en otras ANP similares. El sistema de tarifas propuesta incluye recomendaciones como tarifas preferenciales o especiales para estudiantes, menores de edad, turistas con deseos de hacer múltiples ingresos, turistas nacionales, y la población local. La recaudación teórica de las tarifas propuestas se calculó en US\$136,618 (S/. 464,500). Esto equivale a 176% más que la recaudación promedio del periodo 2000-2001, y asimismo es suficiente para cubrir todos los costos de administración y manejo de la RNTAMB/PNBS y para aportar fondos al Sistema Nacional de Areas Naturales Protegidas por el Estado (SINANPE).
- Kirkby, C. 2002. Taller sobre estándares ecoturísticos para la Reserva Nacional Tambopata Candamo, el Parque Nacional Bahuaja Sonene y sus zonas de amortiguamiento. Unpublished report for the Instituto Nacional de Recursos Naturales (INRENA) and World Wildlife Fund-Perú. Puerto Maldonado. 41 pages.
- Kirkby, C. 2002. Estándares ecoturísticos para la Reserva Nacional Tambopata, el Parque Nacional Bahuaja Sonene y sus zonas de amortiguamiento. Unpublished report for the Instituto Nacional de Recursos Naturales (INRENA) and World Wildlife Fund-Perú. 30 pages. ABSTRACT: Este reporte examina el tema de estándares ecoturísticos y su utilidad como herramientas en el manejo integral del turismo de áreas naturales protegidas, centrándose en los métodos más comúnmente utilizados para u definición, así como los principios ecoturísticos que son tan importantes como línea base ya que delimitan el marco ético y lógico del proceso. Se presenta los resultados de un estudio concertado y participativo que se llevó a cabo durante un periodo de cuatro meses, cuyo objetivo era la identificación de una serie de lineamientos generales y estándares ecoturísticos básicos que podrían normar la actividad turística en la Reserva Nacional Tambopata (RNTAMB) y el Parque Nacional Bahuaja Sonene (PNBS), dos ANP ubicadas en el bosque húmedo sub-tropical del departamento de Madre de Dios en el sur-este del Perú, área de reconocida riqueza biológica y cultural. Los 101 participantes y

colaboradores lograron identificar un total de 38 lineamientos y 71 estándares básicos. Los estándares serán propuestos al Instituto Nacional de Recursos Naturales (INRENA), el ente gubernamental que administra las ANP del país, como normas que deberían ser incluidas como reglamentos dentro del Plan de Uso Turístico de la RNTAMB y PNBS. Estos estándares no sólo serían importantes para normar la actividad en esta zona, también podrían ser de utilidad para premiar o incluso certificar a los operadores y guías que muestren un manejo turístico óptimo, como incentivo adicional para la implementación y respeto de dichos estándares.

- Kirkby, C. 2002. Análisis inicial del impacto económico del turismo en Puerto Maldonado y periferia. Unpublished report for the Instituto Nacional de Recursos Naturales (INRENA) and World Wildlife Fund-Perú. 16 pages. ABSTRACT: Este reporte examina el tema del impacto económico de la actividad turística en Puerto Maldonado (PEM), capital de la Biodiversidad del Perú y eje del desarrollo turístico en el departamento de Madre de Dios, centrándose en una discusión de los temas más importantes y la problemática existente en la ciudad. Se presenta los resultados de un análisis inicial del impacto directo e indirecto del turismo en el 2001 utilizando información relacionada a los ingresos económicos de hoteles urbanos y establecimientos de hospedaje en la zona periférica; los gastos locales de seis albergues en particular; y datos no publicados de un análisis de sueldos en ocho albergues realizado por Ashton en el 2000. Dieciséis hoteles urbanos y seis albergues estudiados recibieron un total de 3,084 y 13,203 turistas en el 2001, los cuales generaron ingresos estimados de US\$ 43,555 (S/. 148,086) y US\$ 2,860,207 (S/. 9,724,704), respectivamente. Extrapolando estos datos, se estimó que el turismo en Tambopata generó alrededor de US\$ 4,051,268 (S/. 13,774,310) en moneda extranjera para el país. Sin embargo, el impacto económico directo e indirecto a nivel local (dentro y alrededor de Puerto Maldonado) fue de US\$ 1,828,620 \pm 296,000 (S/. 6,217,308 \pm 1,006,400). En general se estimó que el 67% del dinero captado por la industria turística no entra al sistema económico local o pronto escapa de este. Existe un mercado anual potencial significativo para varios productos consumidos por la industria turística local pero que actualmente provienen exclusivamente de áreas fuera de Madre de Dios, por ejemplo: jabón de tocador US\$ 2,899 (S/. 9,857); mermelada US\$ 3,046 (S/. 10,356); café US\$2,878 (S/. 9,785); productos en base de chocolate US\$955 (S/. 3,247); y velas US\$ 3,840 (S/. 13,056). Con inversión adecuada, dichos productos así como otros no mencionados en ésta oportunidad podrían ser elaborados en PEM a futuro. Esta y otras recomendaciones son detalladas para poder incrementar el impacto económico local del turismo, ya que de esta manera la industria podría ganar el respeto que muchos de los involucrados reclaman.
- Kirkby, C. 2004. Manual metodológico para el monitoreo ambiental y socioeconómico de la Reserva de Biosfera del Manu. Unpublished report for the Proyecto Aprovechamiento y Manejo Sostenible de la Reserva de Biosfera y Parque Nacional del Manu (PRO-MANU). Cusco. 130 pages.
- Kirkby, C. 2004. Implementación del plan de monitoreo de la Reserva de Biosfera del Manu. Unpublished report for the Proyecto Aprovechamiento y Manejo Sostenible de la Reserva de Biosfera y Parque Nacional del Manu (PRO-MANU). Cusco. 206 pages.
- Kirkby, C., W. Arizabal A., A. Cornejo Farfán, T. Doan, H. Lloyd and J. C. Oyola Ponce. 1997. Investigations on populations of rainforest mammals, birds and herpetofauna at tourism locations in and around the Tambopata-Candamo Reserved Zone, south-eastern Peru. Unpublished report of the Tambopata Reserve Society (TReES), Report No. 1.
- Kirkby, C. and A. Cornejo Farfán. 2000. The impact of trail-use by tourists on the mammal fauna of Tambopata, south-eastern Peru. Pages 14-62 in C. Kirkby (ed.), *Tourism development and the status of neotropical lowland wildlife in Tambopata, south-eastern Peru: Recommendations for tourism and conservation*. Tambopata Reserve Society.
- Kirkby, C., T. M. Doan, H. Lloyd, A. C. Farfán, W. A. Arriaga and A. P. Marin. 2000. Tourism and development and the status of Neotropical lowland wildlife in Tambopata, South-eastern Peru: Recommendations for tourism and conservation. Unpublished report of the Tambopata Reserve Society.
- Kirkby, C. and B. Griscom. 2001. Bamboo research and development strategy for the Los Amigos Conservation Concession and associated areas. Unpublished report for the Asociación para la Conservación de la Cuenca Amazónica. 29 pages.
- Kirkby, C. and P. Padilla. 1998. An evaluation of the population and management of *Tayassu tajacu* and *T. pecari* in Madre de Dios, Peru. Unpublished report for the Instituto Nacional de Recursos Naturales (INRENA) and CITES. Lima.
- Kirkby, C. and B. Zlatar. 2002. Realizando el potencial del bambú (*Guadua* spp.) en los bosques tropicales de Madre de Dios, Perú: Análisis del mercado, mapeo del recurso e integrando bambú en el manejo integral de concesiones forestales. Unpublished document developed by the authors. 8 pages.

- Kohler, J., V. R. Morales, S. Lotter, S. Reichle and J. Aparicio. 1998. A new green species of frog, genus *Eleutherodactylus*, from Bolivia and Peru (Amphibia, Anura, Leptodactylidae). *Studies on Neotropical Fauna and Environment* 33(2-3): 93-99. ABSTRACT: *Eleutherodactylus olivaceus* sp. n., a member of the *E. unistrigatus* group is described. The new species is known from montane rainforests of the Departamento Cochabamba, Bolivia, as well as from lowland rainforest of the Departamento Madre de Dios, Peru. *E. olivaceus* is mainly characterized by its predominantly olive green dorsal color and a papilla on the tip of the snout. Advertisement call and habitat of *E. olivaceus* are described. The occurrence of *Eleutherodactylus mendax* in Bolivia is briefly discussed.
- Kometter, R. F., M. Martinez, A. G. Blundell, R. E. Gullison, M. K. Steininger and R. E. Rice. 2004. Impacts of unsustainable mahogany logging in Bolivia and Peru. *Ecology and Society* 9(1): 12. ABSTRACT: Although bigleaf mahogany [*Swietenia macrophylla* King (Meliaceae)] is the premier timber species of Latin America, its exploitation is unsustainable because of a pattern of local depletion and shifting supply. We surveyed experts on the status of mahogany in Bolivia and Peru, the world's past and present largest exporters. Bolivia no longer has commercially viable mahogany (trees > 60 cm diameter at breast height) across 79% of its range. In Peru, mahogany's range has shrunk by 50%, and, within a decade, a further 28% will be logged out. Approximately 15% of the mahogany range in these two countries is protected, but low densities and illegal logging mean that this overestimates the extent of mahogany under protection. The international community can support mahogany conservation by funding park management and by encouraging independent verification of the legality of mahogany in trade. Our findings demonstrate that a systematic expert survey can generate reliable and cost-effective information on the status of widespread species of concern and help to inform appropriate management policy.
- Kratter, A. W. 1995. Status, habitat and conservation of the Rufous-fronted Antthrush *Formicarius rufifrons*. *Bird Conservation International* 5(2-3): 391-404. ABSTRACT: Habitat preferences of the Rufous-fronted Antthrush *Formicarius rufifrons* were studied along the Rio Tambopata in south-eastern Peru. All territories of this threatened species, endemic to lowland forests in the department of Madre de Dios, Peru, contained the near-juxtaposition of two distinct vegetation types: tall floodplain forest with shaded understorey, and more open, second-growth vegetation with a very dense layer of vegetation close to the ground. The latter habitat type was closely associated with disturbances, such as river erosion, tree falls, or human clearings. Two measures of antthrush density were calculated for the study area. A satellite photograph was used to identify appropriate habitat along the upper Rio Tambopata, and using the antthrush density figures, a population size of 100-500 pairs was estimated for this area. This estimate was then used to calculate a global population of 700-3,500 pairs. Approximately 20% of the global population occurs within currently protected areas. The habitat and diet of this species are discussed in relation to two other congeners.
- Kratter, A. W. 1997. Bamboo specialization by Amazonian birds. *Biotropica* 29(1): 100-110. ABSTRACT: Spec-mapping of territories was used to document the restriction of nineteen bird species to thickets of bamboo (*Guadua weberbaueri*) in lowland forests in southeastern Peru. These species were defined as bamboo specialists. An additional seven species showed a preference for such thickets, but also used other habitats. These results correspond with previous, qualitative descriptions of the habitat preferences of bamboo specialists. At least four specialists are restricted to thickets throughout their entire geographic range (obligate bamboo specialists); another nine specialists may use other habitats sparingly away from southeastern Peru (near-obligate bamboo specialists); the remaining six species are frequent users of habitats lacking bamboo away from southeastern Peru (facultative bamboo specialists). The nonbamboo habitats used by the 13 near-obligate and facultative specialists are predominantly dense habitats with low canopy cover, including treefall gaps and early successional vegetation along rivers. The obligate and near-obligate specialists generally have small geographic ranges centered in southwestern Amazonia; a few have sister taxa in southeastern Brazil that are also bamboo specialists suggesting a common evolutionary history. The facultative specialists are generally more widespread. Bamboo specialists are more abundant in bamboo habitats than are other bird species in more generalized habitats.
- Kratter, A. W. 1998. The nests of two bamboo specialists: *Celeus spectabilis* and *Cercomacra manu*. *Journal of Field Ornithology* 69(1): 37-44. ABSTRACT: The nests of *Celeus spectabilis* (Rufous-headed Woodpecker) and *Cercomacra manu* (Manu Antbird) are described. These are the first published descriptions of the nests of these species, both of which are restricted to thickets of spiny bamboo (*Guadua weberbaueri*) in southwestern Amazonia. The nest of the woodpecker, a hole placed 2.8 m high in a softwooded dead tree, was similar to the nests of other species in the genus. The nest was in an area of almost pure bamboo. The nest of the antbird, also in a dense bamboo thicket, was a pensile pouch suspended by the nest rim. The nest was 3.5 m high and attached to small bamboo branches. The previously defined groups in the genus (the tyrannina group and the nigricans group) may differ in nest structure, although comparative material is scant.

- Küchmeister, H. 2000. Pasos para un plan de manejo sostenible de la cuenca del río Los Amigos. Unpublished report for the Asociación para la Conservación de la Cuenca Amazónica.
- Kuroiwa, A. and C. Ascorra. 2002. Dieta y densidad de posibles presas de jaguar en las inmediaciones de la Zona de Reserva Tambopata-Candamo, Perú. Pages 199-207 in R. A. Medellín, C. Equihua, C. L. B. Chetkiewicz, P. G. Crawshaw, Jr., A. Rabinowitz, K. H. Redford, J. G. Robinson, E. W. Sanderson and A. B. Taber (eds.), *El jaguar en el nuevo milenio*. Fondo de Cultura Económica, Universidad Nacional Autónoma de México, and Wildlife Conservation Society, México, DF.
- Kuroiwa, A. and C. Ascorra. 2004. Dieta y densidad de posibles presas de jaguar (*Panthera onca*) en las inmediaciones del TRC (Reserva Nacional Tambopata, Perú). Pages 305-308 in M. Napravnik Pesce (ed.), *Guía interpretativa para Tambopata Research Center y Posada Amazonas*. 1ra Edición 1994-2004. Rainforest Expeditions S. A. C. and INNOVA Arquitectura Integral S. R. L., Lima.
- Kvist, L. P. and G. Nebel. 2000. Bosque de llanura aluvial del Perú: Ecosistemas, habitantes y uso de los recursos. *Folia Amazonica* 10(1-2): 5-55.
- Kvist, L. P. and G. Nebel. 2001. A review of Peruvian flood plain forests: Ecosystems, inhabitants and resource use. *Forest Ecology and Management* 150(1-2): 3-26. ABSTRACT: The lowland Peruvian Amazon remains sparsely populated and densely forested. Few roads exist and rivers provide much of the infrastructure. Over 12% of the area is comprised of flood plains inundated by the larger rivers, but due to their easy access and relatively fertile conditions, they provide a much larger share of the resources extracted in the region, and sustain most of the rural villages. The largest area of annually flooded land, constituting more than 60,000 km², surrounds the lower reaches of the Ucayali and Marañon rivers above their confluence to the Amazon proper, including almost 90% of the 20,600 km² large Pacaya-Samiria National Reserve. The entire area is constantly reshaped by erosion and deposition by the two main rivers, but also by smaller rivers which carry fewer sediments and less nutrients. The vegetation constitutes a complex mosaic of habitats defined by combinations of hydrological, physical, chemical and biological characteristics. Sixteen habitats including 12 forest formations are classified and described. Most flood plain inhabitants have lost their native identity, but they descend mostly from Amerindians rather than from recent immigrants, and preserve much knowledge on the flood plain environment and its habitats and uses. They combine agriculture, fishery, hunting and extraction of other forest products, and they market increasing amounts of these products. Growing populations and an increase in the need for monetary incomes as well as in external economic interventions, increasingly endanger economically important flood plain plants, animals and fishes. This is even the case within the Pacaya-Samiria National Reserve, making it urgent to develop and implement sound management systems in the marginal zones of the reserve, and elsewhere in Peruvian flood plains. (C) 2001 Elsevier Science B.V. All rights reserved.
- Kyle, T. 2001. *Geography in the Amazon: Mammalian and avian utilization of clay-licks in Amazonian Peru*. Master's thesis. Frostburg State University. pages.
- La Rosa, D. 2002. Patrones de uso estacional de las colpas por vertebrados mayores en el Centro de Investigación Río Los Amigos, Madre de Dios. Unpublished report for the Asociación para la Conservación de la Cuenca Amazónica. 3 pages.
- La Rosa, D. 2003. Patrones de uso de colpas por mamíferos en el Río Los Amigos, Madre de Dios. Unpublished report for the Asociación para la Conservación de la Cuenca Amazónica. 11 pages.
- La Rosa, D., L. H. Emmons, M. Trolle and V. Pacheco (2003). Uso de colpas por el tapir de tierras bajas *Tapirus terrestris* (Perissodactyla: Tapiridae) en el Río Los Amigos, Madre de Dios. XII Reunión Científica. Universidad Nacional Mayor de San Marcos, April 2003, Lima.
- Lacaze, D. 1999. Jardín etnobotánico "Koriwayti": Guía de identificación. Unpublished report.
- Lacaze, D. and M. Alexiades. 1995. *Salud para todos: Plantas medicinales y salud indígena en la cuenca del río Madre de Dios, Perú: Un manual práctico*. FENAMAD and the Centro de Estudios Regionales Andinos "Bartolomé de las Casas", Cusco. 287 pages.
- Lamas, G. 1981. La fauna de mariposas de la Reserva de Tambopata, Madre de Dios, Peru (Lepidoptera: Papilionoidea y Hesperioidea). *Revista de la Sociedad Mexicana de Lepidopterología* 6(2): 23-40. ABSTRACT: En la ZRT, se han registrado 492 especies de mariposas diurnas. Dichas especies fueron colectadas u observadas en una superficie de 2 km², durante Noviembre de 1979 y Julio-Agosto de 1980. Se estima que el número de especies presente debe alcanzar o superar el millar. Sorprende la escasa cantidad de especies de Papilionidae y

la ausencia de especies de Dismorphiinae. La evaluación inicial de flora y fauna, llevada a cabo en 1979, comprendió tres semanas de trabajo de campo. Los resultados para la entomofauna indican los siguientes números de especies: Odonata (103); Coleoptera: Cicindelidae (19); Diptera: Asilidae (21); Lepidoptera: Saturniidae (58). En la ZRT se encuentra la mayor diversidad de Odonata comparada con cualquier otra área en el mundo (Pearson 1980). La investigación se realizó en las cercanías de las instalaciones turísticas (Explorer's Inn y construcciones aledañas), de la empresa privada peruana Peruvian Safaris S.A. La colecta se llevó a cabo principalmente a lo largo de los senderos, en especial el que conduce del albergue a la laguna Cocococha, con una extensión de 5.1 km, así como en los senderos secundarios. Además, se hizo cortas incursiones (usualmente de no más de 100 m) hacia el interior del bosque, a cada lado de los senderos. No se pudo muestrear en suelos de arenas blancas, que probablemente contienen una fauna peculiar. Un número relativamente escaso de mariposas características de lugares abiertos o del dosel del bosque se encuentra representado en la lista de especies. Aparte de la colecta convencional con red entomológica, se utilizaron trampas de malla (tipo "Charaxes"), cebadas con plátanos (*Musa* sp.) en descomposición, así como una trampa "Malaise". Igualmente, se emplearon cebos de *Heliotropium* sp. (Boraginaceae), para la subfamilia Ithomiinae, y se aprovechó de la presencia natural de flores, excrementos (especialmente de *Tayassu* spp.), cadáveres de animales, y frutos en descomposición. Además unas pocas especies fueron registradas sólo visualmente e identificadas con seguridad. Un gran número de especies aparentemente posee densidades poblacionales muy bajas. Posiblemente, sea evidente la presencia de variaciones estacionales importantes en la composición faunística. Se incluye una lista taxonómica de las especies de mariposas diurnas (Papilionoidea y Hesperioidea) y se compara con las cifras registradas para otras dos áreas ecológicamente similares de la Amazonia (Limoncocha en Ecuador, 441 especies; y Jaru en Brasil, casi 789 especies).

- Lamas, G. 1982. Un nuevo registro de *Paititia neglecta* Lamas (Nymphalidae: Ithomiinae). *Revista de la Sociedad Mexicana de Lepidopterología* 7(1): 15-16. ABSTRACT: Se reporta un nuevo ejemplar de la rara especie de mariposa *Paititia neglecta*. En Setiembre de 1981 se colectó un individuo de esta especie en la ZRT (que representa el punto más septentrional de su distribución). Es el quinto ejemplar conocido de la especie; las localidades de colección de los cuatro anteriores se ubican en los departamentos de San Martín (Juanjui y Achinamiza) y Madre de Dios (Iberia). Se le considera una especie muy rara en la naturaleza, pues es el primer ejemplar obtenido en Tambopata, a pesar de la intensidad de las capturas en años anteriores. Su habitat parece ser el bosque tropical lluvioso de tierras bajas, con una marcada estación seca. Es muy posible que esta especie también se encuentre en el oeste de Brasil (Acre) y noroeste de Bolivia (Beni).
- Lamas, G. 1982. A preliminary zoogeographical division of Peru, based on butterfly distributions (Lepidoptera, Papilionoidea). Pages 336-357 in G. T. Prance (ed.), *Proceedings of the Fifth International Symposium for the Association of Tropical Biology*. Columbia University Press, New York.
- Lamas, G. 1983. Butterflies attracted by army ants in the nature preserve of Tambopata, Peru. *Revista de la Sociedad Mexicana de Lepidopterología* 8(2): 49-51. ABSTRACT: Fifteen species of Pyrrhopyginae and Pyrginae (Hesperiidae) are reported as associated with army ant (Hymenoptera: Formicidae, Ecitoninae) swarm raids, in the Tambopata National Reserve, Madre de Dios, Peru (*Pyrrhopyge thelorsa*, *Elbella intersecta intersecta*, *E. merops*, *E. patrobas blanda*, *E. umbrata umbrata*, *Nosphistia zonara*, *Temadia newitsonii hewitsonii*, *Myscelus pardalina pardalina*, *Passova ganymedes gelina*, *Aspitha agenoria sanies*, *Phocides metrodorus metrodorus*, *P. novalis*, *Polythrix minvanes*, *P. auginus* and *Chrysoplectrum perniciosus perniciosus*).
- Lamas, G. 1983. Adiciones y correcciones a la lista de mariposas de la Reserva de Tambopata. *Revista de la Sociedad Mexicana de Lepidopterología* 6(2): 13-24. ABSTRACT: Tres viajes adicionales de colecta a la ZRT en 1981 y 1982, han permitido añadir 373 especies a la lista previa de mariposas registradas para el área (Lamas 1981, con 492 especies). Con la ayuda de varios colaboradores se consiguió registrar las especies adicionales, en aproximadamente 400 horas/hombre de colecta intensiva. Se ha visto necesario realizar cierto número de correcciones a la primera lista de mariposas, debido a algunas identificaciones erradas y a nuevas interpretaciones taxonómicas. Indudablemente, se seguirán descubriendo errores de determinación en esta lista y, estando la taxonomía y nomenclatura de las mariposas neotropicales en un estado bastante fluctuante aún, habrá seguramente un apreciable número de modificaciones en el futuro. Sin embargo, se confía en que la presente lista refleje, en la mejor forma posible, el estado de conocimiento de la abundante fauna lepidopterológica de Tambopata. Debido al hallazgo de varias especies cuya presencia en Tambopata ha resultado inesperada, el autor ha revisado sus estimados sobre el número total de especies que puede albergar la ZRT; así, considera ahora que tal cifra puede muy bien alcanzar a 1,200 especies, en lugar de las 1,039 supuestas en 1981.
- Lamas, G. 1983. Mariposas atraídas por hormigas legionarias en la Reserva de Tambopata, Perú. *Revista de la Sociedad Mexicana de Lepidopterología* 8(2): 49-51. ABSTRACT: Se registra la presencia de 15 especies de mariposas de las subfamilias Pyrrhopyginae y Pyrginae (Lepidoptera: Hesperidae), asociadas a enjambres de hormigas legionarias (Hymenoptera: Formicidae: Ecitoninae) en la ZRT. La presencia de enjambres de hormigas

legionarias es un fenómeno relativamente común en los bosques tropicales de América Central y del Sur (Michener & Michener 1951, Hoghe 1972). Recientemente ha sido reportada la presencia de algunas especies de mariposas que acompañana a los enjambres de dichas hormigas en Honduras y Costa Rica (Drummond 1976, Ray & Andrews 1980). En muestreos de la fauna de mariposas de la ZRT, durante los últimos tres años (Lamas 1981, 1983), se ha observado aproximadamente una docena de enjambres de hormigas legionarias de por lo menos dos especies distintas (*Eciton* spp.). En todas las observaciones se notó la presencia de algunas aves; ciertos escarabajos Staphylinidae y abundantes dípteros acompañando la marcha de los enjambres. Siempre se encontró por lo menos algunos individuos de mariposas Hesperiiidae (Pyrrhopyginae y/o Pyrginae) asociados a las hormigas, mas no así especies de otras familias de lepidópteros. Generalmente se observó la presencia de las mariposas antes que la de los enjambres de hormigas, por lo menos en los primeros encuentros. Con más experiencia, se comprobó que se pueden localizar los enjambres auditivamente, a distancias de aproximadamente 10 m, por el ruido que producen, que se asemeja al murmullo ocasionado por la brisa sobre las hojas o a menor distancia, por su parecido al crepitar del fuego quemando hojarasca. En ningún caso se pudo percibir un olor particularmente ofensivo asociado a los enjambres, como cita la literatura.

- Lamas, G. 1985. Los Papilionoidea (Lepidoptera) de la Zona Reservada Tambopata, Madre de Dios, Perú. I: Papilionidae, Pieridae y Nymphalidae (en parte). *Revista Peruana de Entomología* 27: 59-73. ABSTRACT: Entre 1979 y 1984 se registraron unas 1,122 especies de mariposas diurnas (Lepidoptera) en la ZRT. En este trabajo, 151 de ellas son tratadas con mayor detalle, incluyendo información sobre su taxonomía; abundancia relativa en el área de estudio; posibles plantas hospederas de sus larvas; y ambientes que frecuentan los adultos. Se describen una especie y once subespecies nuevas, basándose en material obtenido en la ZRT. Se reportaron 25 especies de Papilionidae, de las aproximadamente 60 que existen en el Perú; se supone que otras 15 especies podrían encontrarse eventualmente en la ZRT. De las 200 especies de Pieridae que son conocidas para el Perú, según datos inéditos de Lamas, 25 son reportadas en el presente trabajo. Existe incertidumbre en la clasificación de diversos géneros de esta familia y no hay un tratamiento cladístico del grupo. Dentro de los Nymphalidae, se han registrado tres de las seis especies de la subfamilia Danaeinae conocidas para Perú; se piensa que todas podrían ser encontradas en la ZRT. En la subfamilia Ithomiinae (con una sistemática muy compleja) de las aproximadamente 200 especies registradas para el Perú, en Tambopata se han registrado 40, de las cuales siete subespecies y una especie son nuevas. En la subfamilia Morphinae, con una taxonomía infragénica caótica, se estima que existen unas 18 especies en el país, aunque la cifra puede variar con un análisis sistemático riguroso; por lo menos 11 especies han sido registradas en la ZRT y es probable la presencia de otras cinco.
- Lamas, G. 1985. The Castniidae and Sphingidae (Lepidoptera) of the Tambopata Reserved Zone, Madre de Dios, Peru: A preliminary list. *Revista Peruana de Entomología* 27: 55-58. ABSTRACT: Five species of butterflies of Castniidae and 43 of Sphingidae were collected in the TRZ between 1980 and 1984, in an area of 2 km². *Castnia licus* is the most common species in the TRZ; however, its population density does not appear to be as great as in other places in east Peru. The species appears to be polymorphic, with at least three phenotypes observed among the material obtained. With the exception of *Castnia licus* all the species of the Castniidae family are scarce in nature. About 25 species have been reported in Peru; of these, 12-15 are present in Tambopata. The number (43) of Sphingidae found in the ZRT is slightly less than those found in other localities which have been more intensively sampled. This is due to the sporadic nature of the collecting and the low intensity of sampling. It is conservatively estimated that between 100 and 120 species of Sphingidae may be present at Tambopata. All the material cited in this work has been deposited in the collections of the Department of Entomology of the Javier Prado Museum of Natural History of the UNMSM (Universidad Nacional Mayor de San Marcos, Lima).
- Lamas, G. 1988. Lista preliminar de los Saturniidae, Oxytenidae, Uraniidae y Sematuridae (Lepidoptera) de la Zona Reservada de Tambopata, Madre de Dios, Perú. *Revista Peruana de Entomología* 31: 57-60. ABSTRACT: Se presenta una lista de especies de lepidópteros colectados en la ZRT entre 1979 y 1988. Esta lista está basada principalmente en el material colectado por el Dr. John B. Heppner en 1979, e identificado por el Dr. Claude Lemaire; se complementó esta lista con material obtenido durante colectas esporádicas en la ZRT; encontrándose especies de Oxytenidae(2), Uraniidae(1), Sematuridae(1) y 7 especies adicionales de Saturniidae (capturando individuos atraídos por la luz eléctrica del Explorer's Inn entre las 19:00 y 20:00 horas). La especie de Uraniidae fue colectada durante el día y la de Sematuridae en el crepúsculo. Se incluyen a manera de apéndice, algunas adiciones y correcciones a la lista de Castniidae y Sphingidae presentada anteriormente. La mayoría de los especímenes incluidos en esta lista se encuentran depositados en el Museo de Historia Natural de la Universidad Nacional Mayor de San Marcos.
- Lamas, G. 1992. List of the butterflies from Pampas del Heath. Unpublished report of unknown provenance. Puerto Maldonado.
- Lamas, G. 1994. The butterflies of the Pampas del Heath. Pages 73-74, 178-184 in R. B. Foster, J. L. Carr and A. B.

Forsyth (eds.), *The Tambopata-Candamo Reserved Zone of southeastern Peru: A biological assessment*. Conservation International, Washington, DC, USA.

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- Lamas, G., O. H. Mielke and R. K. Robbins. 1993. The Ahrenholz technique for attracting tropical skippers (Herperiidae). *Journal of the Lepidopterists' Society* 47(1): 80-82.
- Lamas, G. and E. Pérez. 1983. Danainae e Ithomiinae (Lepidoptera: Nymphalidae) atraídos por *Heliotropium* (Boraginaceae) en Madre de Dios, Perú. *Revista Peruana de Entomología* 24(1): 59-62. ABSTRACT: En la ZRT se han registrado 42 especies de mariposas de las subfamilias Danainae e Ithomiinae. De éstas, 25 han sido colectadas atrayéndolas con cebos de *Heliotropium indicum* (el 94% de los especímenes obtenidos fueron machos). Cierta número de especies de lepidópteros son atraídos por raíces, tallos o inflorescencias marchitas de plantas productoras de alcaloides de pirrolizina y se considera que los insectos que se alimentan en estas plantas ingieren los alcaloides que necesitan para producir feromonas, las que sirven principalmente en los procesos de reconocimiento sexual. Se comparan estos resultados con información similar obtenida en Rancho Grande (Parque Nacional Henri Pittier, Venezuela). Se sugiere también la evolución de un sistema mutualista ya que dichos lepidópteros cumplen funciones polinizadoras.
- Lamas, G., R. K. Robbins and D. J. Harvey. 1991. A preliminary survey of the butterfly fauna of Pakitza, Parque Nacional del Manu, Peru, with an estimate of its species richness. *Publicaciones del Museo de Historia Natural, Serie Zoológica, UNMSM (A)* 40: 1-19.
- Lambert, J. E. and P. A. Garber. 1998. Evolutionary and ecological implications of primate seed dispersal. *American Journal of Primatology* 45(1): 9-28. ABSTRACT: In this paper, we evaluate patterns of fruit eating and seed dispersal in monkeys and apes and draw an important distinction between 1) the ecological consequences of primates as seed dispersers and 2) the evolutionary implications of primates on the seed and fruit traits of the plant species they exploit. In many forest communities, primates act as both seed predators and seed dispersers and are likely to have an important ecological impact on patterns of forest regeneration and tree species diversity. Evidence from Kibale National Park, Uganda, and Manu National Park, Peru, as well as several other South American sites indicates that monkeys and apes display a wide range of fruit-processing behaviors, including spitting seeds, dropping seeds, masticating seeds, and swallowing seeds. Differences in consumer body size, diet, ranging patterns, and oral and digestive morphology result in different patterns in the distance and distribution of seeds from the parent plant. In the case of South American monkeys, for example, despite their relatively small body size, platyrrhines were found to exploit larger fruits and swallow larger seeds on average than did Old World monkeys and apes of the Kibale forest. We found little evidence to support the existence of a coevolutionary relationship between a single or set of primate dispersers and the particular plant species they disperse. This is due to variability in the manner in which monkeys and apes select fruits and treat seeds, the fact that many species of primates and nonprimates exploit and disperse the same fruit species, and the fact that extremely high levels of postdispersal seed, seedling, and sapling mortality serve to dilute the influence that any primate species may have on the recruitment of the next generation of adult trees. It is apparent that many primate lineages exhibit dental, digestive, and/or sensory adaptations that aid in the exploitation of particular food types and that many lineages of flowering plants have evolved characteristics of fruits and seeds that facilitate seed dispersal. However, in light of currently available data, we argue that these represent evolutionary rather than more strictly defined coevolutionary relationships.
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ABSTRACT: Adult specimens of *Kaira* are rarely collected and the females are difficult to separate. The few specimens in collections represent 14 species, all American. Five species are new: *Kaira cobimcha* from southern Brazil; *K. diana* from southeastern Peru; *K. erwini* from Peru; *K. shinguito* from northern Peru; *K. tulua* from Depto. Valle, Colombia. The female of *K. hiteae* is described and *Araneus sexta* is transferred to *Kaira*. *Haliger* is a new synonym of *Kaira*, with *H. corniferus* a synonym of *K. altiventer*. *Kaira obtusa* and *Wagneriana minutissima* are synonyms of *K. gibberosa*. Doubtful synonyms are *Caira capra* of *K. altiventer*, and *Macpos monstrosus* of *K. gibberosa*.

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also higher than average (*Astrocaryum* Wet Experiment). For each experiment, four or five plots, each containing 75 seeds, were placed in each of four zones from early to late succession. The entire design was replicated in two successional transects that were separated by 6 km. Seedling survivorship of *Astrocaryum* was highest in the late-seral zones of both transects, which corresponded closely to its restricted natural distribution. Hence, postdispersal limitations, perhaps in conjunction with restricted seed dispersal, apparently contributed heavily to the general absence of *Astrocaryum* from the early- and mid-seral floodplain forests. Flooding did not appear to influence *Astrocaryum* seedling survivorship. Postdispersal factors also seemed to influence strongly *Iriartea* establishment, as evidenced by the significant variation in seedling survivorship across seral zones and between transects. Moreover, in the *Iriartea* Dry Experiment, seedling survivorship was negatively correlated with level of flooding. During the *Iriartea* Wet Experiment, survivorship was substantially lower in all seral zones, probably due to the heavy flooding. Thus, flooding, as a postdispersal factor, appeared to play a major role in shaping the natural distribution of *Iriartea* in the successional floodplain forests. Because seedling survivorship in one midseral zone was substantially higher than would be predicted from the natural *Iriartea* seedling density, results from transplant experiments also suggest that limited seed dispersal may contribute to this palm's early-seral distribution. For *Iriartea*, seed dispersal limitation may play a role complementary to that of flooding. In Amazonian primary-successional floodplain forest, the habitat specificity of at least one, and perhaps two, large-seeded species appears to result from both dispersal limitation and postdispersal limitation factors.

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- Medina, M. C., R. K. Robbins and G. Lamas. 1997. Vertical stratification of flight by Ithomiinae butterflies (Lepidoptera: Nymphalidae) at Pakitza, Manu National Park, Peru. Pages 211-216 in D. E. Wilson and A. Sandoval (eds.), *Manu: The biodiversity of southeastern Peru*. Smithsonian Institution and Editorial Horizonte, Lima. ABSTRACT: In samples of ithomiine butterflies collected with insect nets, flying height was correlated

with wing pattern and wing length, but not with sex or time of day. Wing pattern and length were also correlated with each other, so that larger, tiger-patterned individuals tended to fly higher in the forest than did smaller, transparent patterned individuals. Since samples from traps showed that same correlation between wing pattern and size, this result was not likely to be a result of bias in sampling methods. Vertical stratification by wing has been previously explained in terms of predator avoidance strategies. We suggest that stratification by wing length may be related to differences in flight behavior (e.g., flight distance, time aloft) at different strata.

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la influencia de la fauna sobre la producción agrícola en la Zona Reservada Tambopata Candamo y se relacionó este efecto a una posible pérdida/ganancia mediante la cacería realizada por los mismos pobladores. En esta investigación se analiza la fauna desde otro punto de vista, el de estimar el efecto negativo que puede producir la presencia de especies que provoquen daños y pérdidas a los cultivos agrícolas.

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- Mennega, A. M. W. 1984. Notes on new world Salacioideae (Celastraceae including Hippocrateaceae): 1. New species of Salacia. *Proceedings of the Koninklijke Nederlandse Akademie Van Wetenschappen Series C Biological and Medical Sciences* 87(1): 81-90. ABSTRACT: Three new species of Salacia are described. *S. bullata* sp. nov., a liana, characterized by bullate leaves, was collected in Brazil, Territorio Amapa. It is related to *S. amplectens*. A.C. Smith's key (1940) should be amended to include a new group AMPLECTENTES. This group, containing *S. bullata* and *S. amplectens* would be near *Arboreae*. *S. alwynii*, sp. nov., a vining species comes from Peru, Maynas and is characterized by very large leaves and large cauliflorous flowers. It belongs to the species group *Ellipticae* sensu Smith. It was also collected in Venezuela. *S. paradoxa* sp. nov. is a liana collected in Brazil along the Manaus-Caracarai road. Its long leaves are narrowly elliptic, its flowers are extremely small. In leaf characters it is strikingly similar to *S. solimoensis* of Smith's species group *Ellipticae*, the shape of the disk suggests the species group *Crassifoliae*. Specimens with fruits, collected in western Brazil may belong either to *S. paradoxa* or to *S. solimoensis*.
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- Mielke, O. H. H. Year unknown. Revision of *Elbella* Evans and related genera (Lepidoptera, Hesperidae, Pyrrhopyginae). *Revista Brasileira de Zoologia* 11(3): 395-586. ABSTRACT: A systematic study of the genera *Microceris* Watson, 1893, *Elbella* Evans, 1951, *Parelbella*, gen.n. (type species: *Hesperia polyzona* (Latreille, 1824)), *Pseudocroniades*, gen.n. (type species: *Ericides* (sic) *machaon* Westwood, (1852)) and *Protellabella*, gen.n. (type species: *Pyrrhopyga* (sic) *alburna* Mabilie, 1891), a natural group of the Pyrrhopyginae, here called "Elbella Complex", is presented. The following are spp.n. and ssp.n.: *Elbella intersecta* paraensis, Brazil: Para; *Elbella intersecta* rufitegula, Brazil: Pernambuco, Bahia, Minas Gerais, Espirito Santo and Rio de Janeiro State; *Elbella viriditas* boliviana, Bolivia: La Paz; *Elbella lampra* albociliata, Brazil: Sao Paulo, Parana and Santa Catarina; *Elbella azeta* giffordi, Brazil: Distrito Federal and Sao Paulo; *Elbella patrobas* mexicana, Mexico: Chiapas and Quintana Roo; *Elbella patrobas* evansi, Colombia: Cauca, Caldas and Boyaca; *Elbella patrobas* tingo, Brazil: Rondonia and Peru: Huanuco and Madre de Dios; *Elbella patrobas* amazonica, Brazil: Amazonas; *Parelbella* peruana, Peru: Junin; *Pseudocroniades machaon* seabrai, Brazil: Rio de Janeiro State; *Protellabella alburna* brasiliensis, Brazil: Amazonas, Rondonia and Mato Grosso, and French Guiana: Montagne aux Cheveaux. The following genus is a syn.n.: *Hegesippe* Evans, 1951 of

Elbella Evans, 1951. The following species and subspecies are syn.n.: *Pyrrhopyga* (sic) *semidentata* Mabille, 1877 and *Elbella intersecta ilona* Evans, 1951 of *Elbella intersecta intersecta* (Herrich-Schaffer, 1869); *Pyrrhopyge carriae* Bell, 1931 of *Elbella viriditas viriditas* (Skinner, 1920); *Pyrrhopyga* (sic) *menecrates* Mabille, 1878 and *Pyrrhopyge margimmiscus* Hayward, 1935 of *Elbella lampra lampra* (Hopffer, 1874); *Elbella etna moda* Evans, 1951 of *Elbella etna* Evans, 1951; *Jemadia umbrata* Mabille & Boulet, 1908 of *Elbella patroclus patroclus* (Plotz, 1879); *Pyrrhopyga* (sic) *jamina* Butler, 1870 and *Pyrrhopyga* (sic) *zimra* Hewitson, 1871 of *Parelbella ahira ahira* (Hewitson, 1857); *Elbella zesta* Evans, 1951 of *Croniades pieria* (Hewitson, 1857). The following are comb.n.: *Elbella viriditas viriditas* (Skinner, 1920); *Elbella viriditas chia* Evans, 1951; *Elbella mariae molinai* (Hayward, 1940); *Elbella patroclus acala* Evans, 1951; *Parelbella polyzona* (Latreille, (1824)); *Parelbella ahira ahira* (Hewitson, 1866); *Parelbella ahira extrema* (Rober, 1925); *Parelbella macleannani* (Godman & Salvin, 1893); *Pseudocroniades machaon machaon* (Westwood, 1852); *Protellabella alburna alburna* (Mabille, 1891). The following are stat.n.: *Elbella mariae molinai* (Hayward, 1940); *Elbella lustra* Evans, 1951; *Elbella blanda* Evans, 1951. The following is a sp.rev.: *Elbella patroclus patroclus* (Plotz, 1879). The following is a nom.rev.: *Elbella mariae molinai* (Hayward, 1940). The following are stat.rev.: *Elbella miodesmia* (Rober, 1925); *Parelbella ahira ahira* (Hewitson, 1866); *Parelbella macleannani* (Godman & Salvin, 1893). Lectotypes are designated for the following species or variety: *Myscelus intersecta* Herrich-Schaffer, 1869; *Pyrrhopyga* (sic) *fluminis* Butler, 1873; *Pyrrhopyga* (sic) *semidentata* Mabille, 1877; *Pyrrhopyge lamprus* Hopffer, 1874; *Pyrrhopyga* (sic) *menecrates* Mabille, 1878; *Pyrrhopyga* (sic) *dulcinea* Plotz, 1879; *Pyrrhopyga* (sic) *luteizona* Mabille, 1877; *Hesperia iphinous* Latreille, (1824); *Pyrrhopyga* (sic) *azeta* Hewitson, 1866; *Pyrrhopyga* (sic) *patrobas* Hewitson, 1857; *Jemadia azeta* var. *melanina* Mabille & Boulet, 1908; *Pyrrhopyga* (sic) *ahira* Hewitson, 1866; *Pyrrhopyga* (sic) *jamina* Butler, 1870; *Pyrrhopyga* (sic) *zimra* Hewitson, 1871; *Jemadia macleannani* Godman & Salvin, 1893; *Ericides* (sic) *machaon* Westwood, (1852); *Pyrrhopyga* (sic) *alburna* Mabille, 1891. Neotypes are designated for the following species: *Sarbia amoena* Rober, 1925; *Pyrrhopyga* (sic) *othello* Plotz, 1879; *Mimoniades mimetes* Mabille, 1909; *Jemadia miodesmia* Rober, 1925; *Jemadia umbrata* Mabille & Boulet, 1908; *Jemadia extrema* Rober, 1925.

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valle del Candamo en el Perú. Pages 168-177 in L. O. Rodríguez (ed.), *El Manu y otras experiencias de investigación y manejo de bosques neotropicales*. Proyecto Aprovechamiento y Manejo Sostenible de la Reserva de Biosfera y Parque Nacional del Manu (PRO-MANU), Lima.

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canopy tree seedlings. Understanding what generates variation in understory light availability represents one step in understanding processes regulating seedling banks, the beginning capital of regeneration in tropical forests. Near the forest floor, variation in light availability may be strongly influenced by the structure and composition of the understory. I examined abundance of understory foliage and patterns of light attenuation in five Neotropical forests (La Selva Biological Station, Costa Rica = LS; Barro Colorado Nature Monument, Panama = BCI; Cocha Cashu Biological Station, Mann National Park, Peru = CC; Kilometer 41, Manaus, Brazil = KM41; and Nouragues, French Guiana = NG). I used hemispherical canopy photos to estimate light availability at two heights (0.65 and 1.7 m) above the forest floor and counted foliage between these heights. Light availability differed significantly among sites, and site rankings depended on measurement height. At 0.65 m, NG had significantly lower mean light availability than CC, with KM41, LS, and BCI equivalent and intermediate. At 1.7 m, light availability was still lowest at NG, and highest at CC, but LS had levels similar to CC while KM41 and BCI remained intermediate. Across sites, light attenuation was positively related to foliage density. LS had the most understory foliage and the highest light attenuation between 0.65 and 1.7 m. KM41, NG and CC had intermediate amounts of foliage and intermediate light attenuation. BCI had the lowest density of understory foliage and no difference between light at the two measurement heights. My results show significant effects of understory foliage on understory light and indicate that the selective environment of canopy tree seedlings differs among sites.

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(Huánuco), como *D. pictus*, por algunas características similares en ambas poblaciones. Las dos especies difieren de la descripción original de *D. pictus* realizada por Duméril & Bibron (1841). Los sonogramas de los especímenes de *Dendrobates* sp. 1 de Tambopata, Tingo María y Bosque de Castilla muestran una frecuencia decreciente del llamado (KHz), de sur a norte. El patrón de la línea dorsal es más angosto en la muestra de Tambopata que en las de Tingo María y Bosque de Castilla, por esta razón se considera la posibilidad de dos subespecies o una clina latitudinal. Los sonogramas de *Dendrobates* sp. 1 difieren de los de *D. quinquevittatus* estudiados por Schuller (1981) en el Perú y por Lescure & Bechter (1982) en Guyana Francesa; y también existen diferencias en la duración del llamado. Además se cree que los especímenes identificados como *D. quinquevittatus* por Schuller (1981) y Lescure and Betcher (1982) podrían ser sinónimos de *D. minutus* (identificado por Myers and Bechter (1976) y estudiado en Colombia y Panamá), ya que presentan sonogramas similares. También se describen los llamados de *D. femoralis* de Cusco Amazónico, *D. smaragdinus* del Bosque de Castilla y *D. trivittatus* del Bosque de Castilla y Tambopata.

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specific gravity (oven-dry weight divided by fresh volume, sometimes also referred to as wood density in the literature) differed significantly among sites, varying inversely with soil fertility and independently of rainfall, seasonality and temperature. Mean wood specific gravity values were much higher at Kilometer 41, Manaus, Brazil, where soils are extremely poor, than at Cocha Cashu, Peru, Barro Colorado Island, Panama, or La Selva, Costa Rica, where soils are better and mortality rates of trees are higher. Within sites, wood specific gravity varied widely among species. On Barro Colorado Island, among-species variation was significantly, albeit weakly, negatively correlated with sapling and tree mortality and relative growth rates. Altogether, the results suggest that the distribution of tree life history strategies in a community varies substantially among sites, with important consequences for community and ecosystem properties such as aboveground carbon stores.

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uplands, dissected side slopes and recent flood plains dominate the topography in this region. Soil textures vary from clayey to sandy, depending on the texture of sedimentary materials from which each pedon formed. Parent material textural variation is a result of differences in the energy of the meandering rivers that deposited the ancient alluvium. Fourteen soil profiles were described and sampled in the field and analyzed in the laboratory. Data for eight soil profiles representative of the region are presented here. The profiles include soils formed in both sandy and fine-textured parent materials and soils with moisture status ranging from well drained to poorly drained. Soil moisture conditions vary with position on the landscape, such that as distance from streams increases, average depth to the fluctuating water table decreases. Redoximorphic features are present in all mineral soils. The average depth to redoximorphic features is least in locations furthest from streams. Soils in landscape positions that are poorly or somewhat poorly drained contain significant amounts of plinthite. In all soils, kaolinite is the dominant mineral in the < 0.2) mm fraction, while quartz is the dominant mineral in very fine and fine sand fractions. All soils have low cation exchange capacity (CEC), low base saturation, and acid pH. Coarse-textured spodic soils with well developed zones of iron and organic matter translocation are formed in recent sand deposits of flood plains of 2nd-order streams. Organic soils are found in the wetlands associated with flood plains of some 3rd-order streams. Most properties of these soils appear to be controlled by the textures of their sedimentary parent materials and by their position on the landscape. The soils classify as Paleustults, Plinthaquults, Kandiusults, Placaquods and Troposaprists according to Soil Taxonomy. New subgroups of Paleustult are proposed.

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reported: *Chauna torquata*, *Porphyrola flavirostris*, *Coccyzus cinereus*, *Sinallaxis albescens*, *Myrmotherula iheringi*, *Myiozetetes cayanensis*, *Catharus fuscescens* and *Oporornis agilis*. The following species, known from 10 specimens or less, are also considered: *Simoxenops ucayalae*, *Myrmeciza goeldii* and *Poecilatriccus albifacies*. The collections carried out have demonstrated that the ant-eating bird (Formicariidae) described as *Percnostola macrolopha* is in reality the male of *Percnostola lophotes* and not a separate species. A range of resident species, including *Dryophila devillei* and *Ramphotricon megacephala*, are definitely associated with bamboo habitats (*Guadua* sp.). The small proportion of the birdlife comprising southern migratory birds include species such as *Coccyzus cinereus*, *Satrapa icterophrys*, *Casiornis rufa*, *Pseudocolopteryx acutipennis*, *Inezia inornata* and *Turdus amaurochalinus*.

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- Patterson, B. D., V. Pacheco and S. Solari. 1996. Distributions of bats along an elevational gradient in the Andes of south-eastern Peru. *Journal of Zoology* 240(4): 637-658. ABSTRACT: At least 193 species of mammals are known to occur within the Manu Biosphere Reserve in south-eastern Peru, contributing to its stature as one of the world's richest protected areas. Bats (Order Chiroptera) comprise more than 42% (82 species) of this diversity. Analyses of bat capture records over a transect extending more than 3 km in elevation show that most bat species at Manu are widely distributed in the Amazon Basin. Few are montane endemics or are localized in south-eastern Peru, although exceptions to this generalization include two species new to science. Highland bat faunas tend to be attenuated versions of those found below, and the elevational zonation of bat communities is weak. Species turnover with elevation is monotonic and more-or-less smooth, with Jaccard's similarity values falling to 0.5 for sites differing by 750 m in elevation. Subtle and orderly change in species composition with elevation is also reflected in the nested-subset structure of these communities; over 19

different levels, this pattern of hierarchical structure is both striking and highly significant. Elevational ranges of species generally increase with elevation, in accordance with Stevens' extension of 'Rapoport's rule' of range amplitude. However, support for 'Stevens' rule' may be trivial, given Amazonian richness and Andean impoverishment. Reduced richness and poorly developed endemism in Andean bat communities contrast with patterns shown by sympatric rodent faunas, which are diverse and strongly endemic on the Altiplano and markedly zoned along the Eastern Versant. Contrasts are less sharp with bird communities, which nevertheless exhibit stronger zonation and higher endemism. Factors responsible for these distinctive distributional patterns are discussed.

- Patterson, B. D., D. F. Stotz, S. Solari, J. W. Fitzpatrick and V. Pacheco. 1998. Contrasting patterns of elevational zonation for birds and mammals in the Andes of southeastern Peru. *Journal of Biogeography* 25(3): 593-607. ABSTRACT: To determine the generality of avian diversity patterns, we investigated patterns of elevational zonation shown by birds and mammals along the eastern slope of the Andes Mountains in southeastern Peru. The strong environmental gradient sampled, entirely within Peru's Manu National Park and Biosphere Reserve, supports highly diverse faunas. Elevational distributions of 901 bird species, 129 bat species, and twenty-eight species of native mice exhibit contrasting patterns in species richness, species composition, and species turnover. Birds and bats showed smooth declines of species richness with elevation, whereas the richness of mouse assemblages was unrelated to elevation. For all three groups, the greatest differences were between lowland and highland faunas, although cutoff points for this contrast varied among groups (~500 m for birds, 750 m for bats, and 1000 m for mice). Differences in composition also separated bird and bat faunas on either side of c. 1400 m (the boundary between montane forest and cloud forest); for mice, this faunal transition may take place nearer to 2000 m. Bird and bat faunas lacked the more discrete zonations suggested for mouse assemblages, as indicated by elevational range profiles and nested subset analyses. Distinct highland assemblages are apparent in two-dimensional histograms of range limits of birds and mice, but not for bats. Highland bat species occupy broader elevational ranges than lowland bat species, but for both birds and mice, species at intermediate elevations had the broadest amplitudes. Finally, clumping of range maxima and minima along the gradient identified zones of pronounced species turnover in each group, but these were generally not strongly associated with the locations of ecotones. Differences in zonation of these groups appear to reflect their different biological attributes and phylogenetic histories. Such differences obviously complicate discussions of 'general' diversity patterns, and limit the usefulness of birds to forecast or predict diversity patterns in other more poorly known groups - other groups may show elevated diversity and endemism in areas where avian diversity patterns appear unremarkable. The pronounced contrasts between bats and mice, and the generally intermediate character of avian patterns, suggest that future analyses might profitably partition birds into finer, more homogenous groups of histologically and/or ecologically similar species. Group differences in zonation may ultimately prove explicable with information on both species-abundance patterns and resource distributions.
- Paucar Soncco, D. 1999. *Reforestación del Centro Educativo 52188 "Los Cedros" con especies forestales de castaña, para fomentar la educación para el desarrollo sostenible*. Unknown thesis type. Instituto Superior Parroquial Pedagógico Nuestra Señora del Rosario, Puerto Maldonado. 53 pages.
- Paulson, D. 1981. Provisional key to the Odonata known from the Tambopata Reserve. Unpublished report.
- Paulson, D. 1985. Odonata of the Tambopata Reserved Zone, Madre de Dios, Peru. *Revista Peruana de Entomología* 27: 9-14. ABSTRACT: A total of 151 species of Odonata were collected or observed between June 1977 and June 1984 in the TRZ. The main aquatic habitats - large and small lakes, marshes and water courses - were moderately sampled, but future visits by specialists should increase the list to 180-200 species. Tambopata contains a greater wealth of species of Odonata than any other locality so far studied in the world. In brief, many species are restricted to marshes and streams under the canopy, and many others appear to be characteristic of temporary lagoons which are peculiar to the Amazon basin. The collection examined is composed of 1,535 specimens of 147 species; the 4 remaining species correspond to visual recordings. At least 3 other unidentified species were observed. Of the 151 species recorded, 118 were identified as species which have been described and 33 have not yet been described. Of the total number of species identified, 47 (just over a third) are new recordings in Peru. Of the 33 not identified, at least 10 and possibly up to 30 are species new to science. Only one list of species of Odonata has previously been published for South America; this is a contribution by Jurzitza (1981) for the Iguazu National Park (Argentina), in which 106 species were recorded in 3 months of collecting. Another list, unpublished, exists for Limoncocha (Province of Napo, Ecuador); the wealth of Odonata there is similar to that of Tambopata: 145 species collected over several years.
- Paulson, D. R. 1994. Partial field key to the dragonflies known from the Tambopata Reserve, Madre de Dios, Peru. Unpublished report. ABSTRACT: This key has been developed as an aid in the identification of the mature adult Odonata in the field. This key is based, mainly in the coloration of life individuals, which is not applied to the museum specimens. When possible the wing venation is not considered, but it is required basic

knowledge of the anatomy of the Odonata. To use the key, it is required to have the individual in the hand, since many details have to be observed very closely. At this time, the key presents many limitations: (1) it is not applied to females of Calopterygidae, Protoneuridae, Coenagrionidae or Libellulidae (since they are difficult to differentiate): (2) Teneral (just-emerged individuals) have a different coloration than the adults and it is not always possible to differentiate the sexes: (3) immature adults generally are very different than the mature adults and generally look like females: (4) even males of some very similar species cannot be distinguished (5) there is an identification problem among the Coenagrionidae and (6) despite that a considerable work has been carried out in Tambopata, there are still many species to collect, which does not permit an adequate identification. Some guidelines are also given for collection techniques, data registration and specimens preservation.

- Pautrat, L. 2001. Caracterización preliminar de la explotación aurífera en el departamento de Madre de Dios y su influencia en la biodiversidad. Pages 110-128 in L. O. Rodríguez (ed.), *El Manu y otras experiencias de investigación y manejo de bosques neotropicales*. Proyecto Aprovechamiento y Manejo Sostenible de la Reserva de Biosfera y Parque Nacional del Manu (PRO-MANU), Lima.
- Pautrat, L. 2001. Identificación de la biodiversidad focal prioritaria para la conservación de la zona de conectividad Manu-Tambopata. Unpublished report of World Wildlife Fund-Perú and the Sociedad Peruana de Eco-Desarrollo. Lima.
- Pautrat, L. 2001. Análisis de amenazas y oportunidades para la conservación de la biodiversidad de la zona de conectividad ríos Manu-Tambopata. Unpublished report of the Sociedad Peruana de Eco-desarrollo. Puerto Maldonado.
- Pautrat, L. 2001. Elementos de la biodiversidad focal prioritarias para la conservación de la zona de conectividad Manu-Tambopata. Unpublished report of WWF-Perú and the Sociedad Peruana de Ecodesarrollo.
- Pautrat, L. 2002. Comercialización de artesanías confeccionadas a partir de especies silvestres: Un estudio preliminar. Unpublished report for the Embajada de Finlandia, the Instituto Nacional de Recursos Naturales, the Asociación Peruana para la Conservación, and World Wildlife Fund-Perú. Lima. 32 pages.
- Pearson, D. 1985. The tiger beetles (Coleoptera: Cicindelidae) of the Tambopata Reserved Zone, Madre de Dios, Peru. *Revista Peruana de Entomología* 27: 15-24. ABSTRACT: During a period of five years between 1979 and 1984, in an area covering 25 km² in the vicinity of the Explorer's Inn. Twenty-nine species of a group of predator beetles of the family Cicindelidae were recorded; these were recently recognized as a super-tribe (Cicindelitae) of the Carabidae family. Recent studies indicate that this group of beetles is suitable for the generalization of ecological experiments in the tropics, as they are well known taxonomically and are easily observed and managed in the fields, qualities which are even more evident in the laboratory. This contribution presents a list of species, a field key for their identification, and observations on the natural history of each species. The 29 species recorded up to 1984 in the TRZ make this place the tropical forest with the greatest wealth of tiger beetles in the world.
- Pearson, D. 1995. Tiger beetles of Pakitza, Madre de Dios: Identification, natural history and a comparison to the Peruvian fauna (Coleoptera: Cicindelidae). *Cicindela, Revista de la Pontificia Universidad Católica del Ecuador* 27(1-2): 1-28.
- Pearson, D. 1995. Reconocimiento preliminar de flora y fauna: Zona Reservada Tambopata, Madre de Dios, Perú. Pages 9-11 in U. Valdez O. and A. Tovar (eds.), *Reporte Tambopata: Resúmenes de investigaciones en los alrededores del Explorer's Inn/Abstracts of investigations around Explorer's Inn*. Unpublished report by the Centro de Datos para la Conservación (CDC), Universidad Nacional Agraria de La Molina, Conservation International, and Tambopata Reserve Society, Lima.
- Pearson, D. L. 1980. Patterns of limiting similarity in tropical forest tiger beetles (Coleoptera: Cicindelidae). *Biotropica* 12(3): 195-204. ABSTRACT: Sympatric tiger beetles in tropical forests comprise one of the few insect assemblages to exhibit patterns of limiting similarity, principally known for vertebrates (Hutchinsonian ratios). On 10 sites in the Old World (Borneo, New Guinea, Gabon) and New World tropics (Costa Rica, Panama, Ecuador, Peru, Bolivia), the most similar-sized sympatric tiger beetle species had a median mandible length (chord) ratio of 1.35. This ratio was the smallest on sites with more than three ground or undergrowth species ($x = 1.26$) and largest on sites with only two such species ($x = 1.36$). It was also small among species on the same site that foraged for insect prey on different substrates (ground, undergrowth leaves, tree trunks, etc.). Mandible ratios on sites with only two common species that were both ground-foragers were significantly greater than expected from random matches of tiger beetle species pairs. Populations of species that occurred on more than one site all varied geographically in mandible length but showed consistent mandible ratios

(≥ 1.35) with the most similar-sized congener on each site. Preliminary base resource sampling by sticky traps showed a generally similar abundance and size distribution among sites during the initial part of the rainy season. Marked seasonal differences in insect abundance and size range from site to site likely influenced the number of tiger beetle species per plot. The number of dry months (<150 mm hivin x monthly rainfall) was inversely correlated with the number of ground and low foliage foraging tiger beetle species on each plot.

- Pearson, D. L. 1980. Preliminary floral and faunal survey, Tambopata Reserved Zone, Madre de Dios, Peru. Unpublished report for Peruvian Safaris. 35 pages. ABSTRACT: During three weeks of evaluation in the field in November 1979, a small group of Peruvian and foreign scientists made a preliminary inventory of the flora and fauna of TRZ. Dr. Gary S. Hartshorn (Tropical Science Center, Costa Rica), led the vegetation survey. The TRZ is almost entirely covered by unaltered forest. The forest vegetation ranges from impressively tall trees down to the various types of low, stunted vegetation which develops under scattered emergent trees. The survey of invertebrates was coordinated by Dr. David L. Pearson (Pennsylvania State University, USA). In general, little is known of the invertebrate fauna of the TRZ. However, certain groups have been well studied. Ann L. Rypstra reports that less than half of the species of spider found in the lower strata of the forest can be identified at species level. However, she estimates that about 44 species belonging to 33 different families have been found in areas of 15 m². Ronald L. Huber has identified 20 species of tiger beetle (Coleoptera: Cicindelidae) collected in the TRZ. Nine of them are found in the forest and 11 around the river. So far, only Borneo (Indonesia) is known to be as rich in species of beetles as Tambopata (Pearson, previous survey). Drs. John Heppner and David L. Pearson added 15 species to the list of Odonata previously known in the TRZ (Dr. Dennis R. Paulson and colleagues: 88 species belonging to 11 families). The total number: 103 species (10% recently identified) is a world record for any locality of comparable area. Eric M. Fisher identified 21 species of Asilidae flies (Diptera), 12 of them probably not described. Drs. John B. Heppner and Gerardo Lamas collected moths and butterflies (Lepidoptera), but the identification and counting of species will take some time. Basing himself on these preliminary collections, Heppner has estimated that there must be a total of 20,000 species of Lepidoptera in the TRZ. Knowledge of reptiles and amphibians in the ZRT is still relatively limited. The inventory directed by Dr. Roy McDiarmid (National Fish and Wildlife Laboratory, Washington, D.C., USA) revealed the existence of 80 species of reptiles and amphibians (many of them new to science), including three species of tortoise (Chelidae), three caymans (Crocodylidae), 14 lizards, one amphisbaenid, 16 snakes and 43 toads and frogs (Anura). It is estimated that the total number of reptile and amphibian species present may reach 200. The black cayman (*Melanosuchus niger*), currently in danger of extinction, is well represented in the TRZ. The birdlife of the TRZ is extremely rich in species and in unusual forms. The total list of species recorded under the direction of Theodore A. Parker (Louisiana State University, USA) includes 509 species and constitutes the largest inventory of birds recorded in any locality in the world. This exceptional diversity is in part due to the presence of species characteristic of three different systems within the Amazon basin: the high forest of the eastern slopes of the Andes; the basin of the river Ucayali and the upper Amazon; and the basin of the river Madre de Dios and the Madeira. The unusual abundance and diversity of parrots (18 species, including six macaws, *Ara* spp.), and toucans (eight species) indicates that the disturbance of bird life by human activities has been minimal (except for some cracids, particularly *Mitu mitu*); even *Harpia harpyja* is still found in this locality. The organization of the inventory on mammals was in the hands of Dr. Louise H. Emmons (Smithsonian Institution, USA). Most of the species found in the TRZ have a wide distribution in western Amazonia. Some, such as *Dasyprocta variegata yungarum* and *Marmosa cinerea* cf. *rapposa*, are characteristic of the southern drier part of Amazonia. Another unusual species is *Speothos venaticus*, which has been observed several times in the vicinity of the lodge; other noteworthy species are the giant river otter *Pteronura brasiliensis* and *Tapirus terrestris*, four species of Felidae and nine species of primates.
- Pearson, D. L. 1992. Tiger beetles (Coleoptera: Cicindelidae) as indicators for biodiversity patterns in Amazonia. *National Geographic Research and Exploration* 8(1): 116-117.
- Pearson, D. L. and J. J. Anderson. 1985. Perching heights and nocturnal communal roosts of some tiger beetles (Coleoptera, Cicindelidae) in southeastern Peru. *Biotropica* 17(2): 126-129. ABSTRACT: Roosting and perching in insects is a behaviour pattern which is easy to observe and quantify in tropical forest habitats. This report presents data from observations of tiger-beetles made in the TRZ between September 1981 and August 1983. These observations can be compared with observations of perching and nocturnal rest described for other groups of insects in tropical forests. For example, the height of perching correlates with body size, a behavior pattern which has been attributed to search behavior for a limited resource; the frequently communal nocturnal roost of butterflies has been attributed to thermoregulation and protection against physical factors and predation. When tiger-beetles (Coleoptera: Cicindelidae) of diurnal activity are disturbed, they fly from their feeding site, in the undergrowth, to temporary perches where they remain for 10 to 15 minutes. The height of these perches correlates with the body size of the species, so the bigger ones use higher perching positions. At night, these Coleoptera rest for between 10 and 12 hours at the same height as the perches that they use temporarily during the day. At the beginning of the rainy season, some species congregate in communal sleeping places in groups of 2 to 9 individuals. The species that inhabit riverside beaches rest on

grass plants; when 10 individuals were taken from their resting places and deposited on the ground, 4 of them were caught by bigger, nocturnally active tiger-beetles within 2 minutes. This reinforces the idea that nocturnal rest at a distance from the surface of the ground avoids the action of terrestrial predators.

- Pearson, D. L. and F. Cassola. 1992. Worldwide species richness patterns of tiger beetles (Coleoptera, Cicindelidae): Indicator taxon for biodiversity and conservation studies. *Conservation Biology* 6(3): 376-391. ABSTRACT: The family of tiger beetles (Cicindelidae) is an appropriate indicator taxon for determining regional patterns of biodiversity because (1) its taxonomy is stabilized; (2) its biology and general life history are well understood; (3) individuals are readily observed and manipulated in the field; (4) the family occurs world-wide and in a broad range of habitat types; (5) each species tends to be specialized within a narrow habitat; (6) patterns of species richness are highly correlated with those of other vertebrate and invertebrate taxa; and (7) the taxon includes species of potential economic importance. Logistical advantages provide some of the strongest arguments for selecting tiger beetles as an appropriate indicator taxon. Species numbers of tiger beetles are relatively well known for 129 countries. Eight countries alone account for more than half the world total of 2028 known species. Species numbers are also indicated for eleven biogeographical zones of the world. For gridded squares across North America, the Indian subcontinent, and Australia, species richness of tiger beetles, birds, and butterflies shows significant positive correlations. However, tiger beetle species numbers can be reliably determined within fifty hours on a single site, compared to months or years for birds or butterflies, and the advantage of using tiger beetles in conservation biology is evident.
- Pearson, D. L. and J. A. Derr. 1986. Seasonal patterns of lowland forest floor arthropod abundance in southeastern Peru. *Biotropica* 18(3): 244-256. ABSTRACT: A two-year study with semi-monthly collections of forest floor arthropods and periodic monitoring of temperature, relative humidity and soil moisture for three habitats of different soil drainage (terra firme, bamboo and flood plain) was conducted at the TRZ. Several diurnal and seasonal patterns of arthropod biomass occurred. All habitats followed parallel and coincident profiles of arthropod biomass through the four major seasons covered by this study (two years of wet and dry seasons). Biomass in wet seasons was greater than biomass in dry seasons. The strongest association between arthropod biomass and environmental measures occurred with the contemporary measurement of maximum temperature, but only two habitats, terra firme and bamboo, showed this association. The flood plain habitat showed no detectable associations between arthropod biomass and short term environmental measures. The total number of individual arthropods trapped over the two years was highest for the bamboo habitat and lowest for the flood plain. The smallest overall mean individual mass was in the bamboo habitat, and the highest was in the flood plain. The seasonal change in this mean individual mass value was regular for the flood plain, less regular for the bamboo habitat and irregular for the terra firme forest. Of all the higher arthropod taxa trapped, the Coleoptera and to a lesser extent the Collembola, exhibited consistent and distinct seasonal patterns. Other taxa such as ants, Diptera and Orthoptera either showed seasonal patterns in one forest type or none at all.
- Pearson, D. L. and R. L. Dressler. 1985. Two-year study of male orchid bee (Hymenoptera: Apidae: Euglossini) attraction to chemical baits in lowland south-eastern Peru. *Journal of Tropical Ecology* 1: 37-54. ABSTRACT: A number of male bee pollinators of orchids were attracted and captured, using chemical baits reassembling natural orchid scents, at locations in both forest subject to flooding and on terra firma in the TRZ. 38 species of bees were attracted by these chemical substances and collected in the two locations; of these, 11 were significantly more common in one of the habitats than in the other. A great variation was found in the number and types of chemical baits that interested the bees, and there were two seasonal periods of abundance of individuals and species of bees using the chemical baits. The greatest success was achieved at the end of the first month of the rainy season, and the least success was during the dry season. Individual body size by species was associated with seasonal activity, though other factors such as floral phenology and parasitoids could also have been involved. The number of euglossine bee species found in the TRZ was similar to that found in other forested areas of Costa Rica, Panama and central and eastern Brazil. This homogeneity of species richness contrasts notably with other groups of insects such as: Odonata, Lepidoptera, Diptera (Asilidae and Tabanidae) and Coleoptera (Cicindelidae), in which the numbers of species found in the TRZ are the highest in the world (when compared with areas of similar size). Of the total of 20 baits that were tried, four did not attract any bees, 11 attracted just a few and five were the main attractors. Males of a total of 39 orchid pollinating bee species, belonging to the genera *Eufriesia*, *Euglossa*, *Eulaema* and *Exaerete*, were found in the TRZ. Only *Eulaema polyzona* was not attracted by any chemical bait, and two species: *Euglossa perviridis* and *Exaerete dentata*, were collected with baits other than the five best. As in Costa Rica and Panama, there is considerable species variation in the types and range of chemical substances to which the bees were attracted. Some species such as *Euglossa despecta* and *E. mixta* were attracted by a particular bait, while species like *E. augaspis* were attracted by the five most effective baits. With regard to seasonal changes in chemical attraction, it was found that of the six commonest species, three of the ones that were the first arrivals at one or two chemical attractants, *Euglossa imperialis*, *E. mixta* and *Eulaema meriana* showed no significant difference in any of the five temporal comparisons of frequency of chemical attraction. Species that were attracted to a wider range of baits, such as *Euglossa augaspis* and *E. chalybeata*, showed significant differences

for the five seasonal comparisons that were carried out.

- Pejoves, J. 1991. Crianza de mariposas en la Zona Reservada Tambopata, Madre de Dios, Perú. Unpublished preliminary report no. 3 of the Centro de Estudios Biológicos. 40 pages.
- Pereira, L. A., D. Foddai and A. Minelli. 1997. Zoogeographical aspects of Neotropical Geophilomorpha (Chilopoda). *Entomologica Scandinavica Supplement* 51: 77-86. ABSTRACT: Of the ca.1000 species of Geophilomorpha known world-wide, nearly one in three has been described from the Neotropical Region (NTR); that is (out of brackets, figures for NTR plus the whole of Mexico (Mx); in brackets NTR without Mx): 330(268) species in 96 (81) genera in 12 (10) families. Of the 81 NTR genera, 39 are monotypic (48%). The endemic genera in the NTR without Mx are 50 out of 81 (62%). In the Caribbean area there are nine endemic genera and 39 endemic species. This fauna is apparently young, nearly all endemic taxa belonging to world-wide or at least pantropical families. However, the genera with the largest species number on mainland NTR are poorly represented in the Caribbean area. On the Galapagos Is. there are two endemic genera and five endemic species. A Magellanian fauna is hardly recognizable. The geophilid genus *Geoperingueyia* and the family Aphilodontidae link the Neotropical to the South African fauna. Other NTR taxa have close relatives in tropical Africa or, more generally, in the tropics. The Mexican fauna is quite rich and diverse. It is difficult to identify the Northern limits of the NTR and, consequently, to ascertain the origin of the several genera whose distribution is centred in Mx, with a few outliers. Overall, there is hardly any evidence of genera having crossed the Panama bridge in either direction. The high altitude fauna is poorly known. Most common on the Peruvian Andes are the widespread (sub)genera *Schendylops* and *Ribautia* (*Schizoribautia*), with endemic species. Many species of *Schendylops*, *Pectiniunguis* and *Ribautia* are endemic to areas identified as Pleistocenic Refugia by Prance (1982, *Forest refuges: evidence from woody Angiosperms*, in Prance (Ed.): *Biological diversification in the Tropics*. New York).
- Peres, C. A. 1997. Primate community structure at twenty western Amazonian flooded and unflooded forests. *Journal of Tropical Ecology* 13: 381-405. ABSTRACT: This paper presents data from a standardized series of line-transect censuses on the species and subspecies composition, population density, and crude biomass of western Amazonian primate communities occurring at eight flooded (=varzea) and 12 unflooded (=terra firme) forests. These were located primarily along one of the largest white-water tributaries of the Amazon (=Solimoes), the Jurua river. On average, terra firme forests contained twice as many primate species, lower population densities, and less than half of the total community biomass than did adjacent varzea forests. There was a clear habitat-dependent positive association among primate species, particularly within varzea forests, as well as marked shifts in guild structure between forest types. Species turnover between these two forest types involved primarily understorey insectivores (e.g. *Saguinus* sp.), which do not occur in seasonally inundated forest. These were consistently replaced by squirrel monkeys (*Saimiri* sp.), which are extremely abundant in annually flooded varzea forests. Similarly, large-bodied folivores such as red howler monkeys (*Alouatta seniculus*) were uncommon or rare in terra firme forests, but very abundant in varzea forests, even though they are hunted less intensively in the former than in the latter. This can be largely explained by the nutrient-rich alluvial soils of young floodplains, compared to the heavily weathered terra firme soils occurring even within short distances of major white-water rivers. This study clearly shows a reversed diversity/density pattern resulting from the lower species richness, but high overall community biomass of seasonally flooded Amazonian forests, which can now be generalized for a wide range of terrestrial vertebrate taxa, including amphibians, birds, and several other orders of mammals.
- Peres, C. A. 1999. The structure of nonvolant mammal communities in different Amazonian forest types. Pages 564-581 in J. F. Eisenberg and K. H. Redford (eds.), *Mammals of the Neotropics: The central Neotropics*. University of Chicago Press, Chicago.
- Peres, C. A. 2000. Effects of subsistence hunting on vertebrate community structure in Amazonian forests. *Conservation Biology* 14(1): 240-253. ABSTRACT: Subsistence hunting affects vast tracts of tropical wilderness that otherwise remain structurally unaltered, yet distinguishing hunted from nonhunted tropical forests presents a difficult problem because this diffuse form of resource extraction leaves few visible signs of its occurrence. I used a standardized series of line-transect censuses conducted over a 10-year period to examine the effects of subsistence game harvest on the structure of vertebrate communities in 25 Amazonian forest sites subjected to varying levels of hunting pressure. Crude vertebrate biomass, which was highly correlated with hunting pressure, gradually declined from nearly 1200 kg km⁻² at nonhunted sites to less than 200 kg km⁻² at heavily hunted sites. Hunting had a negative effect on the total biomass and relative abundance of vertebrate species in different size classes at these forest sites, but it did not affect their overall density. In particular, persistent hunting markedly reduced the density of large-bodied game species (>5 kg), which contributed a large proportion of the overall community biomass at nonhunted sites (65-78%) and lightly hunted sites (55-71%). Nutrient-rich floodplain forests contained a consistently greater game biomass than nutrient-poor unflooded forests, once I controlled for the effects of hunting pressure. Conservative

estimates of game yields indicate that as many as 23.5 million game vertebrates, equivalent to 89.224 tons of bushmeat with a market value of US\$190.7 million, are consumed each year by the rural population of Brazilian Amazonia, which illustrates the enormous socioeconomic value of game resources in the region. My cross-site comparison documents the staggering effect of subsistence hunters on tropical forest vertebrate communities and highlights the importance of considering forest types and forest productivity in game management programs.

- Peres, C. A., C. Baider, P. A. Zuidema, L. H. O. Wadt, K. A. Kainer, D. A. P. Gomes-Silva, R. P. Salomao, L. L. Simoes, E. R. N. Franciosi, F. C. Valverde, R. Gribel, G. H. Shepard, M. Kanashiro, P. Coventry, D. W. Yu, A. R. Watkinson and R. P. Freckleton. 2003. Demographic threats to the sustainability of Brazil nut exploitation. *Science* 302(5653): 2112-2114. ABSTRACT: A comparative analysis of 23 populations of the Brazil nut tree (*Bertholletia excelsa*) across the Brazilian, Peruvian, and Bolivian Amazon shows that the history and intensity of Brazil nut exploitation are major determinants of population size structure. Populations subjected to persistent levels of harvest lack juvenile trees less than 60 centimeters in diameter at breast height; only populations with a history of either light or recent exploitation contain large numbers of juvenile trees. A harvesting model confirms that intensive exploitation levels over the past century are such that juvenile recruitment is insufficient to maintain populations over the long term. Without management, intensively harvested populations will succumb to a process of senescence and demographic collapse, threatening this cornerstone of the Amazonian extractive economy.
- Peres, C. A. and P. M. Dolman. 2000. Density compensation in neotropical primate communities: Evidence from 56 hunted and nonhunted Amazonian forests of varying productivity. *Oecologia* 122(2): 175-189. ABSTRACT: Density compensation is a community-level phenomenon in which increases in the abundance of some species may offset the population decline, extirpation, or absence of other potentially interacting competitors. In this paper we examine the evidence for density compensation in neotropical primate assemblages using data from 56 hunted and nonhunted, but otherwise undisturbed, forest sites of Amazonia and the Guianan shields from which population density estimates are available for all diurnal primate species. We found good evidence of density compensation of the residual assemblage of nonhunted mid-sized species where the large-bodied (ateline) species had been severely reduced in numbers or driven to local extinction by subsistence hunters. Only weak evidence for density compensation, however, was detected in small-bodied species. These conclusions are based on the effects of ordinal measures of hunting pressure on the aggregate primate biomass across different size classes after controlling for the effects of forest type and productivity. These results are interpreted primarily in relation to patterns of niche partitioning between different primate functional groups or ecospecies. This study suggests that while overhunting drastically reduces the average body size in multi-species assemblages of forest vertebrates, depletion of large-bodied species is only partially offset (i.e. undercompensated) by smaller taxa.
- Peres, C. A. and J. W. Terborgh. 1995. Amazonian nature reserves: An analysis of the defensibility status of existing conservation units and design criteria for the future. *Conservation Biology* 9(1): 34-46. ABSTRACT: Many tropical nature reserves are woefully understaffed or exist only on paper. Without effective implementation tropical reserves cannot count on in situ enforcement and consequently are subject to a wide range of invasive threats. Weak institutional structures are aggravated by reserve designs that facilitate rather than discourage unlawful human activities. Taking into account severe financial and institutional constraints we consider the current status of forest reserves in lowland Amazonia. We ask how the criteria by which reserves are delimited may affect the efficiency with which the contained areas are defended. In a GIS analysis, we found that 40 to 100% of the area of all existing nature reserves in Brazilian Amazonia are directly accessible via navigable rivers and/or functional roads. Such access greatly facilitates the illegal harvest and conversion of forest resources in a region where each guard is responsible for protecting an area larger than the State of Delaware. Cost-effective defense of large areas can be achieved through appropriate delimitation of reserves along watershed divides and by efficient deployment of limited infrastructure and personnel. Given current and probable future levels of financial resources allocated to reserve maintenance in Amazonia, any new nature reserves in this region should be designed and situated so that their defensibility is maximized. Defensibility criteria should complement site considerations based on biological criteria, such as presumed centers of diversity and endemism.
- Perez-Pereyra, A. 1993. Perfiles de proyectos agrarios y agroindustriales para la selva de Madre de Dios. Madre de Dios. 290 pages.
- PERPNM. 1997. Memoria anual. Unpublished report of the Proyecto Especial Regional del Parque Nacional del Manu (PERPNM).
- PERPNM. 1998. Memoria anual. Unpublished report of the Proyecto Especial Regional del Parque Nacional del Manu (PERPNM).

- Peters, H. A., A. Pauw, M. R. Silman and J. W. Terborgh. 2004. Failing palm fronds structure Amazonian rainforest sapling communities. *Proceedings of the Royal Society of London Series B-Biological Sciences* 271: S367-S369. ABSTRACT: The senescence and loss of photosynthetic and support structures is a nearly universal aspect of tree life history, and can be a major source of disturbance in forest understoreys, but the ability of falling canopy debris in determining the stature and composition of understorey communities seems not to have been documented. In this study, we show that senescent fronds of the palm *Iriartea deltoidea* cause substantial disturbance in tropical forest sapling communities. This disturbance influences the species composition of the canopy and subcanopy by acting as an ecological filter, favouring sapling species with characteristics conducive to recovery after physical damage. The scale of this dominance suggests that falling *I. deltoidea* debris may be influencing sapling community structure and species composition in Amazonian rainforests over very large spatial scales.
- Petty, J. M. 1989. *Observations on the ecology of a Peruvian Ameiva lizard*. Undergraduate thesis. Biology Department, Princeton University, Princeton, USA. 30 pages.
- Pflucker, L. 1903. Gomales en el río Inambari. *Boletín del Ministerio de Fomento* 1(11): 47.
- Phillips, K. A., B. W. Grafton and M. E. Haas. 2003. Tap-scanning for invertebrates by capuchins (*Cebus apella*). *Folia Primatologica* 74: 162-164.
- Phillips, O. 1990. *Ficus insipida* (Moraceae): Ethnobotany and ecology of an Amazonian anthelmintic. *Economic Botany* 44(4): 534-536. ABSTRACT: *Ficus insipida* (oje), is the most widespread of the neotropical non-strangling figs. It is well-known among the local inhabitants due to its antihelminthic effects of its latex, which seems to be caused by the enzyme ficin. Near Iquitos (Peru), the latex was commercially exploited earlier this century for export as a vermifuge; at present time there is a world market for dried latex, as digestive aid, as a meat tenderizer and as child-proofing in beer. Due to this commercial pressure the species is already extinct in some locations of western Amazon. In spite of the situation of the species, the need of an anthelmintic for the Amazonian human population has been increasing, since many groups of indians, pertaining to missions and communities have been affected by sanitary problems. In most villages over 90% of individuals are infected by parasites and the most affected are children, who sometimes die due to this infection. Clinical studies have proved that the latex of *F. insipida* is a safe and highly effective remedy for intestinal helminthiasis. This work presents the results of an inventory made in 50 ha of the main forest types in TRZ where the density of *F. insipida* was evaluated as well as the possibilities that individuals of this species reach their maturity without perturbations of human activities and that of storing viable seeds to establishing nurseries. Suggestions to promote the sustainable use of the species are offered, based in a 4-month study, and on the uses that the ethnic group Ese-Ejá, living in this region, gives to it.
- Phillips, O. 1993. The potential for harvesting fruits in tropical rainforests: New data from Amazonian Peru. *Biodiversity and Conservation* 2: 18-38. ABSTRACT: In recent years, the interest in the sustainable yield of non-timber forest products has grown as an alternative to deforestation. Ecologists and social scientists have begun to evaluate the actual and potential value of these products, therefore many biological aspects remain unanswered (broad research on edible fruits and nuts have been highly publicized, but little is known about productivity). This work tried to solve the following questions about the forest productivity in the southeast Peruvian Amazon: How does total productivity vary from one forest type to another?; How accessible is this productivity to the ground-based collector?; Are there marked seasonal peaks and troughs in fruit availability? The data shows that edible fruit and nut production on Amazonian forests are lower than most conservationists assume. Direct measures of Peruvian Amazon show that two terra firme forest types produce significantly less edible fruit than an alluvial soil forest. Swamp forest has the highest edible fruit productivity than any other forest type measured. Palms contribute with 60% of edible fruit productivity (averaged over three forest types), but the most preferred palm fruits are difficult to harvest because they are too high for easy access by collectors.
- Phillips, O. 1993. Una clasificación y descripción de los bosques de Tambopata. Unpublished report. 41 pages. ABSTRACT: Se presenta una clasificación y clave de identificación de los nueve tipos de bosque de la ZRT. Se describe la topografía, hidrología, suelos, composición florística, vegetación y productividad de cada tipo de bosque. Se exponen los procesos naturales de sucesión y perturbación que determinan las características de los bosques de la zona. Finalmente, se describen los tipos de bosque de la ZRT que la red de trochas atraviesa, con fines de facilitar estudios en el área.
- Phillips, O. 1994. Summary of the vegetation of Explorer's Inn Reserve. Pages 52-54 in R. B. Foster, J. L. Carr and A. B. Forsyth (eds.), *The Tambopata-Candamo Reserved Zone of southeastern Peru: A biological assessment*. Conservation International, Washington, DC, USA.

- Phillips, O. and T. Baker. 2002. Manual de campo para el establecimiento y remediación de parcelas permanentes. Unpublished report of the Red Amazónica Inventarios Forestales (RAINFOR). 13 pages.
- Phillips, O. and A. H. Gentry. 1993. The useful plants of Tambopata, Peru. 1. Statistical hypotheses tests with a new quantitative technique. *Economic Botany* 47(1): 15-32. ABSTRACT: This paper describes a new, simple, quantitative technique for evaluating the relative usefulness of plants to people. The technique is then compared to the quantitative approaches in ethnobotany that have been developed recently. Our technique is used to calculate the importance of over 600 species of woody plants to non-indigenous mestizo people in Tambopata, Amazonian Peru. Two general classes of hypotheses are formulated and tested statistically, concerning (1) the relative importance of different species, and (2) the importance of different families. The plant families are compared with respect to all uses, and with respect to five broad groups of uses. Palms, Annonaceae, and Lauraceae were found to be the most useful woody plant families. On average, the 20 largest woody plant families are most important to mestizos for subsistence construction materials, followed in descending order by commercial, edible, technological, and medicinal uses.
- Phillips, O. and A. H. Gentry. 1993. The useful plants of Tambopata, Peru. 2. Additional hypothesis-testing in quantitative ethnobotany. *Economic Botany* 47(1): 33-43. ABSTRACT: We present results of applying a simple technique to statistically test several hypotheses in ethnobotany, using plant use data from non-indigenous people in southeast Peru. Hypotheses tested concern: (1) the power of eight different variables as predictors of a plant's use value; (2) comparisons of ethnobotanical knowledge among informants; and (3) the relationship between informant age and knowledge of plant uses. Each class of hypothesis is evaluated with respect to all uses, and classes (1) and (3) are evaluated for each of the following subsidiary use categories: construction, edible, commerce, medicine, and technology. We found that the family to which a plant belongs explains a large part of the variance in species' use values. Each of the other factors analyzed (growth-form, density, frequency, mean and maximum diameter, mean and maximum growth rate) is also significantly predictive of use values. Age significantly predicts informant knowledge of (1) all uses, and (2) of medicinal uses. Plant medicinal lore is particularly vulnerable to acculturation.
- Phillips, O., A. H. Gentry, C. Reynel, P. Wilkin and B. C. Gálvez Durand. 1994. Quantitative ethnobotany and Amazonian conservation. *Conservation Biology* 8(1): 225-248. ABSTRACT: We use quantitative ethnobotanical data to compare the usefulness of six floristically distinct forest types to mestizo people at Tambopata, southeast Peru. We aim to evaluate which forest types are most useful, and why. Ethnobotanical data were collected with informants in inventory plots and analyzed using a new technique that uses a two-tier calculation process to derive an "informant indexed" estimate of each species' use value. Use values are estimated based on the degree of consistency between repeated interviews of each informant and between different informants. We show that (1) in 6.1 ha, 94% of woody stems are "useful" to mestizos. (2) Based on percentages of useful plants per plot, there is little difference between each forest type. (3) Simply calculating the percent of useful plants is misleading, however, because most species have minor uses and only a few are exceptionally useful. (4) Using the informant indexing technique, we demonstrate significant differences between each forest type's utility. Mature forests of present and former floodplains are more useful than other forest types, mostly due to their importance as sources of construction materials and food. (5) Lower floodplain is more useful medicinally, swamp more important commercially, and terra firme sandy more important technologically; they are not easily substituted for some of these uses. (6) On average, 80% of the value of forest plant products to mestizos is subsistence value; only 20% is commercial. We conclude that (1) to maintain cultural autonomy, Amazonian people may need access to all local forest types, and (2) present and former floodplain forests in western Amazonia should be a conservation priority. We make these broad conclusions on the basis of evidence of: (1) ethnoecological similarities among mestizo cultures in Peruvian Amazonia; (2) the similarity of family-level floristic composition at Tambopata and elsewhere in western Amazonia; (3) rapid floodplain deforestation; and (4) floodplain resource overextraction. Conservationists should focus on helping communities gain control of floodplain resources.
- Phillips, O. L. 1992. *Ficus insipida* (Moraceae): Etnobotánica y ecología de un antihelmíntico Amazónico. *Revista Forestal del Perú* 19: 91-95.
- Phillips, O. L. 1993. *Comparative valuation of tropical forests in Amazonian Peru*. Ph.D. dissertation. Washington University, St. Louis, USA. pages.
- Phillips, O. L. 1996. Long-term environmental change in tropical forests: Increasing tree turnover. *Environmental Conservation* 23(3): 235-248. ABSTRACT: Analyzing permanent plot data from 40 tropical forest sites, Phillips and Gentry (1994) found that there has been a significant tendency for tree turnover - as measured by tree mortality and recruitment - to increase since the 1950s. The dataset is now substantially improved, and includes 67 mature forest sites with turnover data representing most of the major tropical forest regions of the

world. This paper presents an updated and expanded analysis of the latest data, and confirms that tree turnover has increased in mature tropical forest plots. Several artifactual explanations have been suggested but none are supported by the available data, suggesting that surviving mature tropical forests have been recently affected by large-scale anthropogenic or natural change. The effects of increased turnover may include impacts on future global atmosphere, climate, and biodiversity. Better understanding of the ecological changes in mature tropical forests depends on progress in two critical research areas - a ground-based monitoring network of long-term, fully identified tropical forest plots, and controlled manipulation of atmospheric conditions in forest experiments. Research activity in both areas needs to be substantially increased if we are to understand and predict the complex interactions between tropical forest ecology and global environmental change.

- Phillips, O. L. 1997. The changing ecology of tropical forests. *Biodiversity and Conservation* 6(2): 291-311. ABSTRACT: The threat to tropical forests is often gauged in terms of deforestation rates and the total area remaining. Recently, however, there has been a growing realization that forest can appear intact on a satellite image yet be biologically degraded or vulnerable to degradation. The array of direct threats to humid tropical forest biodiversity, in addition to deforestation, includes: selective extraction of plants; selective extraction of animals, biological invasion; fragmentation; climate change; changing atmospheric composition; and increasing tree turnover rates. The threats are linked to one another by a poorly understood network of causality and feedback effects. Moreover, their potential impacts on forest biodiversity are hard to assess because each threat is as likely to precipitate indirect effects as direct effects, and because several threats are likely to interact synergistically with one another. In spite of the uncertainties, it is clear that the biological health of tropical forests can become seriously degraded as a result of these threats, and it is unlikely that any tropical forest will escape significant ecological changes. Some groups of plants and animals are likely to benefit at the expense of others. Species diversity is expected to decline as a consequence of the changes in forest ecology. In the 21st century scientists and conservationists will be increasingly challenged to monitor, understand, prevent and head off these threats.
- Phillips, O. L., T. R. Baker, L. Arroyo, N. Higuchi, T. J. Killeen, W. F. Laurance, S. L. Lewis, J. Lloyd, Y. Malhi, A. Monteagudo, D. A. Neill, P. N. Vargas, J. N. M. Silva, J. Terborgh, R. V. Martinez, M. Alexiades, S. Almeida, S. Brown, J. Chave, J. A. Comiskey, C. I. Czimczik, A. Di Fiore, T. Erwin, C. Kuebler, S. G. Laurance, H. E. M. Nascimento, J. Olivier, W. Palacios, S. Patino, N. C. A. Pitman, C. A. Quesada, M. Salidas, A. T. Lezama and B. Vinceti. 2004. Pattern and process in Amazon tree turnover, 1976-2001. *Philosophical Transactions of the Royal Society of London Series B-Biological Sciences* 359(1443): 381-407. ABSTRACT: Previous work has shown that tree turnover, tree biomass and large liana densities have increased in mature tropical forest plots in the late twentieth century. These results point to a concerted shift in forest ecological processes that may already be having significant impacts on terrestrial carbon stocks, fluxes and biodiversity. However, the findings have proved controversial, partly because a rather limited number of permanent plots have been monitored for rather short periods. The aim of this paper is to characterize regional-scale patterns of 'tree turnover' (the rate with which trees die and recruit into a population) by using improved datasets now available for Amazonia that span the past 25 years. Specifically, we assess whether concerted changes in turnover are occurring, and if so whether they are general throughout the Amazon or restricted to one region or environmental zone. In addition, we ask whether they are driven by changes in recruitment, mortality or both. We find that: (i) trees 10 cm or more in diameter recruit and die twice as fast on the richer soils of southern and western Amazonia than on the poorer soils of eastern and central Amazonia; (ii) turnover rates have increased throughout Amazonia over the past two decades; (iii) mortality and recruitment rates have both increased significantly in every region and environmental zone, with the exception of mortality in eastern Amazonia; (iv) recruitment rates have consistently exceeded mortality rates; (v) absolute increases in recruitment and mortality rates are greatest in western Amazonian sites; and (vi) mortality appears to be lagging recruitment at regional scales. These spatial patterns and temporal trends are not caused by obvious artefacts in the data or the analyses. The trends cannot be directly driven by a mortality driver (such as increased drought or fragmentation-related death) because the biomass in these forests has simultaneously increased. Our findings therefore indicate that long-acting and widespread environmental changes are stimulating the growth and productivity of Amazon forests.
- Phillips, O. L. and A. H. Gentry. 1994. Increasing turnover through time in tropical forests. *Science* 263(5149): 954-958. ABSTRACT: Tree turnover rates were assessed at 40 tropical forest sites. Averaged across inventoried forests, turnover, as measured by tree mortality and recruitment, has increased since the 1950s, with an apparent pantropical acceleration since 1980. Among 22 mature forest sites with two or more inventory periods, forest turnover also increased. The trend in forest dynamics may have profound effects on biological diversity.
- Phillips, O. L., P. Hall, A. H. Gentry, S. A. Sawyer and R. Vasquez. 1994. Dynamics and species richness of tropical rain-forests. *Proceedings of the National Academy of Sciences of the United States of America* 91(7): 2805-2809. ABSTRACT: We present a worldwide analysis of humid tropical forest dynamics and tree species

richness. New tree mortality, recruitment, and species richness data include the most dynamic and diverse mature tropical forests known. Twenty-five sites show a strong tendency for the most species-rich forests to be dynamic and aseasonal. Mean annual tree mortality and recruitment-turnover is the most predictive factor of species richness, implying that small-scale disturbance helps regulate tropical forest diversity. Turnover rates are also closely related to the amount of basal area turnover in mature tropical forests. Therefore the contribution of small-scale disturbance to maintaining tropical forest diversity may ultimately be driven by ecosystem productivity.

- Phillips, O. L., Y. Malhi, N. Higuchi, W. F. Laurance, P. V. Núñez, R. M. Vásquez, S. G. Laurance, L. V. Ferreira, M. Stern, S. Brown and J. Grace. 1998. Changes in the carbon balance of tropical forests: Evidence from long-term plots. *Science* 282(5388): 439-442. ABSTRACT: The role of the world's forests as a "sink" for atmospheric carbon dioxide is the subject of active debate. Long-term monitoring of plots in mature humid tropical forests concentrated in South America revealed that biomass gain by tree growth exceeded losses from tree death in 38 of 50 Neotropical sites. These forest plots have accumulated 0.71 ton, plus or minus 0.34 ton, of carbon per hectare per year in recent decades. The data suggest that Neotropical forests may be a significant carbon sink, reducing the rate of increase in atmospheric carbon dioxide.
- Phillips, O. L., Y. Malhi, B. Vinceti, T. Baker, S. L. Lewis, N. Higuchi, W. F. Laurance, P. N. Vargas, R. V. Martinez, S. Laurance, L. V. Ferreira, M. Stern, S. Brown and J. Grace. 2002. Changes in growth of tropical forests: Evaluating potential biases. *Ecological Applications* 12(2): 576-587. ABSTRACT: Over the past century almost every ecosystem on Earth has come under the influence of changes in atmospheric composition and climate caused by human activity, Tropical forests are among the most productive and extensive ecosystems, and it has been hypothesized that both the dynamics and biomass of apparently undisturbed, old-growth tropical forests have been changing in response to atmospheric changes. Long-term forest sample plots are a critical tool in detecting and monitoring such changes, and our recent analysis of pan-tropical-forest plot data has suggested that the biomass of tropical forests has been increasing, providing a modest negative feedback on the rate of accumulation of atmospheric CO₂. However it has been argued that some of these old forest plot data sets have significant problems in interpretation because of the use of nonstandardized methodologies. In this paper we examine the extent to which potential field methodological errors may bias estimates of total biomass change by detailed examination of tree-by-tree records from up to 120 Neotropical plots to test predictions from theory. Potential positive biases on measurements of biomass change include a bias in site selection, tree deformities introduced by the measurement process, poor methodologies to deal with tree deformities or buttresses, and nonrecording of negative growth increments. We show that, while it is important to improve and standardize methodologies in current and future forest-plot work, any systematic errors introduced by currently identified biases in past studies are small and calculable. We conclude that most tropical-forest plot data are of useful quality, and that the evidence does still weigh conclusively in favor of a recent increase of biomass in old-growth tropical forests.
- Phillips, O. L., R. V. Martinez, L. Arroyo, T. R. Baker, T. Killeen, S. L. Lewis, Y. Malhi, A. M. Mendoza, D. Neill, P. N. Vargas, M. Alexiades, C. Ceron, A. Di Fiore, T. Erwin, A. Jardim, W. Palacios, M. Saldias and B. Vinceti. 2002. Increasing dominance of large lianas in Amazonian forests. *Nature* 418(6899): 770-774. ABSTRACT: Ecological orthodoxy suggests that old-growth forests should be close to dynamic equilibrium, but this view has been challenged by recent findings that neotropical forests are accumulating carbon(1,2) and biomass(3,4), possibly in response to the increasing atmospheric concentrations of carbon dioxide(5,6). However, it is unclear whether the recent increase in tree biomass has been accompanied by a shift in community composition. Such changes could reduce or enhance the carbon storage potential of old-growth forests in the long term. Here we show that non-fragmented Amazon forests are experiencing a concerted increase in the density, basal area and mean size of woody climbing plants (lianas). Over the last two decades of the twentieth century the dominance of large lianas relative to trees has increased by 1.7-4.6% a year. Lianas enhance tree mortality and suppress tree growth(7), so their rapid increase implies that the tropical terrestrial carbon sink may shut down sooner than current models suggest(8-10). Predictions of future tropical carbon fluxes will need to account for the changing composition and dynamics of supposedly undisturbed forests.
- Phillips, O. L., P. Núñez and M. E. Timana. 1998. Tree mortality and collecting botanical vouchers in tropical forests. *Biotropica* 30(2): 298-305. ABSTRACT: There is growing concern about the potential impact of researchers on tropical forest ecology, but few data. The aim of this paper is to examine the effects of collecting botanical specimens from tropical forest trees on their subsequent survivorship, using mortality data from plots in Amazonian Peru that were established in 1989 and reinventoried in 1994. In total, 2017 trees were originally tagged and collections were made from 948 trees. Making voucher collections always involved using unsterilized telescopic plant collecting poles to cut representative small branches, and sometimes also involved using iron-spiked tree-climbing gear to gain access to the canopy. Annual mortality in the four plots averaged 1.99 percent. Among the whole population of dicotyledenous trees, there was no detectable difference between the mortality rate of collected trees (1.96%) and noncollected trees (2.29%). We conclude that in spite of the

physical damage caused to collected trees, collecting voucher specimens from tropical moist forest trees may not affect their survivorship, at least in the short-term. Further studies are needed to fully evaluate the potential impacts of research activities on permanent forest plots in the tropics.

- Phillips, O. L., P. N. Vargas, A. L. Monteagudo, A. P. Cruz, M. E. C. Zans, W. G. Sanchez, M. Yli-Halla and S. Rose. 2003. Habitat association among Amazonian tree species: A landscape-scale approach. *Journal of Ecology* 91(5): 757-775. ABSTRACT: 1. Unravelling which factors affect where tropical trees grow is an important goal for ecologists and conservationists. At the landscape scale, debate is mostly focused on the degree to which the distributions of tree species are determined by soil conditions or by neutral, distance-dependent processes. Problems with spatial autocorrelation, sparse soil sampling, inclusion of species-poor sites with extreme edaphic conditions, and the difficulty of obtaining sufficient sample sizes have all complicated assessments for high diversity tropical forests. 2. We evaluated the extent and pervasiveness of habitat association of trees within a 10,000 km² species-rich lowland landscape of uniform climate in south-west Amazonia. Forests growing on two non-flooded landscape units were inventoried using 88 floristic plots and detailed soil analyses, sampling up to 849 tree species. We applied single-species and community-level analytical techniques (frequency-distributions of presence records, association analysis, indicator species analysis, ordination, Mantel correlations, and multiple regression of distance matrices) to quantify soil/floristic relationships while controlling for spatial autocorrelation. 3. Obligate habitat-restriction is very rare: among 230 tree species recorded in greater than or equal to 10 localities only five (2.2%) were always restricted to one landscape unit or the other. 4. However, many species show a significant tendency to habitat association. For example, using Monte Carlo randomization tests, of the 34 most dominant species across the landscape the distributions of 26 (76.5%) are significantly related to habitat. We applied density-independent and frequency-independent estimates of habitat association and found that rarer species tend to score higher, suggesting that our full community estimates of habitat association are still underestimated due to the inadequate sampling of rarer species. 5. Community-level floristic variation across the whole landscape is related to the variation in 14 of 16 measured soil variables, and to the geographical distances between samples. 6. Multiple regression of distance matrices shows that 10% of the floristic variation can be attributed to spatial autocorrelation, but even after accounting for this at least 40% is attributable to measured environmental variation. 7. Our results suggest that substrate-mediated local processes play a much more important role than distance-dependent processes in structuring forest composition in Amazonian landscapes.
- Phillips, O. L., R. Vásquez Martínez, A. Monteagudo Mendoza, T. R. Baker and P. Núñez Vargas. 2005. Large lianas as hyperdynamic elements of the tropical forest canopy. *Ecology* 86(5): 1250-1258. ABSTRACT: Lianas (woody vines) are an important component of lowland tropical forests. We report large liana and tree inventory and dynamics data from Amazonia over periods of up to 24 years, making this the longest geographically extensive study of liana ecology to date. We use these results to address basic questions about the ecology of large lianas in mature forests and their interactions with trees. In one intensively studied site we find that large lianas (>10 cm diameter) represent 5% of liana stems, but 80% of biomass of well-lit upper canopy lianas. Across sites, large lianas and large trees are both most successful in terms of structural importance in richer soil forests, but large liana success may be controlled more by the availability of large tree supports rather than directly by soil conditions. Long-term annual turnover rates of large lianas are 5–8%, three times those of trees. Lianas are implicated in large tree mortality: liana-infested large trees are three times more likely to die than liana-free large trees, and large lianas are involved in the death of at least 30% of tree basal area. Thus large lianas are a much more dynamic component of Amazon forests than are canopy trees, and they play a much more significant functional role than their structural contribution suggests.
- Phillips, O. L., R. Vásquez Martínez, P. Núñez Vargas, A. L. Monteagudo, M.-E. Chuspe Zans, W. Galiano Sánchez, A. Peña Cruz, M. Timaná, M. Yli-Halla and S. Rose. 2003. Efficient plot-based floristic assessment of tropical forests. *Journal of Tropical Ecology* 19: 629-645. ABSTRACT: The tropical flora remains chronically understudied and the lack of floristic understanding hampers ecological research and its application for large-scale conservation planning. Given scarce resources and the scale of the challenge there is a need to maximize the efficiency of both sampling strategies and sampling units, yet there is little information on the relative efficiency of different approaches to floristic assessment in tropical forests. This paper is the first attempt to address this gap. We repeatedly sampled forests in two regions of Amazonia using the two most widely used plotbased protocols of floristic sampling, and compared their performance in terms of the quantity of floristic knowledge and ecological insight gained scaled to the field effort required. Specifically, the methods are assessed first in terms of the number of person-days required to complete each sample ('effort'), secondly by the total gain in the quantity of floristic information that each unit of effort provides ('crude inventory efficiency'), and thirdly in terms of the floristic information gained as a proportion of the target species pool ('proportional inventory efficiency'). Finally, we compare the methods in terms of their efficiency in identifying different ecological patterns within the data ('ecological efficiency') while controlling for effort. There are large and consistent differences in the performance of the two methods. The disparity is maintained even after accounting for regional and site-level variation in forest species richness, tree density and the

number of field assistants. We interpret our results in the context of selecting the appropriate method for particular research purposes.

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- Piana, R. 2000. *Traditional forest use and ecotourism at the Infierno Native Community: Two different income-generating activities and their impact on local peoples' economy*. Master's thesis. Department of Economy and Natural Resources, The Royal Veterinary and Agricultural University, Copenhagen, Denmark. 72 pages.
- Piana, R. 2002. The Harpy Eagle (*Harpia harpyja*) in the Bawaja-Sonene National Park, the Tambopata National Reserve and the Infierno native community. Unpublished report.
- Piana, R. 2004. El proyecto águila arpía. Pages 288-292 in M. Napravnik Pesce (ed.), *Guía interpretativa para Tambopata Research Center y Posada Amazonas*. 11ra Edición 1994-2004. Rainforest Expeditions S. A. C. and INNOVA Arquitectura Integral S. R. L., Lima.
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- Pierpont, N. 1986. Competencia y coexistencia de trepadores. Pages 1-13, Chapter 12 in M. A. Rios (ed.), *Reporte Manu*. Centro de Datos para la Conservación, Universidad Nacional Agraria La Molina, Lima.
- Pierpont, N. and J. W. Fitzpatrick. 1983. Specific status and behavior of *Cymbilaimus sanctaemariae*, the Bamboo Antshrike, from southwestern Amazonia. *Auk* 100(3): 645-652. ABSTRACT: *Cymbilaimus sanctaemariae* (Formicariidae), previously considered to be a little known sub-species of *Cymbilaimus lineatus*, is a separate species. The two species overlap to a considerable extent in respect of their ranges of distribution, but are distinct in plumage, song and habitat. Both are found in the TRZ, where T. Parker (pers. comm.) has made sound recordings of their song, and found that they have different preferences in regard to habitat. *C. sanctaemariae* is smaller than *C. lineatus* and its beak is markedly smaller and more slender. The plumages of the two species are rarely similar, but there are common characteristics in both males and females. The most striking characteristic is the bars on the tail. In the males of all varieties of *C. lineatus*, the white bars are thin and arched and almost meet in the middle of each tail feather. In *C. sanctaemariae* these bars are short, wide and stubby on both edges of the plumage, so they never meet in the middle; both the females and the males of *C. sanctaemariae* have a long black crest. The different songs of the two species are evidence consistent with their being separate species. In *C. lineatus* both sexes have the same song, while in *C. sanctaemariae* the male has a harmonious and rasping call. *C. sanctaemariae* appears to be a specialist in bamboo (*Guadua* sp.) and, like all members of the formicariidae family, is insectivorous. It normally forages in very dense masses of bamboo branches, and lives in the tops of plants 12-15 m high, being exclusively found in this type of habitat. They appear to live in pairs in exclusive territories. *C. lineatus* forages for insects usually in dense vegetation with creepers at a height of 6-20 m in the undergrowth and sub-canopy of tall tropical forest (40-50 m tall). It appears to be monogamous and is frequently associated with mixed zones of undergrowth and low canopy. *C. sanctaemariae* appears to be the link between the genera *Cymbilaimus* and *Thamnophilus*; it is one of a number of bird species known to be endemic in South America and associated with bamboo.
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- Pitman, N. C. A. 2000. *A large-scale inventory of two Amazonian tree communities*. Ph.D. dissertation. Department of Botany, Duke University, Durham, USA. pages. ABSTRACT: Two tree communities at the western margin of the Amazon basin were inventoried via networks of small plots scattered over several thousand square kilometers of forest. Yasuni National Park, Ecuador, is a moist, aseasonal, hyperdiverse lowland forest near the equator. Manu National Park, Peru, ~1,400 km and eleven degrees to the south of Yasuní, is a moist, seasonal, moderately diverse lowland forest. The aims of the research were to document patterns of distribution, abundance, and diversity among Amazonian tree species at a variety of different spatial scales, and to investigate explanations for the patterns. The communities were surprisingly similar in composition and structure. Most species encountered in the inventories are believed to grow throughout western Amazonia, and a large proportion of them occur in both plot networks. Species common at one site tend to be common at the other, and the palm *Iriartea deltoidea* dominates both forests at identical densities. Most species in these forests occur preferentially in one forest type, but probably fewer than 15-26% of species are restricted to a single forest type. The great majority of species are rare at all spatial scales, but at both sites a small proportion of common taxa account for >50% of individual trees across the terra firme landscape. Common species tend to be large-statured trees, and are especially prevalent in the families Arecaceae, Myristicaceae, Moraceae, and Violaceae. The Ecuadorean forest is more diverse than the Peruvian forest at all taxonomic levels and all spatial scales. It also has a higher stem density, a larger proportion of smaller-statured species, a larger proportion of rare species, and higher-than-expected increases in the diversity of certain families. I argue that a large component of species composition and structure in these forests is homogeneous, and demonstrate that the tree communities in unvisited plots are largely predictable without any reference to local environmental conditions. However, I suggest that local processes related to the higher rainfall and higher stem density in Ecuador are more likely causing its higher diversity than large-scale or historical influences. Many of the observed patterns remain unexplained.
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approximately 400 km², to explore how tree species are distributed across upper Amazonia at a variety of spatial scales. For each of 825 tree species occurring in the plots we asked three questions: (1) Does the species have a large or small geographic range? (2) Is the species restricted to a single forest type, or is it found in several? (3) Is the species locally abundant anywhere or is it scarce everywhere? The answers served to classify a subset of species under Rabinowitz's classification scheme for rare species. Three main conclusions emerged. First, the great majority of tree species at Manu are geographically widespread. Every species identified to date occurs elsewhere in South America, outside the department of Madre de Dios; more than two-thirds of them have been collected 1500 km away in Amazonian Ecuador. Second, 15-26% of species appear to be restricted to a single forest type, when forest types are defined by historical river dynamics (i.e., terra firme forest, mature floodplain forest, swamp forest, and primary successional floodplain forest). The proportion of restricted species declined with increasing sampling effort, making 15% a more reliable figure. Third, while 88% of species occurred at densities of <1 individual/ha over the entire network of plots, at least half occurred somewhere at densities of >1.5 individuals/ha. Extrapolating these results provides a first guess at how tree species are distributed across the western portion of the Amazon basin. We conclude with the suggestion that most tree species in the region are habitat generalists occurring over large areas of the Amazonian lowlands at low densities but large absolute population sizes.

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- Pitman, N. C. A., J. W. Terborgh, M. R. Silman, P. Nunez, D. A. Neill, C. E. Ceron, W. A. Palacios and M. Aulestia. 2002. A comparison of tree species diversity in two upper Amazonian forests. *Ecology* 83(11): 3210-3224. ABSTRACT: We inventoried two Amazonian tree communities separated by similar to 1400 km of continuous lowland tropical forest, in an effort to understand why one was more diverse than the other. Yasuni National Park, near the equator in eastern Ecuador, has one of the most diverse tree communities in the world. Manu National Park, at 12 degrees S in Peru's Madre de Dios region, is only moderately diverse by upper Amazonian standards. Following the field inventories, a database of morphological, ecological, and other traits was compiled from the taxonomic literature for 1039 species from the plots. Our goals were (1) to describe how terra firme tree communities at the two sites differed in composition, diversity, and structure; (2) to characterize the "extra" species responsible for the higher diversity at Yasuni; and (3) to assess, in the light of those observations, some explanations for why forests near the equator are so diverse. Yasuni has similar to 1.4 times as many tree species as Manu at all three spatial scales we examined: local (1 ha), landscape (<10000 km²), and regional (<100000 km²). Yasuni samples contain more families and genera, more individual trees per unit area, and a larger proportion of small trees. Tree species at Yasuni have smaller stature, larger leaves, larger seeds, and smaller geographic and altitudinal ranges than those at Manu, and disproportionate increases in species diversity are observed within the Myrtaceae, Lauraceae, Melastomataceae, and several

other families. Community structures were strikingly similar, with the same species (*Iriartea deltoidea*, a palm) dominating both sites at identical densities. Common species at Yasuni occur at the same densities as equally ranked species at Manu, but there are substantially more very rare species at Yasuni. The poorer tree flora is not a nested subset of the richer tree flora, though a majority of species in each inventory do occur at the other site. Several models that offer explanations for geographic variation in tropical tree species diversity are assessed in light of these data. Most do a poor job of accounting for the patterns revealed by the inventories. We speculate that the most important factor in producing the higher diversity in Yasuni is its rainier, aseasonal climate, and we discuss two specific rainfall-related mechanisms that appear to be supported by the data: (1) year-round water availability allowing more species to persist in the understory at Yasuni and (2) a newly described "mixing effect" related to the higher stem density there.

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Madre de Dios. Essentially they are differentiated in the females' colour pattern. Their distribution fits some of the Peruvian zoogeographical units proposed by Brown and Lamas (*Parides aeneas opalinus* (Butler, 1877) stat. et. comb. nov. (*Papilio opalinus*) is described.)

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displays with a subordinate male; the beta males are less sedentary and can be more active than the alpha males in their daily displays. They inherit the ownership of the territories. Once a female arrives, only the alpha male courts her. The display combines visual and acoustic elements, being composed of vocalizations and ritualized movements. The displays of *Pipra fasciicauda* are remarkably similar to those of the other two species. This characteristic, combined with the similar plumage shared by these species, sustains the argument that the three species together form a superspecies.

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100(2): 224-235. ABSTRACT: I studied the foraging ecology and host relations of a population of brood parasitic Giant Cowbirds (*Scaphidura oryzivora*) in the undisturbed Manu National Park of Amazonian Peru. Giant Cowbirds foraged mostly along rivers and lakes where they searched for arthropods, fruit, and nectar. Male cowbirds sometimes foraged on the backs of mammals on which they captured biting flies. The two potential host species, the Russet-backed Oropendola (*Psarocolius angustifrons*) and Yellow-rumped Cacique (*Cacicus cela*) defended their colonies against cowbird parasitism, regardless of colony location. Giant Cowbirds concentrated most of their visits on oropendola nests, which were sometimes left untended when the colony members were foraging together in a flock away from the colony. Yellow-rumped Caciques, however, seldom left their colonies untended and no cowbirds were known to fledge from cacique nests during the five years of the study. This situation differs markedly from that reported by Smith (1968, 1979, 1980) in Panama where Giant Cowbirds parasitized both oropendolas and caciques, and at least some hosts did not chase cowbirds away from their nests. I argue that the major difference between the two study areas is that in Peru, both caciques and oropendolas generally raise only a single young, which means that there can be no advantage to being parasitized as there is in Panama.

Robinson, S. K. 1988. Anti-social and social behavior of adolescent Yellow-rumped Caciques (Icterinae, *Cacicus cela*). *Animal Behaviour* 36: 1482-1495.

Robinson, S. K. 1994. Use of bait and lures by Green-backed Herons in Amazonian Peru. *Wilson Bulletin* 106(3): 567-569.

Robinson, S. K. 1994. Habitat selection and foraging ecology of raptors in Amazonian Peru. *Biotropica* 26(4): 443-458. ABSTRACT: Census results and observations of foraging tactics and diet were compiled for the 35 regularly occurring species of diurnal raptors in an 800-ha section of the lowland Manu National Park of southeastern Peru. Census results show that most forest raptors occurred across a broad array of successional stages. Population densities ranged from a high of one or two territories per 100 ha (e.g., Micrastur forest-falcons, double-toothed kite, *Harpagus bidentatus*) to lows of much less than one territory in the entire study area (e.g., large eagles). A species replacement apparently occurs in the genus *Leucopternis*, with the slate-colored hawk *L. schistacea* occupying flood plain forest and the white-browed hawk *L. kuhli* occupying upland forest. All other congeners showed substantial overlap in habitat use. Based on observations by 35 researchers of over 400 prey items being carried and over 200 attacks, I divided raptors into several preliminary guilds. Forest raptors include seven species that hunt arthropods and small vertebrates from concealed perches (e.g., Micrastur forest-falcons, gray-headed kite, *Leptodon cayanensis*); seven species that hunt large birds and mammals either from concealed perches (e.g., ornate hawk-eagle, *Spizaetus ornatus*) or on long-range attacks on sites where birds or mammals aggregate (e.g., bicolored hawk, *Accipiter bicolor*); and several species with specialized diets of wasps (red-throated caracara, *Daptrius americanus*), snails (hook-billed kite, *Chondrohierax uncinatus*), and snakes (laughing falcon, *Herpetotheres cachinnans*). Species that hunt on the wing include four that feed mostly on flying insects and small vertebrates (two kites, the short-tailed hawk *Buteo brachyurus*, and the bat falcon *Falco ruficularis*), one that dives on perched vertebrates (zone-tailed hawk *Buteo albonotatus*), and two vultures that search for carrion. Raptors of open rivers, lakes, and marshes include a fish specialist (the osprey *Pandion haliaetus*), two snail specialist kites, a carrion-eating vulture, a *Buteo* that dives on arthropods and small vertebrates, and three species with extremely diverse diets (e.g., black-collared hawk, *Busarellus nigricollis*). Snail specialists tended to occur irregularly during the eleven field seasons of this study. Several raptors are known to influence the population dynamics of their prey species. Large forest-dwelling raptors such as the harpy and crested eagles are likely to require the largest preserves.

Robinson, S. K. 1997. Birds of a Peruvian oxbow lake: Populations, resources, predation, and social behavior. Pages 613-639 in J. V. Remsen, Jr. (ed.), *Neotropical Ornithology: Honoring Ted Parker*. Ornithological Monographs No. 48.

Robinson, S. K., J. W. Fitzpatrick and J. Terborgh. 1995. Distribution and habitat use of neotropical migrant landbirds in the Amazon basin and Andes. *Bird Conservation International* 5(2-3): 305-323. ABSTRACT: We documented the geographical distributions and habitat selection of Neotropical migrants in South America along a successional gradient in the lowlands of Amazonian Peru, and along elevational gradients in the Andes of south-eastern Peru and of eastern and western Ecuador. Most of the 30 species of northern migrants that regularly winter in South America appear to be concentrated in the western edge of the Amazon basin and on the lower slopes (<2,000 m) of the Andes. Migrants in a lowland site were documented more often in early successional habitats than in primary forest, and no species were confined to mature forest habitats. The number of species and relative abundance of migrants in primary forest, however, increased with elevation up to about 1,200 m and decreased above that elevation. Several species (*Contopus borealis*, *Dendroica cerulea* and *Wilsonia canadensis*) were largely confined to primary forest in the 1,000-2,000 m elevational zones in both Peru and Ecuador. Migrants on the western slope of the Ecuadorean Andes included several species that primarily winter further north. In general, the species richness of migrants and residents was inversely

correlated, both on a biogeographical and a local scale. Migratory birds are most likely to be adversely affected by deforestation of the lower slopes of the Andes, which is proceeding at a rapid pace. The impact of human alterations of Amazonian forests will be greater on resident than on migratory birds. The loss of mid-successional lowland forests, however, might have a negative effect on several species.

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- Robinson, S. K. and J. Terborgh. 1990. Bird communities of the Cocha Cashu Biological Station in Amazonian Peru. Pages 199-216 in A. H. Gentry (ed.), *Four Neotropical rainforests*. Yale University Press, New Haven.
- Robinson, S. K. and J. Terborgh. 1995. Interspecific aggression and habitat selection by Amazonian birds. *Journal of Animal Ecology* 64(1): 1-11. ABSTRACT: 1. We report that interspecific territoriality is a common spacing mechanism among closely related bird species distributed along a primary successional gradient in the meander belt of an Amazonian whitewater river. 2. In the first phase of the research, we mapped the territories of more than 330 bird species in large census plots encompassing the complete successional gradient. We found species pairs in over 20 genera that showed contiguous but non-overlapping territories, such that early stages of the successional gradient were occupied by one member of the pair, and later stages by the other. Other species pairs showed additional types of spatial relationships, including partially overlapping and completely overlapping territories. 3. Using reciprocal heterospecific playback experiments, we tested for the existence of aggressive interactions between the members of species pairs (usually congeners) showing all three types of spatial relationship. Among 12 species pairs showing contiguous, non-overlapping territories, 10 showed evidence of interspecific aggression (approach to the playback speaker). In eight of these 10 cases, the responses were markedly asymmetric. Target individuals of one species approached the speaker, whereas individuals of the other species remained in place or moved away. The heavier species was consistently the aggressor. 4. In six species pairs showing partial territorial overlap along the successional gradient, only one species displayed statistically significant interspecific aggressiveness, although some individuals in all six pairs approached or avoided the speaker. 5. In species pairs distributed with completely overlapping territories, we found interspecific aggression in only one of five genera tested. 6. We suggest that spatial segregation of congeneric bird species on habitat gradients (presumably including elevational gradients), is commonly underpinned by interspecific territoriality mediated through directed, asymmetrical interspecific aggression. Aggressive asymmetry suggests a despotic model of habitat occupancy, in which the larger species occupies the more productive end of habitat gradients, and the smaller species occupies less productive habitats. 7. The pronounced successional gradients characteristic of Amazonia may explain much of the increased species richness, especially within genera, of Amazonian bird communities.
- Robinson, S. K. and J. Terborgh. 1997. Bird community dynamics along primary successional gradients of an Amazonian whitewater river. Pages 641-672 in J. V. Remsen, Jr. (ed.), *Neotropical Ornithology: Honoring Ted Parker*. Ornithological Monographs No. 48.
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- Robinson, S. K. and D. S. Wilcove. 1989. Conserving tropical raptors and game birds. *Conservation Biology* 3(2): 192-193.
- Robinson, W. D., J. D. Brawn and S. K. Robinson. 2000. Forest bird community structure in central Panama: Influence of spatial scale and biogeography. *Ecological Monographs* 70(2): 209-235. ABSTRACT: Historical and biogeographic contexts can play important, yet sometimes overlooked, roles in determining structure of local communities. In particular, few examinations of historical influences on patterns of species richness and relative abundances in tropical communities have been conducted. In part, that gap in our knowledge has been caused by a paucity of data on tropical communities, even for relatively well-studied taxa such as birds. In the

Neotropics, only two sites, a 97-ha plot in lowland Peru and a 100-ha plot in French Guiana, have been inventoried on a spatial scale sufficient to estimate population densities for a majority of resident bird species. Results from those studies revealed extremely similar species richness, community biomass, and patterns of relative abundance. A third site in lowland Panama was originally censused in 1968-1969 and has often been compared with many other tropical and temperate sites. Results from Panama suggested an exceptionally different community structure from that observed at the Amazonian sites. Informative comparisons among sites have been hampered, however, by differences in sampling protocols. The Panama site was sampled on a much smaller spatial scale (2 ha) than the two Amazonian sites. To improve comparisons, we censused a 104-ha area (the Limbo plot) encompassing the original 2-ha Panama study area and used several census methods, including those used at the Amazonian sites. As expected, spatial scale had a strong effect on estimates of species richness. We detected 252 species on the Limbo plot, compared with 161 detected on the original 2-ha area. Estimates of total individual birds per 100 ha were similar, but estimates from the original study were based on densities measured for one-third fewer species than we measured on our larger study area. Of the 53 species for which both Panama studies estimated population densities, a significant number of estimates were higher in the original study. Thus, the small spatial scale of the original study apparently led to inflated density estimates. The primary cause of disparities appeared to result from undersampling in the smaller plot of many species with patchy distributions and large territory sizes. Compared with Amazonian communities, the Panama community had far fewer rare species. Although 33% of species in Amazonian sites had densities of ≤ 1 pair/100 ha, only 17% were equally rare in Panama. Furthermore, eight species in Panama were, by tropical standards, "superabundant," attaining densities as high as 212 breeding individuals/100 ha; the most abundant species in Amazonia barely reached one-third of that number. In total, those eight species accounted for 36% of all individuals at Limbo. The median abundance at Limbo was 7 pairs/100 ha, vs. 2.5 pairs/100 ha in Amazonia. Consequently, the total number of birds on the Limbo study area was nearly twice that found in Amazonia, despite species richness being only three-fourths as great. We conclude, first, that spatial scale has indeed had an important effect on the characterization of the Panama bird community. The intrinsically patchy distributions of most forest-dwelling bird species raise the need for large-scale censuses. Second, the Panama community, compared with the two Amazonian sites, has a fundamentally different organization; it hosts nearly twice as many individual birds and is distinctly less dominated by rarity. Similar patterns of community structure appear to be present within tree and mammal communities as well. Therefore, results from the Amazonian studies cannot be generalized to all lowland Neotropical communities. We attribute differences in community structure primarily to differing biogeographic histories. The lower species richness and the greater number of total birds present in Panama appear to derive, at least in part, from two important factors: an area effect linked to the location of Panama on a narrow isthmus, and the repeated history of disturbance on multiple temporal scales in Panama.

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- Rockwood, L. L. 1985. Seed weight as a function of life form, elevation and life zone in Neotropical forests. *Biotropica* 17(1): 32-39. ABSTRACT: Seeds from over 365 spp. of eight plant families (Melastomataceae, Gesneriaceae, Bromeliaceae, Bignoniaceae, Araliaceae, Myrsinaceae, Campanulaceae, and Rubiaceae) were excised, and dry wt determined, from fruit previously collected from Costa Rica, Panama and Peru, and deposited in the US National Museum of Natural History. This study was undertaken to determine whether data from tropical plants were consistent with temperate zone work showing correlations of seed size with life form and certain aspects of the physical environment. In order to control for intraspecific variation, a seed wt class system (Baker 1972) was used. As seen in temperature zone studies, tropical species show significant differences in seed wt means among trees, shrubs and herbs (largest to smallest). Tropical epiphytes, however, show a bimodal pattern; though seeds from some plant families (e.g., Orchidaceae) are tiny, many epiphyte seeds (primarily from Melastomataceae, Gesneriaceae and Bromeliaceae) were equivalent to, or larger than, those of shrubs. Seeds from tropical herbaceous vines were comparable in wt to those of herbs, while seeds of woody lianas(all from Bignoniaceae) were comparable to trees in wt. Seed wt analyzed by elevation and life zone showed no conclusive patterns.
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Instituto de Medicina Tropical de Sao Paulo 41(2): 101-105. ABSTRACT: In this present study, preliminary data was obtained regarding the mortality rate of the Amazonian anophelines, *Anopheles nuneztovari*, *Anopheles darlingi* and *Anopheles braziliensis* when subjected to treatment with *Bacillus sphaericus* strain 2362, the WHO standard strain. Initially, experiments were conducted to test the mortality rate of the three species of anopheline larvae. The third larval instar of *An. nuneztovari* and the second and third larval instars of *An. darlingi* proved to be the least susceptible. In other experiments, the same three mosquito species were tested with the standard strain 2362, *An. nuneztovari* was the least susceptible to this insect pathogen, while *An. braziliensis* was the most susceptible. This latter species showed a difference in the level of LC50 concentration, when compared to the former, of 2.4, 2.5 and 1.8 in readings taken 24, 48 and 72 hours after exposure to the bacillus.

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- Rodríguez Gamarra, J. J., G. G. Cárdenas Ramírez, A. De la Cruz Abarca, N. Llerena Martínez, S. Ríos Torres, C. Rivera Gonzáles, E. Salazar Zapata, V. H. Vargas Paredes, P. Soini and K. Ruokolainen. 2003. Comparaciones florísticas y faunísticas entre diferentes lugares de bosques de tierra firme en la selva baja de la Amazonía peruana. *Folia Amazonica* 14(1): 35-72. ABSTRACT: Se investigaron patrones de similitudes y diferencias florísticas y faunísticas entre áreas en cinco zonas de la selva baja peruana (Andoas, Iquitos, Pampa Hermosa, Iñapari y Tambopata), utilizando tres grupos de plantas (helechos, melastomatáceas y palmeras), y tres grupos de animales (aves, anuros y hormigas) como especies indicadoras de las composiciones florísticas y faunísticas locales. El estudio se realizó en el marco del proyecto Diversidad Biológica de la Amazonía Peruana, Perú - Finlandia (BIODAMAZ). La riqueza de especies de plantas varió marcadamente entre zonas, siendo Andoas la zona de mayor riqueza de especies para todos los grupos de plantas, posiblemente debido a la presencia en el área de suelos con material volcánico. Se evidenció un patrón común de similitudes florísticas entre zonas y este patrón no tenía relación con las distancias geográficas entre las zonas. Los grupos de animales no mostraron ningún patrón común de similitudes y diferencias faunísticas entre las localidades de inventario. Las composiciones faunísticas locales de los grupos de animales no mostraron correlaciones significativas, ni con las características edáficas, como tampoco con las composiciones florísticas correspondientes de árboles y palmeras. En contraste con esto, la composición florística de palmeras estuvo altamente correlacionada con la composición de árboles y débilmente correlacionada con las características edáficas. La comparación de las

composiciones florísticas locales con los correspondientes valores de reflectancia en la imagen de satélite indicó la existencia de una buena correlación positiva entre éstos. Los resultados arriba mencionados indican que los tres grupos de plantas utilizados en este estudio son buenos indicadores de las características ambientales (suelo), y por ende pueden ser utilizados como indicadores de los patrones florísticos generales, mientras que los grupos de animales utilizados no lo son.

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- Rodríguez, L. O. 1992. Structure et organisation du peuplement d'anoures de Cocha Cashu, Parque National Manu, Amazonie Péruvienne. *Terre et Vie* 47(2): 151-197. ABSTRACT: The structure, relative abundance and density of the anuran community of Cocha Cashu, in the Amazonian rainforest of Peru (350 m, 11-degrees 55' S, 71-degrees 18' W, Manu National Park) was studied during 395 days of field work, from September 1985 to November 1989. The study compared the two major types of upper Amazonian habitats, floodplain forest and upland forest. The entire assemblage is composed of 81 species (Table I). There are more diurnal species in the upland forest than in the floodplain forest. Although each type of habitat has 20 terrestrial species and 12 food specialists, mainly ant eaters, these guilds account for significantly different proportions on each of the assemblages (Tables II and III). Sixty six species (out of 71) were observed in 250 days of transect sampling in the floodplain, whereas 49 species were counted in only 55 days on the uplands (Fig. 9); ten of these species do not occur in the floodplain and 39 are common to both habitats. Although relative abundance curves of both habitats are similar (Fig. 10), relative abundances of the 39 shared species differ significantly for each type of habitat (Fig. 11). Most of the Anuran species are small. Mean males' Snout-Vent-Length ranges from 13.5 mm in *Eleutherodactylus cf. carvalhoi* to 136 mm in *Leptodactylus pentadactylus*, and at least 80% weigh less than 10 g (Table V). None of the species accounts for more than 15% of the relative abundances in floodplain or in the upland, suggesting a rather equitable distribution of abundance. No significant differences between the two types of habitats were found in terms of numbers of species, grouped by mode of reproduction (Table V). However, when relative abundance of individuals grouped by mode of reproduction were compared, all but the species laying their eggs in vegetation overhanging water and those building terrestrial foam nests without free tadpoles, showed significant differences (Table VI). The Cocha Cashu floodplain data are compared to those from Santa Cecilia (Ecuador, 350 m, 0-degrees 03' N 77-degrees 11' W), the richest site in Anuran species (87 species) until now. There are no differences in the number of species by mode of reproduction, but, except for the Dendrobatidae, all relative abundances of individuals by mode of reproduction differ significantly between the two sites (Tab. VII). Densities were estimated by two methods: 219 censuses of male calling activity of ten forest breeding species (Table VIII), and 80 forest litter plots. Densities estimated by these two methods did not coincide. Plots revealed an uneven distribution of frogs in the forest and densities similar to other amazonian sites, but lower than those estimated for Central America (Table XI). Although most species were observed on transects, pit-fall traps were effective on catching active nocturnal terrestrial species not easily observed by other methods (Table XII). None of the methods used here to estimate diversity or density are efficient enough to sample adequately the entire community. The possible causes of the anuran species richness at Cocha Cashu are briefly discussed. The number of species at Cocha Cashu and Santa Cecilia being very similar (respectively 81 and 87 species) despite the striking differences in rainfall regime between the two sites, high atmospheric humidity cannot be considered as the only determinant of the high species diversity of anurans in tropical rainforests. The importance of historical factors, and more particularly of the effect of river dynamics on the heterogeneity of the Upper Amazonian environment, is emphasized.

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- Rodríguez, L. O. and J. E. Cadle. 1990. A preliminary overview of the herpetofauna at Cocha Cashu, Manu. Pages 410-425 in A. H. Gentry (ed.), *Four Neotropical rainforests*. Yale University Press, New Haven.
- Rodríguez, L. O. and C. W. Myers. 1993. A new poison frog from Manu National Park, southeastern Peru (Dendrobatidae, Epipedobates). *American Museum Novitates*(3068): 1-15. ABSTRACT: *Epipedobates macero* is a new species of dendrobatid poison frog from lowland rain forest of the Manu National Park, in the upper Madre de Dios drainage of southeastern Peru. It is most similar to a few other species occurring along the Andean front in eastern Peru, namely *E. petersi* and *E. cainarachi*, which differ in details of coloration, morphology, and vocalization.
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- Romo, M., H. Tuomisto and B. A. Loiselle. 2004. On the density-dependence of seed predation in *Dipteryx micrantha*, a bat-dispersed rain forest tree. *Oecologia* 140(1): 76-85. ABSTRACT: We studied the effect of seed density on seed predation by following the fate of bat-dispersed *Dipteryx micrantha* (Leguminosae) seeds deposited under bat feeding roosts. The study was conducted in Cocha Cashu biological station, Amazonian Peru, during the fruiting period of *Dipteryx*. Predation of *Dipteryx* seeds in the area is mainly by large to medium-sized rodents. Seed deposits beneath bat feeding roosts were monitored for a 13-week period in an 18-ha study area. A total of 210 seed deposits were found, and on average, seed predators encountered 22% of them during any one week. About one-third of the seed deposits escaped predation, and those deposits that had relatively few seeds were more likely to go unnoticed by rodents than were deposits with many seeds. The mean seed destruction rate was 8% per week; deposits with many seeds tended to lose a smaller proportion of their seeds to seed predators than did deposits with few seeds. Regression tests for the weekly data showed that, at the beginning of the observation period, seed predation was not density-dependent. Later, when the total seed crop beneath roosts was high, the number of seeds predated per deposit was positively density-dependent, while the proportion of seeds predated was negatively density-dependent, indicating predator satiation. Seed deposits that had been visited by seed predators once had a higher probability of being revisited the week after, especially if they contained many seeds when first encountered. This indicates that the foraging behavior of rodents may be affected by their remembering the location of seed-rich patches.
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by birds increased only with greater aril: seed ratio, whereas seed removal by spider monkeys was affected by the quantity of ripe fruit and phenological stage. The finding that dispersal agents responded differently to some tree and fruit traits indicates not only that dispersal agents can exert selection on traits affecting seed dispersal, but also that the resulting selection pressures are likely to be inconsistent. This conclusion is supported by the result that the proportion of the seed crop that was dispersed from individual trees, which accounted for cumulative dispersal by all agents, was not influenced by any tree or fruit trait evaluated. Comparing these results with those from studies of *V. sebifera* and *V. nobilis* in Panama revealed that the disperser assemblages of these three *Virola* species were congruent in their similar taxonomic representation. In Panama the proportion of *V. nobilis* seed crop dispersed was related positively to aril: seed ratio and negatively to seed mass, a result not found for *V. calophylla* in Peru. The greater importance of dispersal by primates versus birds in *V. calophylla*, relative to *V. nobilis*, may explain this difference. Thus, variation in disperser assemblages at regional scales can be another factor contributing to inconsistency in disperser-mediated selection on plant traits.

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- Rypstra, A. L. 1986. Web spiders in temperate and tropical forests: Relative abundance and environmental correlates. *American Midland Naturalist* 115(1): 42-51. ABSTRACT: The number of actively foraging web spiders was monitored at different times of day at three forested areas (temperate zone Pennsylvania, USA; subtropical Peru; tropical Gabon). In Pennsylvania spider activity rose during the day to a peak in the evening and dropped off again at night. In Peru and Gabon spiders were more active at night. A multiple regression analysis was run using abundance of vegetation, insect activity, temperature humidity as potential predictor of spider numbers. Vegetation was consistently the best predictor on all sites. Both insect activity and temperature were significant additional variables. The regression equations generated for the Peru and Gabon sites were not significantly different from one another. Data of this nature may aid in determining when spider populations may exert the most pressure on insect populations. In addition, comparisons can be made between temperate and tropical habitats.
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- Rypstra, A. L. 1990. Prey capture and feeding efficiency of social and solitary spiders: A comparison. *Acta Zoologica Fennica* 190: 339-343. ABSTRACT: Prey capture was monitored in two spider species. A social species, *Anelosimus eximius*, was studied in a subtropical forest of SE Peru. A solitary species, *Achaearanea tepidariorum*, was studied in an urban habitat of SW Ohio, USA. The size distribution of prey captured and efficiency with which each of the spider species captured prey in various size classes were determined from field observations. The ability of each of the species to utilize the resources contained in prey in several size classes was determined by a measure of weight loss of the prey during feeding. *An. eximius* captured a greater range of prey sizes with approximately the same efficiency. This social spider removed a high percentage of the prey biomass in all size classes. The size range captured by the solitary *Ach. tepidariorum* was not as great as it was for the social spider and the capture efficiency of this species declined with prey size. In laboratory experiments, the solitary spider removed a very high percentage of the edible biomass of small prey but was much less successful at completely consuming large prey. These data suggest that the capture of large prey is a characteristic of spiders that forage in groups, whereas the solitary species is specialized to feed effectively on small prey.
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found in 5-7 habitats of different types of forest), the *A. domingo* webs are less frequent and are found distant one from another (the shortest distance between two of them is 2.5 Km.); they look like a basket with dead leaves and adjacent vegetation which is used as shelter. It is estimated that each web shelters several hundreds of individuals which have different functions within its community (capturing prey, guarding eggs and caring very young juveniles). This species captures its prey similar to *A. eximus* and is capable of capturing bigger preys, wrapping them in silk threads before killing them. Although some tolerance and even interspecific cooperation is reported among social spiders, the relationship between *A. domingo* and *A. eximus* is very aggressive.

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to fit the predictions. The systematics of *Thamnomanes* is re-examined, especially the strategies for the capture of prey and the morphological specialization. It is recommended that four species be considered; these are known or deduced to be specialists in prey capture on the wing in flights of long duration, in the genus *Thamnomanes*. Morphological evidence regarding two species commonly classified as *Thamnomanes*: *T. plumbeus* and *T. occidentalis*, indicates that they are specialists in the capture of prey from perches, and they have been excluded from the genus.

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- Sherman, P. T. 1991. Harpy Eagle predation on a red howler monkey. *Folia Primatologica* 56(1): 53-56.
- Sherman, P. T. 1995. Social organization of cooperatively polyandrous White-winged Trumpeters (*Psophia leucoptera*). *Auk* 112(2): 296-309. ABSTRACT: I observed a population of White-winged Trumpeters (*Psophia leucoptera*) in undisturbed rain forest in Peru for over 2,400 h between 1983 and 1987. At this site, I was able to habituate and band three groups of trumpeters and make occasional observations on four unhabituated groups. The habituated trumpeters lived in cooperatively polyandrous groups that defended large ($x = 72$ ha) permanent territories against conspecifics. The habituated groups always contained a dominant male and female, and usually contained two unrelated subordinate adult males, one unrelated subordinate adult female, and the group's offspring. Only the dominant female contributed eggs to the clutch, and the group's adult males competed to obtain copulations with her. In the habituated groups, the dominant male obtained the majority of the successful copulations with the breeding female during her fertile period, and the beta male obtained a greater number of copulations than the gamma male. Individuals assisted to varying degrees with helping to rear the group's chicks. Subordinate males provided significantly more food to the chicks than the dominant male, and the subordinate female provided significantly less food than the dominant female, while the dominant male and female fed chicks equivalent amounts of food. Offspring usually helped raise one brood of siblings, but both males and females dispersed from their natal group at about two years of age, when they reached sexual maturity. The evolution of cooperative breeding in White-winged Trumpeters appears to be related to the need to defend large permanent territories to provide access to sufficient food during the dry season when resources are scarce. Defense of large territories results in a surplus of adults in the trumpeter population relative to the number of available breeding positions. The low probability of acquiring a breeding position for individuals that remain on their natal territory appears to result in sexually mature offspring dispersing from their natal groups and attempting to join new groups where they have some chance of breeding nonincestuously. The apparent need to have multiple adult males within a group for successful territory defense may explain why unrelated males are accepted into territorial groups, where they are able to copulate surreptitiously with the breeding female.
- Sherman, P. T. 1995. Breeding biology of white-winged trumpeters (*Psophia leucoptera*) in Peru. *Auk* 112(2): 285-295. ABSTRACT: I studied the breeding biology of a population of White-winged Trumpeters (*Psophia leucoptera*) in undisturbed lowland rain forest in Manu National Park, southeastern Peru. At this study site, it was possible to habituate trumpeters to humans, allowing groups to be followed and observed at distances of a few meters for entire days. I found that White-winged Trumpeters lived in cooperatively polyandrous groups of 4 to 13 individuals that defended permanent year-round territories. Clutches that averaged three eggs were laid by the

dominant female on the floor of elevated cavities in trees. Eggs were incubated for about four weeks, primarily by the group's dominant male and female. Chicks hatched around the end of October at the beginning of the rainy season. If at least one of the brood survived, a subsequent clutch was not laid until the following breeding season. Predation on eggs and chick mortality resulted in an average of 1.6 young per group-year surviving to adulthood. White-winged Trumpeter chicks were precocial and left the nesting cavity the day after they hatched, able to walk and climb. Chicks were dependent on older birds to provide them with all of their food for over three weeks and were still receiving more than one-half of their food from adults at two months. Trumpeters reached sexual maturity at about two years of age, at which time both male and female offspring dispersed from their natal groups.

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- Sherman, P. T. 2000. Reproductive biology and ecology of white-winged trumpeters (*Psophia leucoptera*) and recommendations for the breeding of captive trumpeters. *Zoo Biology* 19(1): 65-84. ABSTRACT: The reproductive biology and ecology of a wild population of white-winged trumpeters (*Psophia leucoptera*) were studied in southeastern Peru from 1983 to 1987. Because little information is available about any of the trumpeter species and because trumpeters have proven difficult to breed in captivity, information relevant to breeding and management of captive trumpeters is reported in this paper. White-winged trumpeters lived in territorial social groups that ranged in size from four to 13 individuals. A typical territorial group contained three adult males, two adult females, and several sexually immature offspring, but smaller temporary groups sometimes formed for the duration of the breeding season. Only the dominant female contributed eggs to the clutch, and all adult males in the group competed to obtain copulations with her. Eggs were laid in elevated nesting cavities and no nest was constructed. The average clutch size was three eggs and incubation was not begun until the final egg was laid. The dominant male and female shared most of the incubation duties, but subordinate males covered approximately 15% of the incubation shifts. Eggs hatched approximately 27 days after incubation was begun and chicks left the nesting cavity the day after they hatched. Chicks were completely dependent on older birds to feed them for their first three weeks and then gradually began to feed themselves more and more food. The subordinate adult males fed chicks the most food, the dominant male and female and older offspring fed chicks an intermediate amount, and the subordinate adult female fed chicks the least. Young chicks behaved aggressively toward each other but were separated by adults before they injured each other. If at least one chick from the clutch survived, trumpeters did not breed again until the beginning of the next breeding season the following year. (C) 2000 Wiley-Liss, Inc.
- Sherman, P. T. and P. K. Eason. 1998. Size determinants in territories with inflexible boundaries: Manipulation experiments on White-winged Trumpeters' territories. *Ecology* 79(4): 1147-1159. ABSTRACT: We investigated determinants of territory size in White-winged Trumpeters (*Psophia leucoptera*), frugivorous, cooperatively breeding birds that defend large, permanent, all-purpose territories in lowland Amazonian rain forest. During a 7-mo period, we measured changes in food density at a site in Manu National Park, Peru, and conducted full-day focal samples on individuals that allowed us to record daily food intake of territorial birds. We used data from laboratory analyses on energy content of fruit species eaten by trumpeters to calculate a phenology of energy content for food available on territories of focal groups, and to calculate daily energy intake of focal trumpeters. Additionally, we used lab measurements of basal metabolic rate of trumpeters to estimate daily energy requirements of wild trumpeters. Both census and focal sample data suggested that food availability on trumpeter territories varied widely, sometimes greatly exceeding and sometimes falling short of the amount that we calculated was necessary to meet average daily energy requirements of groups. To determine whether trumpeter territory size was related to food density, we conducted fruit removals. Every day, we removed an amount of fruit from the territory that was equivalent to the amount of fruit ingested daily by the focal group during a control period preceding the removal experiment. We conducted removal experiments during periods when food density on territories appeared to be abundant and also when food abundance appeared to be low. Trumpeter food consumption did not change when fruit was removed during periods of resource abundance; however, when experimental removals were conducted during periods of food scarcity, the total energy value of food consumed decreased significantly. These results suggest that food abundance on trumpeter territories sometimes exceeds and sometimes is close to or below the amount needed to meet energy needs of the groups. Based on our data, we propose that territory size of White-winged Trumpeter groups reflects some minimum size needed to provide the group with a baseline level of food intake during seasonal periods of decreased food abundance.
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Ontario 124: 1-182. ABSTRACT: Keys, descriptions, and illustrations distinguish the known New World species of Coptodera (type species–*Coptodera festiva* Dejean), and each taxon is characterized in terms of structural features of adults, habitat, geographical distribution, chorological affinities, and phylogenetic relationships. Twelve new species are described. The New World species of Coptodera are arranged in eleven groups, sequenced according to the reconstructed phylogeny: *C. sallei* group, including *C. sallei* new name; *C. elongata* group, including *C. elongata* Putzeys, *C. schaumii* Chaudoir, *C. megalops* Bates, *C. championi* Bates, and *C. apicalis* new species (type locality-Ecuador, Esmeraldas, Zapallo Grande); *C. aurata* group, including *C. xanthopleura* Bates, *C. aurata* Chevrolat, and *C. viridis* new species (type locality-Mexico, Colima, near Ixtapa); *C. depressa* group" including *C. depressa* Dejean and *C. versicolor* Bates; *C. transversa* group, including *C. dromioides* (Bates), *C. nigrosignata* (Chaudoir); *C. fulminans* (Bates), *C. nigrostriata* (Reiche), *C. lineata* (Bates), *C. stockwelli* new species (type locality-Panama, Canal Zone, Madden Forest), *C. transversa* (Reiche), *C. sigillata* new species (type locality-Brazil, Santa Catarina, Nova Teutonia), and *C. squiresi* (Chaudoir); *C. festiva* group, including *C. sahlbergi* Chaudoir, *C. relucens* Bates, *C. poecila* Bates, *C. pakitza* new species (type locality-Peru, Madre de Dios, Pakitza), *C. festiva* Dejean, *C. foveolata* new species (type locality-Mexico, Veracruz, Tebanca), *C. nigroviridis* new species (type locality-Mexico, Chiapas, Parque Montebello), *C. rufescens* Buquet, and *C. teutonica* new species (type locality-Brazil, Santa Catarina, Nova Teutonia); *C. aeneorufa* group, including *C. aeneorufa* Bates; *C. bifasciata* group, including *C. bifasciata* Putzeys, *C. tripartita* Chaudoir, *C. cupreotincta* Bates, and *C. braziliensis* new species (type locality-Brazil, Santa Catarina, Hansa Humboldt); *C. emarginata* group, including *C. chalcites* Bates, *C. emarginata* Dejean, and *C. acutipennis* (Buquet); *C. picea* group, including *C. picea* Dejean; and *C. aerata* group, including *C. nitidula* (Buquet), *C. brunnea* new species (type locality-United States, Arizona, Cochise County, Guadalupe Canyon), *C. aerata* Dejean, *C. waytkowskii* Liebke, *C. erwini* new species (type locality-Peru, Madre de Dios, Pakitza), and *C. tripunctata* new species (type locality-Peru, Loreto, Cocha Shinguito). Removed from synonymy with *C. lineata* Chaudoir is *C. nigrosignata* Chaudoir, the name of a valid species. Ten synonymies are newly proposed with the senior synonym of each combination listed first *Coptodera* Dejean = *Stenoglossa* Chaudoir, *C. megalops* Bates = *C. pertzeli* Liebke = *C. peruana* Liebke; *C. depressa* Dejean = *C. plaumanni* Liebke; *C. sahlbergi* Chaudoir = *C. discicollis* Chaudoir, *C. festiva* Dejean = *C. chloris* Bates; *C. cupreotincta* Bates = *C. tessellatus* Chaudoir; *C. acutipennis* (Buquet) = *C. scintillans* Bates; *C. picea* Dejean = *C. unicolor* Chevrolat; *C. nitidula* (Buquet) = *C. triangularis* (Buquet) = *C. nubiculosa* Chaudoir = *C. flavodisca* Chaudoir; *C. lineata* (Bates) = *C. nigrosignata* (Chaudoir); and *C. transversa* (Reiche) = *C. picturata* (Chaudoir) = *C. undulata* (Chaudoir). One replacement name is proposed for a junior homonym: *C. sallei* for *C. variegata* Chaudoir. Six species are removed from Coptodera and placed into other genera in the following new combinations: *Microlestodes marcida* Blackburn, *Anchista philippinensis* Jedlicka, *Stenognathus robustus* Bates, *Lelis polygona* Bates, *Lelis latipennis* Bates, and *Lelis rutila* Bates. *Coptodera fasciolata* Macleay is given new status as the previously used name, *C. aurata* Macleay, and synonym, *C. tessellatus* Chaudoir (1883), are both junior homonyms of *C. aurata* Chevrolat and *C. tessellatus* Chaudoir (1869) respectively.

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- Silman, M. R., E. J. Aycaya and J. Brinson. 2003. Los bosques de bambú en la Amazonía occidental. Pages 63-74 in R. Leite Pitman, N. Pitman and P. Álvarez (eds.), *Alto Purús: Biodiversidad, conservación y manejo*. Center for Tropical Conservation, Lima.
- Silman, M. R., J. W. Terborgh and R. A. Kiltie. 2003. Population regulation of a dominant rain forest tree by a major seed-predator. *Ecology* 84(2): 431-438. ABSTRACT: We take advantage of a fortuitous local extinction and recolonization of white-lipped peccaries (WLPs) at the Cocha Cashu Biological Station in southeastern Peru to assess the impact of this high-biomass seed predator on the recruitment of a dominant member of the tree community, the palm *Astrocaryum murumuru*. WLPs were common at Cocha Cashu in the mid-1970s. In 1978, the species vanished from the entire region and did not reappear until 1990. To assess the impacts of the presence-absence of WLPs on *Astrocaryum* recruitment, we conducted transect counts of both the number and spatial distribution of palm seedlings in 1978 (when WLPs were present), in 1990 (after a 12-yr absence of WLPs), and in 1999 (after 10 yr of recovery). Other factors affecting recruitment, such as climate variability, differences in tree fecundity, and fluctuations of vertebrate and invertebrate seed predators were also examined as alternative hypotheses for any changes in seedling spatial distribution and abundance. In the absence of WLPs, the density of *Astrocaryum* seedlings increased 1.7-fold, and the spatial distribution of seedlings with respect to safe sites was significantly altered. After the return of WLPs to the study area, seedling density dropped to its former level, and the spatial distribution of seedlings with respect to safe sites returned to the same pattern found 21, yr earlier in 1978. None of the other factors investigated varied systematically with the census intervals. These results demonstrate that the absence of a single, albeit important, member of a diverse seed predator guild can have a major impact on the demography of a common tree species. We infer that individual seed predators can play central roles in regulating the demography of tropical trees, as envisioned many years ago by Janzen and Connell, and that their extirpation or extinction can have cascading effects in

tropical ecosystems.

- Silva, D. and J. A. Coddington. 1997. Spiders of Pakitza (Madre de Dios, Peru): Species richness and notes on community structure. Pages 253-312 in D. E. Wilson and A. Sandoval (eds.), *Manu: The biodiversity of southeastern Peru*. Smithsonian Institution and Editorial Horizonte, Lima. ABSTRACT: El muestreo cuantitativo realizado en Pakitza durante abril-mayo y setiembre-octubre de 1991, solo de los ejemplares adultos (2616 arañas), dio como resultado 498 especies de arañas distribuidas en 33 familias. El análisis de la estructura de la comunidad de arañas indica que el grupo de tejedoras de telas circulares es dominante en abundancia y diversidad de especies, seguido por el grupo de tejedoras de telas irregulares. Las familias numéricamente dominantes son Theridiidae y Araneidae, cada una representa el 28% del total de ejemplares colectados; la tercera familia mas abundante es Uloboridae (7.1%). La mayoría de las especies colectadas (56%) está representada por solo uno o dos ejemplares, estas especies parecen tener una gran influencia en el estimado de la riqueza cuando se consideran las variaciones por estacionalidad o tipo de bosque; las diferencias no son significativas cuando se excluye las especies representadas solo por un ejemplar. El mismo efecto se observa cuando los únicos se excluyen del estimado total de la riqueza de especies, el que es significativamente mayor a finales de la época seca. La araneofauna de la terraza aluvial antigua (OAT) parece ser más rica en especies que aquella del bosque inundable alto (UFF), aunque puede ser efecto del tamaño de la muestra. La evaluación de los métodos no paramétricos utilizados para el estimado de la riqueza de especies, demuestra que cada uno tiene sus ventajas y desventajas, aunque los intervalos de confianza superimponen. Quizás este rango de valores es suficiente para el estimado de la riqueza de especies. Cuando se compara los diferentes métodos usualmente se encuentra el siguiente orden, partiendo de aquellos que proporcionan los estimados más bajos hasta aquellos que indican los estimados mas altos: log normal, jackknife, Chao 1, Chao 2, y curva de acumulación de especies.
- Silva, J. and A. Ramírez. 1998. Análisis de la capacidad de uso mayor de la tierra en la comunidad de Monterrey: Informe final. Unpublished report of Conservación Internacional Perú and the Federación Agraria de Madre de Dios (FADEMAD). Puerto Maldonado. 76 pages.
- Silvertown, J. 2004. Sustainability in a nutshell. *Trends in Ecology & Evolution* 19(6): 276-278. ABSTRACT: Sustainable exploitation is widely advocated as a strategy for reconciling economic pressures upon natural habitats with nature conservation. Two recent papers examine different aspects of the sustainability of the nut harvest on wild populations of Brazil nut trees *Bertholletia excelsa* in Amazonia. Peres et al. find that many populations of the Brazil nut tree lack juvenile trees and are not regenerating. In a socioeconomic study, Escobal and Aldana find that nut-gathering provides insufficient income on its own to support nut-gatherers and that their other income-raising activities damage the forest. The existence of a market for rainforest products is, therefore, not sufficient on its own to prevent habitat destruction or the over-exploitation of the resource and a more sophisticated approach to sustainability is required. Development of a market in ethically traded Brazil nuts might be one solution.
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- Smith, T. B. 1983. Nest of the Red-stained Woodpecker (*Veniliornis affinis*) from southeastern Peru. *Condor* 85(4): 499-499. ABSTRACT: In spite of the wide distribution of *Veniliornis affinis* in the neotropics, there do not appear to be any publications on the subject of its nesting habits. This contribution describes a nest with two chicks, discovered in the tropical rainforest, at the TRZ. The tree (species undetermined) containing the nest was located beside a very well used path; it was almost 10 m high, with a DBH of 23 cm. The canopy above it, was continuous and of an estimated height of 25-30 m. The forest immediately adjacent to the tree appeared to

be undisturbed, and rather open in its lower strata. The nest contained two chicks of about the same size, whose main wing feathers were already emerging from their sheaths. Measurements are given of the nest cavity and of its height above ground. This nest was watched for a total of three hours during the afternoons of 30th and 31st May 1982, and both the activity of the adults feeding the chicks and the response of the latter were recorded.

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- Solari, S., V. Pacheco and E. Vivar. 1999. Nuevos registros distribucionales de murciélagos peruanos. *Revista Peruana de Biología* 6(2): 152-159. ABSTRACT: Basados en colectas recientes y revisión de especímenes, actualizamos los datos de distribución geográfica para diez especies de murciélagos de Perú, e incluimos información sobre su morfología, estado sistemático y ecología. Los registros incluyen dos extensiones latitudinales (*Lonchophylla robusta* y *Thyroptera lavalii*), y una extensión altitudinal (*Anoura latidens*). Dos especies de *Cynomops*, *paranus* y *planirostris*, se presentan en Perú, y son documentadas por nuestros especímenes. Algunas identificaciones erróneas, reportadas en publicaciones previas, son corregidas y presentadas en su actual estado taxonómico. La diversidad de murciélagos de Jenaro Herrera y Cocha Cashu-Pakitza es corregida a 63 y 62 especies, respectivamente.
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Terborgh, J., E. Losos, M. P. Riley and M. B. Riley. 1993. Predation by vertebrates and invertebrates on the seeds of five canopy tree species of an Amazonian forest. *Vegetatio* 108: 375-386. ABSTRACT: We studied the pre-germination loss of seeds to invertebrate and vertebrate seed predators of five species of Amazonian trees (*Astrocaryum macrocalyx* - Palmae; *Bertholletia excelsa* - Lecythidaceae; *Calatola venezuelana* - Icacinaeae; *Dipteryx micrantha* - Leguminosae (Papilionoidae); *Hymenaea courbaril* - Leguminosae (Caesalpinoideae)). These five species were selected from a large tree flora on several criteria. All possess large (3-10 cm) well-protected seeds that might plausibly be attractive to mammalian seed predators. The reproductive biology of three of the species, or close congeners, had been studied elsewhere in the Neotropics (*Astrocaryum*, *Dipteryx*, *Hymenaea*); one is important to the economy of southeastern Peru (*Bertholletia*); and one, despite large and apparently edible seeds, appeared to suffer no pre-germination loss to predators (*Calatola*). We conducted the research in mature forests in the Manu National Park of southeastern Peru where mammal densities are unperturbed by human activities. Densities of adult trees of the five species in our area range from very high (> 30 per ha: *Astrocaryum*) to very low (much less than 1 per ha: *Hymenaea*). Loss of seeds to all causes, and to mammalian seed predators in particular, was determined for seeds placed in 2- square meter mammal exclosures and in open controls located at 10 m (near) and 50 m (far) from a large mature individual of the target species (with minor variations in the design for *Astrocaryum* and *Calatola*). The exclosures were of two types: impermeable - designed to exclude all mammals, but not invertebrate seed predators, and semipermeable - designed to admit small (< 500 g), but not large mammals. Experimental and control plots were stocked with apparently viable seeds during the dry-wet transition period (October-November) and scored one year later. A significant distance effect (higher predation near vs far from a large conspecific adult) was found in only one of the species (*Astrocaryum*), the only one to be attacked with high frequency by invertebrate seed predators. The absence of any detectable distance effect attributable to mammals suggests that mammals, over the course of a year, thoroughly search the forest floor for seeds. Invertebrates may thus be responsible for most pre-germination distance (density) effects. With respect to the treatments, we found three qualitatively distinct results: seeds of three species (*Astrocaryum*, *Bertholletia*, *Dipteryx*) were significantly protected by the impermeable, but not semipermeable exclosures, implicating small mammals in seed loss; the seeds of one species (*Hymenaea*) were significantly protected by exclosures of both types, implicating large mammals; and the seeds of one species (*Calatola*) exhibited 100% survival, whether or not protected by exclosures. The importance of large mammals as seed predators is generally underestimated in these experiments because semipermeable exclosures may serve as foraging reserves for small mammals. Finally, we noted no relationship between the intensity of mammalian seed predation (as suggested by the survival of unprotected seeds) and the abundance of adults of the five species in the environment. The diversity of results obtained for the five species reveals that large-seeded tropical trees may display a wide range of demographic patterns, and points to the likely importance of post-germination bottlenecks in the population biology of many species, even those that may experience severe pre-germination seed loss.

Terborgh, J. and J. Mathews. 1999. Partitioning of the understorey light environment by two Amazonian treelets. *Journal of Tropical Ecology* 15(6): 751-763. ABSTRACT: Primary tropical forests comprise a mosaic of mature, gap and building phase patches, resulting in great spatial variation in the distribution of foliage. Light may consequently penetrate into the forest interior over a wide range of angles. It thus seems possible that understorey tree species might be adapted for distinct understorey light conditions. At the Cocha Cashu Biological Station in Madre de Dios, Peru, there are two understorey treelets distinguished by contrasting crown architectures. One, *Neea chlorantha* (Nyctaginaceae), possesses a much-branched superstructure and displays a smoothly contoured shell of drooping elliptical leaves. The other, *Rinorea viridifolia* (Violaceae), displays planar arrays of horizontally-oriented obovate leaves held on whorls of stiffly radiating horizontal branches. With the aid of hemispherical photography and the program CANOPY, the light environment at large within a 2.25-ha permanent tree plot, and above and below the crowns of *Neea* and *Rinorea* treelets, was investigated. Available light (measured as uncorrected indirect site factor (ISFU) in CANOPY) at control points showed a log-linear increase with height from 2.1 to 14.2 m. The relative amount of lateral illumination also increased with height. Photographs were taken just above and below the crowns of 50 *Neea* and 50 *Rinorea* treelets. *Neea* crowns were more effective at intercepting light from overhead sources, whereas

Rinorea crowns were more effective at intercepting light from lateral sources. Adult Neea and Rinorea treelets occurred at locations in the forest where they were exposed to differing angular distributions of incident light, suggesting that the two species were engaged in a form of resource partitioning, a conclusion that is in conflict with the non-equilibrium model of tropical forest tree species diversity. It is suggested that tropical tree species diversity is, at least in part, a product of adaptive specialization to a spatially heterogeneous light environment.

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species overwhelmingly dominate the ant assemblage but fail to exclude other ant species. Competition appears to limit the number of dominant species that can coexist in small areas, but a large majority of species present do not compete with the dominants and exist to a greater or lesser extent independently of them. The low ecological diversity observed in the sample may be in part a function of the spatial scale of sampling, and increased sampling should lead to a change in this pattern. The extent to which the species abundance distribution would become more equitable cannot be determined at this time. Finally, the structural complexity of the canopy may promote high species richness by creating microhabitat-linked species associations that effectively function as separate, non-competing ant assemblages.

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- Torres, S. 2004. *Composición de especies de bandadas mixtas en la Reserva Nacional Tambopata Candamo*. Bachiller thesis. Universidad Peruana Cayetano Heredia, Lima. pages. ABSTRACT: Los objetivos generales del presente estudio son describir la composición de especies de bandadas mixtas tanto de dosel como de sotobosque en el Estación de Investigación Tambopata (TRC) en la Reserva Nacional Tambopata, Provincia de Tambopata, Región de Madre de Dios, Perú. Este estudio se realizó en el mes de Noviembre del año 2003, considerándose época de lluvia. Las especies, encontradas dentro de una bandada mixta se clasificaron de acuerdo al rol que desempeñaron dentro de la bandada mixta y a su vez al gremio al cual pertenecieron. Se agruparon todas las observaciones de cada bandada mixta con el programa Mathematica 5.0 (Wolfram 2004) en el área de estudio para poder identificar los territorios, basados en investigaciones anteriores. Se ensayaron diferentes tipos de áreas de territorios llegando a determinar que los territorios utilizados para bandadas mixtas de dosel fueron de 20 hectáreas y los territorios para bandadas mixtas de sotobosque de 10 hectáreas. Se obtuvieron en el área de estudio cuatro bandadas mixtas de dosel y cinco bandadas mixtas de sotobosque al final de la investigación. Se determinó una frecuencia de presencia de especies en cada bandada mixta, para confirmar si las especies encontradas en un determinado territorio, tenían relación o no con territorios de otras bandadas mixtas. El método de análisis de datos permitió estimar los territorios de las bandadas mixtas sin tener que anillar a las aves.
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bondari, sp. n. (Linhares, Espirito Santo, Brazil); *S. tumidipectus*, sp. n. (Caruaru, Pernambuco, Brazil); *S. exilis*, sp. n. (Yarinha-Cocha, Rio Ucayali, Loreto, Peru). *S. gracilis*, sp. n. (Baixo Cauaburi, Amazonas, Brazil); *S. cracens* sp. n. (Caracas, Venezuela); *S. petilus*, sp. n. (Santarem, Para, Brazil); *S. subcoronatus* sp. n. (Linhares, Espirito Santo, Brazil); *S. hirsutus*, sp. n. (12 miles W of Santa Maria, Magdalena, Colombia), *S. coroni*, sp. n. (Bartica, Mazaruni-Potaro, Guyana); *S. prolatus* sp. n. (Natal, Rio Grande do Norte, Brazil); *S. apicalis*, sp. n. (Pedra Azul, Minas Gerais, Brazil); *S. remotus*, sp. n. (Saint Vincent, Lesser Antilles); *S. propinquus*, sp. n. (Mustique Island, Grenadines, Lesser Antilles); *S. contiguus*, sp. n. (Saint Vincent, Lesser Antilles); *S. championi*, sp. n. (Samana, Dominican Republic); *S. truncatipennis* sp. n. (Port au Prince, Haiti); *S. schoenherii*, sp. n. (4 km SE Rio Limpio, La Estrelleta, Dominican Republic); *S. sleeperi*, sp. n. (Cayamas, Cuba); *S. insidiosus*, sp. n. (20 km from Ucayali on Rio Calleria, Colonia Calleria, Loreto, Peru), *S. delusor*, sp. n. (Paraiso, Canal Zone, Panama); *S. inermis*, sp. n. (Tefe, Amazonas, Brazil); *S. abbreviatus* sp. n. (San Martin, San Martin, Peru), *Hammatostylus exiguus*, sp. n. (Barro Colorado Island, Canal Zone, Panama); *H. inhumeralis*, sp. n. (Tarapoto, San Martin, Peru); *H. erebus*, sp. n. (Forte Principe da Beira, Rondonia, Brazil); *H. vix*, sp. n. (Cochabamba, Bolivia); *H. difficilis*, sp. n. (Utinga, Belem, Para, Brazil); *H. consimilis*, sp. n. (Igarape Belem, Rio Solimoes, Amazonas, Brazil). The following new synonyms are established: *Erodiscus filirostris* (Chevrolat)=*E. scutellaris* (Chevrolat)=*E. denticollis* (Pascoe); *Pimelerodius gallinago* (Kirsch) =*P. motacilla* (Boherman); *Pimelerodius variabilis* var. *niger* (Hustache)=*P. variabilis* (Hustache); *Pimelerodius nigricornis* (Hustache)=*P. rectirostris* (Hustache)=*P. gryphus* (Boherman); *Sicoderus alutaceus* (Hustache)=*S. distinguendus* (Hustache); *Lancearius mycterius* (Monte)=*L. longirostris* (Pascoe); *Ludovix albipennis* Monte=*L. fasciatus* Gyllenhal. Two species, formerly placed in the Erodiscini, are removed from the tribe: *Erodiscus gazella* (Fabricius) returns to be genus *Myrmex* (Otidoccephalini); *Erodiscus grallator* Gyllenhal (Oriental species ?) cannot be maintained in the Otidoccephalinae and is tentatively assigned to the Hylobiinae. A discussion of the general morphology of the tribe is presented and important structures are discussed and illustrated. The presence of a stridulatory apparatus (elytro-femoral type) is reported fo

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the course of 202 sampling dates from 1991 to 1994, we recorded a total of 64 nonvolant species by conventional trapping, arboreal platform trapping, pitfall trapping, diurnal and nocturnal hunting, and interviews with local residents. Included in this total species count are 12 marsupials, nine xenarthrans, six primates, 10 carnivores, five ungulates, and 22 rodents. Systematic research with nonvolant mammal specimens collected as voucher material resulted in the discovery of new taxa, documented range extensions of previously described species, and helped resolve many longstanding taxonomic problems: (1) *Gracilinanus emiliae* (Thomas), herein reported for the first time from French Guiana, is redescribed and its known geographic distribution documented; based on examination of type material and original descriptions, *G. longicaudus* Hershkovitz is considered a junior synonym of *G. emiliae*, but *Marmosa agricolai* Moojen is not. (2) A new genus is proposed for *Gracilinanus kalinowskii* Hershkovitz, a taxon previously known only from eastern Peru, in recognition of its trenchant morphological differences from all other known didelphimorph marsupials. (3) *Marmosops parvidens* (Tate) and *M. pinheiroi* (Pine), the latter originally described as a subspecies of the former, are distinct species that occur sympatrically at Paracou; based on examination of type material, other taxa hitherto synonymized with *M. parvidens* are also judged to be valid species, including *M. juninensis* (Tate) and *M. bishopi* (Pine). (4) *Monodelphis breviceaudata* (Erxleben), *M. glirina* (Wagner), and *M. palliolata* (Osgood) are all distinct species diagnosable by unique combinations of morphological traits; based on examined specimens, *M. breviceaudata* (with type locality emended herein as Kartabo, Guyana) appears to be endemic to the Guiana subregion of Amazonia and to include both bicolored and tricolored phenotypes; a neotype from Cayenne, French Guiana, is designated to fix the application of *Viverra touan* Shaw as the oldest available name for the tricolored form. (5) *Saguinus midas* (Linnaeus) and *S. niger* (E. Geoffroy), currently treated as synonyms or conspecific races, are unambiguously diagnosable species that do not appear to be sister taxa; a neotype is designated to conserve current usage of *niger* E. Geoffroy for the black-handed tamarin of southeastern Amazonia. (6) Two new small species of *Neacomys* are described from material collected at Paracou; their diagnostic attributes are documented by detailed comparisons with other like-sized con genera from northern South America. (7) *Nectomys melanius* Thomas is recognized as a species distinct from *N. squamipes* (Brants) and *N. palmipes* J. A. Alien and Chapman; however, *N. parvipipes* Fetter is not a valid taxon and is herein synonymized with *N. melanius*. (8) The diagnostic characters of *Neusticomys oyapocki* (Fetter and Dubost), a species previously known only from the holotype, are reevaluated and illustrated from freshly collected material. (9) *Oecomys auyantepui* Tate and *O. paricola* (Thomas), previously treated as synonyms, are valid species distinguished by consistent cranial differences and occupy allopatric ranges north and south of the Amazon, respectively. (10) A critical examination of small *Oecomys* specimens from Paracou and other Guianan localities supports the conclusions of other investigators that *O. rutilus* Anthony and *O. bicolor* (Tomes) are unambiguously diagnosable species. (11) *Oligoryzomys fulvescens* (Saussure) and *O. microtis* (J. A. Alien), currently regarded as valid allopatric species occurring north and south of the Amazon, respectively, are difficult to diagnose unambiguously and may be conspecific; new information is provided about the hitherto ambiguous type locality of the latter taxon. (12) *Rhipidomys nitela* Thomas is reported from French Guiana for the first time and its previously unpublished diagnostic differences from other congeners are tabulated and discussed. (13) A lectotype is designated for *Coendou melanurus* (Wagner), and the species is redescribed based on all known specimens in North American and European museums; diagnostic differences between this species and *C. insidiosus* (Olfers) are illustrated for the first time. (14) A red-rumped agouti (*Dasyprocta*) is designated as the neotype of *Mus aguti* Linnaeus to preserve current usage of *Dasyprocta prymnolopha* (Wagler) for the black-rumped agouti. (15) The diagnostic differences between red and green acouchies (*Myoprocta*) are discussed and a neotype is designated for *Cavia acouchy* Erxleben to fix the application of that name to the red species; other nominal taxa of *Myoprocta* are identified as red or green acouchies based on examination of type material and original descriptions. (16) The diagnostic morphological traits of *Proechimys cuvieri* Fetter and *P. guyannensis* (E. Geoffroy) are reevaluated and discussed based on character variation in topotypical (French Guianan) material. Analyses of our sampling results indicate that distinct sets of nonvolant species are effectively sampled by different inventory methods, and that increased sampling effort with any method generally results in more species. Although the rate of discovery of new species always decreases with increasing sample size, none of our graphs of species accumulation indicate that an asymptotic value was reached with any method. Instead, nonparametric statistical extrapolations suggest that the Paracou nonvolant mammal fauna consists of somewhere between 69 and 74 species; by implication, our nonvolant inventory is about 86-93% complete. Most missing species are probably marsupials and rodents, but one or two expected primate species might have been locally extirpated by hunters prior to our fieldwork. In terms of higher taxonomic composition, the Paracou nonvolant mammal fauna is typical of those found throughout the humid Neotropical lowlands. However, a quantitative analysis of nonvolant faunal similarity at the species level among 12 exemplar rainforest inventories first clusters the Paracou list with others from the Guiana subregion of Amazonia, next with lists from elsewhere in Amazonia, and lastly with Central American lists. Pairwise similarity values likewise show an obvious positive correlation between faunal resemblance and geographic proximity within the Neotropical rainforest biome. At least 24 species (38%) of the Paracou nonvolant fauna are Amazonian endemics, but 18 (28%) are essentially pan-Neotropical in distribution; the remaining 22 species exhibit a variety of distributional patterns that suggest past connections among different sets of currently disjunct rainforested regions. Species richness comparisons

among nonvolant faunal inventories are complicated by a variety of familiar problems including inconsistent methodology, presence or absence of certain key habitats, and uneven sampling effort. A conservative interpretation of sampling results from La Selva (Costa Rica), Paracou, and Manu (Peru), however, suggests progressive increases in richness of about 23% from Central America to the Guianas, and of about the same amount from the Guianas to western Amazonia; over the entire gradient (Central America to western Amazonia), the net increase in observed richness is at least 50%. Whereas rodents are consistently the most diverse clade in all well-sampled nonvolant faunas, rankings of other orders by relative richness exhibit considerable site-to-site variation, at least some of which appears to reflect real geographic differences in taxonomic diversity rather than sampling artifacts. Nonvolant rainforest mammals are hard to classify into trophic guilds due to behavioral plasticity and incomplete knowledge of relevant natural history. Preliminary guild comparisons among three exemplar faunas, however, suggest that the Paracou nonvolant community is substantially less diverse in arboreal frugivores and more diverse in terrestrial animalivores than are nonvolant communities at some Central American and western Amazonian sites. Subsistence and recreational hunting has clearly affected local populations of some nonvolant mammals at Paracou; whereas popular game species (e.g., large primates) were seldom sighted, density compensation may explain high local densities of certain other taxa (e.g., *Potus flavus* and *Cuniculus paca*). Patterns of differential habitat use between closely related nonvolant species at Paracou were mostly observed within the terrestrial granivore/frugivore guild. Combining these results with those previously reported for the sympatric bat fauna, we recorded a total of 142 mammalian species at Paracou. By statistical extrapolation from our sampling data, the entire local community perhaps contains 155-168 species; because the known French Guianan rainforest mammal fauna contains at least 167 species for which suitable habitat is present in our study area, such estimates are plausible. By implication, our inventory is perhaps 85-92% complete overall. A synthesis of biogeographic information analyzed in this monograph and by Simmons and Voss (1998) suggests that faunal turnover with increasing geographic distance is much higher for nonvolant mammals than for bats, a necessary consequence of observed group differences in endemism: whereas many nonvolant rainforest mammals have geographic ranges bounded by obvious topographic or habitat discontinuities (e.g., large rivers, xeromorphic vegetation), most rainforest bats are geographically widespread. Not surprisingly, most of the taxa that usefully define a Guianan center of mammalian endemism are nonvolant species. The geographic limits of Guianan endemism appear to be remarkably similar for mammals, birds, snakes, lizards, and trees, suggesting a common pattern of biotic differentiation. Overall, the Paracou mammal fauna conforms broadly with previous generalizations about community-wide patterns of diel activity and substrate use by Neotropical rainforest mammals, but appears to diverge significantly from conventional views about trophic structure. Whereas there are many more species of secondary consumers than primary consumers at Paracou, primary consumers appear to outnumber secondary consumers by an equally large margin at some western Amazonian inventory sites. Sampling artifacts perhaps explain some of the community differences observed in such comparisons, but real geographic variation in trophic structure is also apparent.

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502-507. ABSTRACT: In the spring of 1996, multiple cases of an acute febrile illness resulting in several deaths in remote locations in Peru were reported to the Centers for Disease Control and Prevention (CDC). The clinical syndromes for these cases included dysphagia and encephalitis. Because bat bites were a common occurrence in the affected areas, the initial clinical diagnosis was rabies. However, rabies was discounted primarily because of reported patient recovery. Samples of brain tissue from two of the fatal cases were received at CDC for laboratory confirmation of the rabies diagnosis. An extensive array of tests on the formalin-fixed tissues confirmed the presence of both rabies viral antigen and nucleic acid. The virus was shown to be most closely related to a vampire bat rabies isolate. These results indicate the importance of maintaining rabies in the differential diagnosis of acute febrile encephalitis, particularly in areas where exposure to vampire bats may occur.

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- Weng, C. Y., M. B. Bush and M. R. Silman. 2004. An analysis of modern pollen rain on an elevational gradient in southern Peru. *Journal of Tropical Ecology* 20: 113-124. ABSTRACT: The sensitivity of pollen as an indicator of elevation in neotropical lowland and Andean forests was measured using modern pollen samples collected from moss-polsters along a transect between 340 m and 3,530 m elevation and from surface sediments in lowland swamps (240 m) of Madre de Dios, Peru. A blind study, using samples collected from the same transect in the following year, provided a test of reproducibility. The results show (1) clear elevational distribution patterns and (2) the ability of calibration data to predict the altitude of the blind samples. Characteristic associations of pollen taxa are found under differing hydrologies and elevations. The floodplain pollen assemblages are characterized by abundant *Mauritia*, *Sloanea*, *Ficus*, *Iriartea* and *Arecaceae* pollen types. At higher elevations, these lowland types decrease or are absent. *Alchornea*, *Urticaceae/Moraceae*, *Bignoniaceae* and *Cecropia* are dominant components of the pollen rain of the low-elevation zone (< 1000 m). *Acalypha*, *Alchornea*, *Cecropia*, *Rubiaceae* and *Urticaceae/Moraceae* are important between 1000 m and 1600 m elevation. Pollen of *Hedyosmum*, *Alnus*, *Poaceae* and *Combretaceae/Melastomataceae* are abundant between 1600 m and 2000 m. *Cecropia* pollen dominates samples from low- to mid-elevation disturbed forests. *Alnus* pollen is most abundant, and *Poaceae* becomes rare, between Myrsine 2000 and 2700 m. At high elevations above 2700 m. *Asteraceae*, *Poaceae*, *Polylepis*, *Muehlenbeckia*-type and *Myrsine* pollen are dominant. Statistical analysis of the data set using Detrended Correspondence Analysis (DCA) shows a precise correlation between community composition and elevation. The DCA axis 1 values are strongly correlated with sample elevation, exhibiting a linear relationship ($r(2) = 0.904$). The results provide an estimate of the sensitivity of pollen analysis in the Neotropics as a proxy for measuring elevation and, by inference, temperature.
- Wheelwright, N. T. and C. H. Janson. 1985. Colors of fruit displays of bird-dispersed plants in two tropical forests. *The American Naturalist* 126(6): 777-799. ABSTRACT: Color is a key characteristic of fruits because it affects the probability that they will be noticed or selected and, consequently, that their seeds will be dispersed. This paper examines the colors of fruit displays of 383 bird-dispersed plant species in two diverse tropical forests in Costa Rica and Peru. We detail the frequency of ripe-fruit color displays and try to explain these patterns by considering a general model of selection of fruit colors. The generalization that "bird fruits tend to be red" is shown not to apply to the Neotropics; most ripe bird fruits in our sample are black, with red being the second most common color. The proportion of plant species bearing either black or red fruits is remarkably similar in Costa Rica, Peru, Europe, and Florida (USA) (62%-66%). Certain color combinations in fruit displays, formed by ripe fruits plus contrasting unripe fruits or accessory structures (bracts, peduncles, persistent calyces), are especially common. The colors black and red, for example, co-occur in about 18% of all fruit displays in Peru and Costa Rica, including species from 26 plant families. Some ripe-fruit colors (black, brown, blue, green) tend to be associated with unripe fruits or accessory structures of contrasting color; other colors (red, orange, white, yellow) tend to occur alone. We propose a model of fruit color suggesting that there is a cost of bearing conspicuous color patterns, either in attracting inappropriate consumers to the fruits or in manufacturing pigments or associated structures. Plants should be selected for increased conspicuousness of fruit display if the benefits of attracting more dispersers outweigh the costs of incidentally attracting lower-quality dispersers

or of being limited in the number of fruits that can be produced. Plant species especially likely to benefit by attracting many dispersers include colonists of patchy habitats, plants with generalized seed and seedling requirements, and plants whose fruits are unlikely to be discovered or eaten because they are nutritionally poor, they occur in small crop sizes, or they grow under poor visibility conditions or at times when dispersers are scarce.

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- White, F. 1986. Census and preliminary observations on the ecology of the black-faced black spider monkey (*Ateles paniscus chamek*) in Manu National Park, Peru. *American Journal of Primatology* 11(2): 125-132. ABSTRACT: The black-faced black spider monkey, *Ateles paniscus chamek*, was studied at Cocha Cashu, Manu National Park, Peru, from June to August 1982. The density of independently locomoting individuals was found to be 31/km², and the average party size was 3.15. Data on age and sex compositions of parties, activity patterns, and diet composition are presented. The spider monkeys spend approximately 30% of observed time feeding, 44% resting, and 25% moving. They ate 80% fruit and 17% new leaves. Spider monkeys appear to be important seed dispersers. The best dispersal observed was for fruits with few, relatively large seeds. A rough day-range of 2,400 m was estimated from measured travel times and distances. The social system of *Ateles* is discussed.
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- Wild, E. R. 1992. The tadpoles of *Hyla fasciata* and *H. allenorum*, with a key to the tadpoles of the *Hyla parviceps* group (Anura, Hylidae). *Herpetologica* 48(4): 439-447. ABSTRACT: The tadpoles of *Hyla fasciata* and *H. allenorum* are described. No features were found to distinguish between the tadpoles of *H. fasciata* and *H. calcarata*, but the former is easily diagnosed from other members of the *H. geographica* group for which the tadpoles are known. The tadpole of *H. allenorum* is typical of tadpoles in the *H. parviceps* group in having a bluntly ovoid body with a broadly curved snout, anteroventral oral disc lacking labial teeth, moderately robust serrate jaw sheaths, lateral eyes, sinistral spiracle, dextral vent, and a tail with a flagellum. It differs in lacking papillae on a reduced oral disc and in having two dorsolateral, longitudinal cream-gold stripes. An illustrated key to the known tadpoles of the *H. parviceps* group is provided.
- Wild, E. R. 1993. *Natural history and resource use of four Amazonian tadpole communities*. Unknown thesis type. Department of Systematics and Ecology, University of Kansas. pages.
- Wild, E. R. 1995. New genus and species of Amazonian microhylid frog with a phylogenetic analysis of New World genera. *Copeia* 1995(4): 837-849. ABSTRACT: A new species and genus of microhylid frog are described from Amazonian Peru. The new genus is diagnosed by an incomplete maxillary arcade, which is an apomorphy of the genus. Furthermore, the new species possesses a remarkably large, Type-2 suspension feeding tadpole with unique, large, scalloped flaps pendant over the mouth. Phylogenetic analysis of New World microhylid genera supports a hypothesis in which the new genus is derived relative to *Ctenophryne*, *Otophyryne*, and *Nelsonophryne* and is the sister taxon to the remaining genera.
- Wild, E. R. 1996. Natural history and resource use of four Amazonian tadpole assemblages. *Occasional Papers, Museum of Natural History, University of Kansas* 176: 1-59. ABSTRACT: Four tadpole assemblages were studied during the 1989-90 rainy season at the Reserva Cuzco Amazonico located on the Rio Madre de Dios, in Amazonian Peru. The ponds varied in size, depth, permanency, light penetration, alkalinity, hardness, and number of anuran and non-anuran species present but were similar in water temperature, dissolved oxygen, and pH. While sets of these characteristics appeared correlated among ponds, none of the characteristics was related to tadpole species richness, evenness, or diversity. Netting sampled 3820 tadpoles of 19 species, plus 1413 individuals of one species of crab, two species of aquatic insects, and 10 species of fish. Patterns of differential use among anuran species were found for most of the resource dimensions. Macrohabitat and time within the rainy season appeared to be the most important resource dimensions, followed by food (represented by ecomorphological guild), microhabitat (level in the water column), and diel time period. Some species demonstrated associations between microhabitat, diel time period, and development. Tadpoles of 25 other anuran species known to occur at Cuzco Amazonico were not encountered. These species probably use other

macrohabitats, but not other time periods, because most aquatic habitats exist only during the rainy season. Rainfall seems to be the most influential factor in determining the patterns of resource utilization by tadpoles, because it determines the degree to which the macrohabitats can be utilized temporally.

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- Wild, E. R. 1997. Description of the adult skeleton and developmental osteology of the hyperossified horned frog, *Ceratophrys cornuta* (Anura: Leptodactylidae). *Journal of Morphology* 232(2): 169-206. ABSTRACT: The adult skeleton and tadpole chondrocranium of the leptodactylid frog, *Ceratophrys cornuta* (Ceratophryinae), are described in detail, including the ontogenetic development of the chondrocranium and the ossification sequence of the skeleton. The chondrocranium of the carnivorous larvae is unique in lacking a frontoparietal fontanelle and possessing a complete dorsal roof of cartilage. Furthermore, the chondrocranium is extremely robust, particularly those elements involved in the feeding mechanism; these include large palatoquadrate cartilages, stout Meckel's, supra-, and infrarostral cartilages, and short, wide, cornua trabeculae. The chondrocranium of *C. cornuta* resembles that described for *Ceratophrys cranwelli*, but differs from the chondrocrania reported for the species of *Lepidobatrachus*. The large adult skull is hyperossified; most elements are fused into a single unit, and nearly all dermal elements are ornamented, casqued, and co-ossified. Calcification is present in nearly every cartilaginous element of the skeleton in larger (older) adults. Several osteological characters previously used in ceratophryine systematics, such as the otic ramus of the squamosal and the columella, are reassessed. Contrary to previous reports, the ossified, dorsal dermal shield above the vertebral column in many ceratophryine anurans is absent in *C. cornuta*. With few exceptions, the ossification sequence relative to metamorphosis is consistent with those that are known for other anurans. The squamosal arises from three distinct centers of ossification, including an otic element. The frontoparietal arises from two centers of ossification that fuse early in development. A robust postorbital arch is formed primarily by the otic flange of the frontoparietal, which articulates laterally with the medial border of the otic ramus of the squamosal. Changes in the timing of development, or heterochrony, are involved with the evolution of the unusual skull and skeleton of ceratophryine frogs. (C) 1997 Wiley-Liss, Inc.
- Wilkerson, R. C. and G. B. Fairchild. 1985. A checklist and generic key to the Tabanidae (Diptera) of Peru with special reference to the Tambopata Reserved Zone, Madre de Dios. *Revista Peruana de Entomología* 27: 37-53. ABSTRACT: 228 species of horseflies (Diptera: Tabanidae) have been recorded in Peru: 73 of these have been collected at the TRZ, which makes it the locality with more species reported so far than any other locality in the Neotropics and possibly in the world. It is even estimated that if further collecting is carried out, about another 25 species may be found. A similar site in Colombia yielded only 44 species in two years of intensive collection. In Panama there are a total of 165 known species, and in Colombia 210. In order to describe the distribution of the horseflies, three main regions were considered: (1) Pacific Coast, where small collections were made in Lima or towards the south, as far as Tacna; the few species recorded to the north of Lima were either relictic populations from the adjacent highlands or species of wide distribution; (2) Highlands, between 1500 and 4000 m above sea-level; the fauna here mainly comprised species of *Scaptia*, *Scione* and *Dasybasis*, collected principally in the south of Peru; and (3) Lowlands of the the east and foothills of mountains, mainly under 1500 m above sea-level, with extensive forest cover ranging from tropical to sub-tropical. These collections reveal the predominance of an essentially Amazonian fauna. The species found in the east of Ecuador and in the north of Colombia up to Panama are generally absent, but many species found in Tambopata are also present as far as the Guyanas in the north and the mouth of the Amazon in the east. The work includes a list and a key for sub-families, tribes and genera of the horseflies known in Peru.
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- Wilson, D. E., C. F. Ascorra and S. Solari. 1997. Bats as indicators of habitat disturbance. Pages 613-626 in D. E. Wilson and A. Sandoval (eds.), *Manu: The biodiversity of southeastern Peru*. Smithsonian Institution and Editorial Horizonte, Lima. ABSTRACT: Bat samples from six areas in Peru show that the relationship between those species that are routinely associated only with undisturbed, primary forest habitats, and those more normally associated with disturbed, secondary growth habitats, might be used to indicate the degree of disturbance of a given habitat.
- Wilson, D. E. and A. Sandoval (eds.). 1997. *Manu: The biodiversity of southern Peru*. Smithsonian Institution Press, Washington, DC.
- Wilson, E. O. 1987. The arboreal ant fauna of Peruvian Amazon forests: A first assessment. *Biotropica* 19(3): 245-251. ABSTRACT: A first assessment has been made of arboreal ants collected during 1982 and 1983 in four types of forest at the Tambopata Reserved Zone, Peru. The sample, comprising over 100,000 workers in 1707 separate species series, was found to contain 40 genera and an estimated 135 species, the most diverse local arboreal ant fauna ever recorded. A large portion of the diversity was caused by the occurrence of many species in close proximity. For example, a single tree yielded 26 genera and 43 species, approximately equal to the entire ant fauna of all habitats in the British Isles [UK]. In pairwise comparisons across the four forest types, 57-63 percent of the species in the smaller fauna were also found in the larger fauna. Consistent with this pattern, 47 percent of the species were found in two or more forest types. The Tambopata arboreal fauna is further characterized by the numerical dominance of three or four species occupying ant gardens, and by a greater diversity and abundance of dolichoderine ants than hitherto recorded in other Neotropical habitats.
- Windfelder, T. L. 1997. *Polyspecific association and interspecific communication between two Neotropical primates: Saddle-back tamarins (Saguinus fuscicollis) and Emperor tamarins (Saguinus imperator)*. Ph.D. dissertation. Department of Zoology, Duke University, Durham, USA. pages.
- Windfelder, T. L. 2000. Observations on the birth and subsequent care of twin offspring by a lone pair of wild emperor tamarins (*Saguinus imperator*). *American Journal of Primatology* 52(2): 107-113. ABSTRACT: The birth of emperor tamarin (*Saguinus imperator*) twins was observed in the wild. The mother was a member of lone pair in a marked population of emperor tamarins in the Manu National Park, Peru. This report describes the birth and provides subsequent information on infant care and survival. Despite some difficulties, this lone pair of relatively young, primiparous emperor tamarins was able to successfully raise twin offspring to the age of at least one month.
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- Wood, T. M., F. Gallo and P. K. Donahue. 1992. Observations at a Paradise Tanager nest. *Wilson Bulletin* 104(2): 360-362. ABSTRACT: At TRZ, the Paradise Tanager (*Tangara chilensis*) can be found in the canopy of tropical forest, in mixed species flocks. Observations of a nest located in a branch of a ceiba (*Ceiba pentandra*) were made from a canopy platform in the same tree. The activity and behavior of a couple during the nest construction, was registered and information on the material used was obtained; afterwards, on the activity of the couple during incubation and on nestlings caring and feeding. The nest probably was attacked by predators and the activity around the nest ended. However, after some weeks a paradise tanager couple was seen

building a nest in the same tree and the activity of the couple was once again registered. On this occasion the presence of another thraupid that visited the couple was detected, with no participation on the nest building.

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- Woodcock, D. W., G. Dos Santos and C. Reynel. 2000. Wood characteristics of Amazon forest types. *Iawa Journal* 21(3): 277-292. ABSTRACT: The Tambopata region of the southern Peruvian Amazon supports a high diversity of both woody plants and forest types. Woods collected from low riverside vegetation, floodplain forest, clay-soil forest on an upper terrace, sandy-soil forest, and swamp forest provide an opportunity to test for significant differences in quantitative anatomical characters among forest types. Vessel-element length in floodplain-forest trees is significantly greater than in the other forest types. Specific gravity is lower in the two early-successional associations (low riverine forest and mature floodplain forest). Vessel diameter and density do not show significant differences among forest types and may be responding to overall climate controls. These two characters, however, show a pattern of variation within a transect extending back from the river along a gradient of increasing substrate and forest age; in addition, sites characterized by frequent flooding or presence of standing water lack vessels in the wider-diameter classes. The six characters analyzed show distributions that are, with the exception of wood specific gravity, significantly nonnormally distributed, a consideration that may be important in representing characteristics of assemblages of taxa. The degree of variability seen in some of the quantitative characters shows the importance of either basing analysis on adequate sample sizes or identifying robust indicators that can be used with small samples.
- Woodman, N., N. A. Slade, R. M. Timm and C. A. Schmidt. 1995. Mammalian community structure in lowland, tropical Peru, as determined by removal trapping. *Zoological Journal of the Linnean Society* 113(1): 1-20. ABSTRACT: Amazonian lowland rain forests are complex three-dimensional formations consisting of a variety of arboreal and terrestrial habitats. The small mammal faunas, particularly of arboreal habitats, are poorly studied, and field research generally has been limited to a few faunal inventories. We sampled the terrestrial and arboreal small mammal fauna in two floodplain forest study zones at Reserva Cuzco Amazonico, southeastern Peru, by removal trapping for 12 consecutive days in dry (June-July 1989) and rainy seasons (January-February 1990). Nineteen taxa of marsupials and rodents were captured. Small mammals were more abundant in the rainy season than in the dry season, but the relative proportions of the 11 most abundant species remained stable between seasons and study zones. Most species showed no decline in capture rates through the 12-day period, indicating that either population densities were high or animals were quite mobile. The small mammal fauna exhibited strong vertical stratification; among the 11 most abundant species, four exhibited strong biases toward terrestrial and five toward above-ground captures. The distinct arboreal small mammal community is grossly underrepresented if traps are placed only at ground level.
- Woodman, N., R. M. Timm, R. Arana C., V. Pacheco, C. A. Schmidt, E. D. Hooper and C. Pacheco. 1991. Annotated checklist of the mammals of Cuzco Amazonico, Peru. *Occasional Papers, Museum of Natural History, University of Kansas* 145: 1-12.
- Woodman, N., R. M. Timm, N. A. Slade and T. J. Doonan. 1996. Comparison of traps and baits for censusing small mammals in neotropical lowlands. *Journal of Mammalogy* 77(1): 274-281. ABSTRACT: Snap-traps, live-traps, and baits affect the ability to capture small mammals, but few previous studies have involved sampling communities of small mammals in tropical environments. We tested differences in captures of small marsupials and rodents by Victor snap-traps versus Sherman live-traps and by two types of bait in lowland rainforest at Reserva Cuzco Amazonico, southeastern Peru. Snap-traps took ca. 3.5 times as many individuals as live-traps. Snap-traps also captured more species (and more rare species), but we attribute this to more numerous captures overall because the relative proportions of species captured by the two traps generally were the same. Type of bait had little impact on our trapping results.
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- Wright, S. J., M. E. Gompper and B. Deleon. 1994. Are large predators keystone species in neotropical forests? The evidence from Barro Colorado Island. *Oikos* 71(2): 279-294. ABSTRACT: Large cats have been hypothesized to act as keystone predators in Neotropical forests by limiting mid-sized terrestrial mammals, which in turn control forest regeneration. The evidence for this is based predominantly on cross-site comparisons involving Cosha Cashu (CC), Peru, with its complete predator complement, and Barro Colorado Island (BCI), Panama, where puma and jaguar are no longer residents. We reevaluate the evidence in light of 725 km of transect censuses performed on BCI, comparisons with additional sites throughout the Neotropics, and historical changes in the BCI mammal fauna. Several mid-sized species showed habituation to humans near the BCI laboratory compound (where previous censuses had been carried out), indicating that cross-site comparisons, despite using similar methodologies, may be biased by differentially meeting technique assumptions, and that densities of these species at BCI and CC may not differ as greatly as previously assumed. Analyses of additional sites also indicate that individual species population density estimates for BCI, while high for several species, are not extreme. Cross-site analyses indicate that most, but not all, species show no significant difference in mean densities at sites with and without large cats. On the other hand, an evaluation of the qualitative historical evidence indicates that as cats were eliminated from BCI by poaching, many potential prey species population densities increased. These increases were not sustained, however, and may reflect natural population variability rather than the status of large cats. Finally, we examine the evidence for prey species controlling forest regeneration. While extreme removal of herbivorous and frugivorous mammals will

profoundly affect forest regeneration, the effects of slight decreases in densities, or the effects of increased densities (as implicated by the keystone predator hypothesis) are equivocal.

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- Yáñez, I., M. Gómez, K. Dexter, A. Tauro, R. A. Saldaña, P. Stevenson and M. Espinoza. 2004. Variación de la densidad y la riqueza de plantas entre claros de diferente edad en un bosque tropical. Pages 100-104 in Servat, G., D. Cadena, K. Balta, and C. García-Robledo (eds.), unpublished compendium of student projects from the OTS course "Ecología de ecosistemas amazónicos 2004-13," sponsored by the Universidad Nacional de la Amazonía Peruana, Centro Amazónico de Educación Ambiental e Investigación & the Organization for Tropical Studies.
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- Young, D. G., R. J. E. Perez and G. Romero. 1985. New records of phlebotomine sand flies from Peru with a description of *Lutzomyia oligodonta*, new species from the Rimac valley (Diptera: Psychodidae). *International Journal of Entomology* 27(1-2): 136-146. ABSTRACT: Phlebotomine sand flies are implicated as vectors of bartonellosis and leishmaniasis. *Brumptomyia galinoides* and 14 spp. of *Lutzomyia* spp. not clearly named sand flies from Tambopata Reserve, Madre de Dios, Peru, are reported in Peru for the first time. Twenty-three other

Lutzomyia species were taken at the same site. A new species *L. oligodonta*, is described based on males and females found in a small cave located in a leishmaniasis and bartonellosis endemic site in the Rimac Valley. This new species has an unusual combination of morphological characters and cannot be placed in any existing subgenus or species group of *Lutzomyia*.

- Young, K. R. and B. Leon. 1991. Observations on the understory climbing fern, *Polybotrya pubens* (Dryopteridaceae) in a Peruvian rain forest. *American Fern Journal* 81(2): 63-67. ABSTRACT: The abundance of *Polybotrya pubens* measured in this study was the same as that found on a 10 by 20 m plot located about 0.5 km away (0.5 plants/m²; Young and Leon, 1989). The percentage of climbing individuals found during the present study, however, was even less than that found previously (15% versus the 25% of Young and Leon, 1989). Only rarely do *P. pubens* individuals in the study area reach situations where they can potentially produce spores. The availability of suitable support elements for climbing was a limiting resource for the studied population, as was the case for lianas in Panama (Putz, 1984). The great number of individuals with short rhizomes suggests high mortality or slow growth during the terrestrial phase of the sporophyte's life. Only a few of the climbing individuals clearly reached their trees after beginning growth on the ground, and these apparently germinated by chance much closer to a tree than the average nonclimber. Rhizome growth of *Polybotrya pubens*, as inferred by examination of rhizome form and characterized by extension in unpredictable directions, seemed well suited to help nonclimbers encounter a support. However, once the fern was climbing, it often doubled back on itself. Vines locating trees by growing towards dark forms (i.e., skototropism; see Strong and Ray, 1975) might face a similar dilemma in that growth that helps to locate a climbing support might act to prevent further upward growth once the support is located. Despite the ability of *Polybotrya pubens*' rhizome to change its angle and orientation of growth, it appears that the potential for reproductive success was due mostly to unpredictable factors, such as the germination site of the spore and local tree spatial patterns and dimeters. *Polybotrya pubens* is restricted to mature forest, perhaps because it requires large trees to climb, in addition to requiring the relatively stable microenvironment of the tropical rainforest understory. Treefalls and regrowth vegetation have much more extreme environmental conditions (e.g., Chazdon & Fetcher, 1984) and offer an array of smaller-diameter support elements to climbing plants. To expand upon these observations, data are needed on the rates of growth of climbing and nonclimbing *P. pubens*, and the length of time nonclimbers can persist on the forest floor without reaching suitable trees to climb.
- Yu, D. W. 1994. The structural role of epiphytes in ant gardens. *Biotropica* 26(2): 222-226.
- Yu, D. W. 1997. *Parasitic castration of the ant-plant Cordia nodosa (Boraginaceae) and the consequences for a metapopulation model of species coexistence*. Ph.D. dissertation. Department of Organismal and Evolutionary Biology, Harvard University, Cambridge, USA. pages.
- Yu, D. W. 2001. Parasites of mutualisms. *Biological Journal of The Linnean Society* 72(4): 529-546. ABSTRACT: Cooperation invites cheating, and nowhere is this more apparent than when different species cooperate, known as mutualism. In almost all mutualisms studied, specialist parasites have been identified that purloin the benefits that one mutualist provides another. Explaining how parasites are kept from driving mutualisms extinct remains an unsolved problem because existing theories explaining the maintenance of cooperation do not apply to parasites of mutualisms. Nonetheless, these theories can be summarized in such a way as to suggest how mutualisms can persist in the face of parasites. (1) For cooperation to occur, the recipient of a benefit must reciprocate, and the reciprocated benefit must be captured by the initial giver or its offspring. (2) For cooperation to persist, the mutualism must be re-assembled each generation. Because most mutualisms are of the 'by-product' type, broadly defined, the first condition is normally always fulfilled. Thus, the maintenance of mutualism usually requires enforcement of the second condition: reliable re-assembly. Hence, I argue that the persistence of mutualism is best understood by using theories of species coexistence, because each mutualist can be considered a resource for the other, and species coexistence theory explains how multiple taxa (e.g. parasites and mutualists) can stably partition a resource over multiple generations. This approach connects the study of mutualism to theories of population regulation and helps to identify key factors that have promoted the evolution, maintenance and breakdown of mutualism. I discuss how these ideas might apply to and be tested in ant-plant, fig-wasp and yucca-moth mutualisms.
- Yu, D. W. 2002. La comunicación entre hormiga y planta. Unpublished report of unknown provenance.
- Yu, D. W. and D. W. Davidson. 1997. Experimental studies of species-specificity in *Cecropia*-ant relationships. *Ecological Monographs* 67(3): 273-294. ABSTRACT: Strict coevolution requires that interactions among organisms be species-specific. We assessed the relative roles of host- and habitat-specificity in determining the match between a genus of myrmecophytic trees and a guild of obligate plant-ants in the moist tropical forests of Madre de Dios, Peru. Four locally coexisting but habitat-restricted *Cecropia* species were cultivated in screen tents until all plants had developed myrmecophytic traits. Saplings were then placed within replicate blocks of each of two habitat types: riversides and small forest light gaps. Colonization events were recorded

every 3 d between June and August of 1992, and queens were later removed from stem internodes for identification and brood censuses. A similar experiment, conducted in September through November of 1993, included just two species of *Cecropia* hosts. Effects of host species and habitat on queen colonization rates were evaluated by log-likelihood goodness-of-fit tests and contingency table tests. For three ant species, we also conducted queen preference experiments to compare queen behaviors across a range of host plants. Differences among ants in the extent of habitat-specificity vs. host-specificity provide evidence for multiple evolutionary routes to obligate association with *Cecropia*. Habitat-specificity exceeded host-specificity in *Azteca ovaticeps* (Dolichoderinae), for which queen preference experiments revealed no significant discrimination among hosts. This extreme riverside specialist is thought to have descended from generalist live-stem nesters in second-growth habitats. In *Azteca australis*, host-specificity was strong, and in this species only, directed toward hosts where brood production was most successful. Conflicting habitat associations in the two experiments indicated the weakness or absence of a consistent habitat affiliation in *Azteca australis* and suggested that colonization frequencies were influenced instead by proximity to foundress sources. Close relatives of *A. australis* live in exposed carton nests, which may have been positioned ancestrally on key resource plants, e.g., those producing lipid- and amino-acid-rich pearl bodies. *Pachycondyla luteola* (Ponerinae) exhibited both strong habitat and host associations and may have undergone pairwise coevolution with its forest-gap-dwelling primary host. Queens of *Camponotus balzani* (Formicinae), possibly a recent and secondary associate of *Cecropia*, were overrepresented in forest gap habitat but were host generalists, underrepresented only on a host with extremely small internodes. Apparently greater host-specificity in *C. balzani* at later stages of colony establishment may be due to differential post colonization mortality on the various hosts. Attack of ant queens by parasitoid wasps was strongly concentrated in the linear riverside habitat and weak to absent in the patchily distributed forest gap habitat. Due to lower rates of either parasitoid attack or other forms of queen mortality, *Camponotus balzani* experienced greater success in the forest gap habitat, where it was overrepresented in colonization experiments. Historical coincidences and preadaptations appear to have strongly influenced pairings between *Cecropia* species and their obligate plant-ants and account for much of the "apparent" niche partitioning observed in the system. Species-specificity seems to be determined mainly by coincident habitat affiliations of ants and plants ("coordinated dispersal") and by preadapted capacities of ants to distinguish among host-plant species. Multiple mechanisms for species-specificity may be characteristic of relationships in which associates disperse separately from one another (i.e., show horizontal transmission). Our results are consistent with the view that coadaptation and co-cladogenesis are more likely in systems where dispersal of associates is tightly coupled.

- Yu, D. W., T. Hendrickson and A. Castillo. 1997. Ecotourism and conservation in Amazonian Peru: Short-term and long-term challenges. *Environmental Conservation* 24(2): 130-138. ABSTRACT: Several authors have suggested that ecotourism can enhance the value of intact wildlands and thereby promote conservation. Two rainforest lodges dating from the 1970s and located in southeastern Amazonian Peru have been held up as early success stories in tourism-driven conservation, but a more recent assessment reveals that both lodges have since lost their rainforest reserves to encroachment. One of the major reasons for failure was that the national land laws in effect at the time did not allow the purchase of land titles. Recently, Peru has instituted a process for the purchase of land titles in the rainforest. One lodge has used the new land tenure laws with some success to create a rainforest reserve. The very attempt to buy land for purposes of conservation can promote encroachment and land-buying speculation, and the lodge's current agreement with its neighbours to provide a school in exchange for non-encroachment is fraught with moral hazards and appears unstable over the long term. Tourism can promote conservation primarily at the national level, and ecotourism projects in the Peruvian Amazon can stabilize land-use patterns at least in the short term. However, the conservation of habitat over the long-term will rest primarily on the ability of the State to enforce a consistent land use policy with regard to land tenure and Park protection.
- Yu, D. W. and N. E. Pierce. 1998. A castration parasite of an ant-plant mutualism. *Proceedings of the Royal Society of London Series B-Biological Sciences* 265(1394): 375-382. ABSTRACT: Exploring the factors governing the maintenance and breakdown of cooperation between mutualists is an intriguing and enduring problem for evolutionary ecology, and symbioses between ants and plants can provide useful experimental models for such studies. Hundreds of tropical plant species have evolved structures to house and feed ants, and these ant-plant symbioses have long been considered classic examples of mutualism. Here, we report that the primary ant symbiont, *Allomerus cf. demerarae*, of the most abundant ant-plant found in south-east Peru, *Cordia nodosa* Lam., castrates its host plant. *Allomerus* workers protect new leaves and their associated domatia from herbivory, but destroy flowers, reducing fruit production to zero in most host plants. Castrated plants occupied by *Allomerus* provide more domatia for their associated ants than plants occupied by three species of *Azteca* ants that do not castrate their hosts. *Allomerus* colonies in larger plants have higher fecundity. As a consequence, *Allomerus* appears to benefit from its castration behaviour, to the detriment of *C. nodosa*. The *C. nodosa*-ant system exhibits none of the retaliatory or filtering mechanisms shown to stabilize cheating in other cooperative systems, and appears to persist because some of the plants, albeit a small minority, are inhabited by the three species of truly mutualistic *Azteca* ants.

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- Yu, D. W., H. B. Wilson and N. E. Pierce. 2001. An empirical model of species coexistence in a spatially structured environment. *Ecology* 82(6): 1761-1771. ABSTRACT: Ecological theory has long supported the idea that species coexistence in a homogeneous habitat is promoted by spatial structure, but empirical evidence for this hypothesis has lagged behind theory. Here we describe a Neotropical ant-plant symbiosis that is ideally suited for testing spatial models of coexistence. Two genera of ants, *Allomerus* cf. *demerarae* and three species of Azteca are specialized to live on a single species of ant-plant, *Cordia nodosa*, in a Western Amazonian tropical rain forest. Empirically, using census data from widely separated localities, we show that the relative colonization abilities of the two ant genera are a function of plant density. A parameterized model shows that this pattern alone is sufficiently robust to explain coexistence in the system. Census and experimental data suggest that Azteca queens are better long-distance flyers, but that *Allomerus* colonies are more fecund. Thus, Azteca can dominate in areas where host-plant densities are low and parent colony-sapling distances are long, and *Allomerus* can dominate in areas where host-plant densities are high. Existing spatial heterogeneity in host-plant densities therefore can allow regional coexistence, and intersite dispersal can produce local mixing. In conclusion, a dispersal-fecundity trade-off appears to allow the two genera to treat spatial heterogeneity in patch density as a niche axis. This study further suggests that a spatially structured approach is essential in understanding the persistence of some mutualisms in the presence of parasites.
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- Zanata, A. M. and M. Toledo-Piza. 2004. Taxonomic revision of the South American fish genus *Chalceus* Cuvier (Teleostei: Ostariophysi: Characiformes) with the description of three new species. *Zoological Journal of the Linnean Society* 140(1): 103-135. ABSTRACT: The Neotropical characid fishes of the genus *Chalceus* Cuvier, 1817, are reviewed. In total, five species are recognized (including three new species). *Chalceus epakros* sp. nov. is the most widespread geographically, occurring in many rivers of the Amazon basin, the Rio Orinoco and in the Essequibo River drainage in Guyana. *Chalceus guaporensis* sp. nov. is restricted to the upper Rio Madeira, Rio Guapore and Rio Madre de Dios, of Brazil, Bolivia and Peru, respectively. *Chalceus spilogyros* sp. nov. occurs only in the Rio Trombetas, lower Rio Tapajos and lower Rio Madeira drainages. *Chalceus macrolepidotus* Cuvier occurs in the Rio Negro drainage, middle and lower Rio Orinoco basin and in the rivers of the Atlantic slopes of the Guianas, and *Chalceus erythrurus* Cope in the Rio Amazonas and Rio Solimoes to Rio Ucayali drainage in Peru. *Chalceus ararapeera* Cuvier & Valenciennes and *Creagrutus pellegrini* Puyo are considered synonyms of *C. macrolepidotus*, and *Pellegrinina heterolepis* Fowler is placed into the synonymy of *C. erythrurus*. Characters pertaining to the monophyly of *Chalceus* are discussed and a key to species is presented.
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