

**Informe final\* del Proyecto K044**  
**Participación de expertos en el séptimo congreso internacional de mastozoología**

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**Resumen:**

El propósito del simposio fue conjuntar a un grupo de expertos que estuvieran realizando investigaciones pioneras sobre los principales tipos de perturbación de hábitat en selvas húmedas alrededor del mundo y como estos afectan a las poblaciones y comunidades de mamíferos. Esto con el fin de discutir y analizar las peculiaridades, semejanzas y diferencias entre los distintos tipos de perturbación, taxa y regiones consideradas. Asimismo, para ver el estado de avance en este tipo de investigación y definir algunas líneas importantes a seguir. Fue de interés especial proponer formas para promover la conservación de los mamíferos y sus hábitats y de mejorar las prácticas actuales de manejo. Se conjuntó un programa de 12 ponencias sobre el tema (18 autores de 16 instituciones en 8 países, con trabajos de todos los continentes donde existen selvas húmedas.

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**INFORME FINAL A LA CONABIO**

**PROYECTO KO44**

**"PARTICIPACION DE EXPERTOS EN EL SEPTIMO CONGRESO  
INTERNACIONAL DE MASTOZOLOGIA"**

(Convenio Núm. FB474/KO44/97)

Responsable del proyecto:

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9 de diciembre de 1997

## **Introducción**

El propósito de este documento es informar sobre los principales logros obtenidos con la celebración del Simposio "Habitat disturbance and tropical mammals: A global perspective" (Perturbación de hábitat y mamíferos tropicales: Una perspectiva mundial), llevado a cabo durante el Seventh International Theriological Congress (ITC7 - Séptimo Congreso Teriológico Internacional), en Acapulco, Guerrero, del 6 al 11 de septiembre de 1997. Este simposio contó con el patrocinio de la CONABIO. El apoyo de la Comisión sirvió particularmente para financiar parte de los gastos del viaje a México de dos expertos visitantes, el Dr. Atul K. Gupta del Indian Forestry Service y el Dr. Ramesh Boonratana, de la Universidad de Chiang Mai en Tailandia. Se hace mención especial en este reporte de las actividades de estos expertos durante su visita a México.

## **Simposio "Perturbación de hábitat y mamíferos tropicales: Una perspectiva mundial"**

El propósito del simposio fue conjuntar a un grupo de expertos que estuvieran realizando investigaciones pioneras sobre los principales tipos de perturbación de hábitat en selvas húmedas alrededor del mundo y como estos afectan a las poblaciones y comunidades de mamíferos. Esto con el fin de discutir y analizar las peculiaridades, semejanzas y diferencias entre los distintos tipos de perturbación, taxa y regiones consideradas. Asimismo, para ver el estado de avance en este tipo de investigaciones y definir algunas líneas importantes a seguir. Fue de interés especial proponer formas para promover la conservación de los mamíferos y sus hábitats y de mejorar las prácticas actuales de manejo.

Se conjuntó un programa con 12 ponencias sobre el tema (18 autores de 16 instituciones en 8 países), con trabajos de todos los continentes donde existen selvas húmedas. Se adjunta una lista de estas ponencias y sus resúmenes respectivos. Lamentablemente hubo cuatro cancelaciones de último momento sobre el programa del simposio que se tenía hasta unas semanas antes del congreso. Esto limitó las perspectivas geográficas, y en menor grado temáticas, del simposio. El Dr. Adriano G. Chiarello canceló ya que el congreso coincidió con la fecha de entrega y la fecha que le asignaron para tener su defensa de tesis doctoral en la Universidad de Cambridge. El Dr. John E. Fa y el Dr. William Laurance cancelaron ya que no lograron obtener todos los fondos necesarios para el viaje. Finalmente, el Dr. Zainuddin Dahaban, quien a pesar de contar con financiamiento y haber confirmado su intención de asistir al congreso, no se presentó. Hasta la fecha desconozco las razones de su ausencia, ya que aún no ha contestado la correspondencia que le hemos enviado.

No obstante estas ausencias, el simposio contó con un rico programa, incluyendo siete ponencias orales y un cartel, además de una sesión de discusión sobre el tema y varias reuniones para organización del simposio y la publicación resultante (ver abajo). Se presentaron trabajos sobre los siguientes temas: agricultura de subsistencia, cacería, extracción forestal, establecimiento de plantaciones y pastizales, fragmentación de selvas, cambios de cobertura vegetal a escala amplia, y restauración de selvas en potreros. Las regiones consideradas fueron: el este de la India, Sabah (Borneo), Malasia peninsular, Guyana Venezolana, la Costa Atlántica de Brasil, El Petén Guatemalteco y México (Veracruz, Chiapas, Tabasco y Campeche), dando una buena perspectiva de los problemas provocados por la perturbación de hábitat en la región neotropical y en Asia tropical.

El simposio se celebró el día 11 de septiembre, de las 8:30 a las 12:30 horas. Se presentaron las siete ponencias mencionadas, contando cada ponente aproximadamente con 20 minutos para su presentación, más tiempo para preguntas. Se concluyó la sesión matutina con una discusión en la que participaron todos los ponentes y el público asistente. Por la tarde, en la sesión de carteles, se presentó un trabajo más.

Durante la mayor parte de las ponencias hubo aproximadamente 50 oyentes. Fue un hecho desafortunado el que el Comité Organizador del Congreso haya programado la celebración simultánea de cuatro de los otros simposios relacionados con asuntos de conservación. Esto diluyó la cantidad de público en cada uno de los simposios y limitó la asistencia de los ponentes a otros simposios de interés. Por otro lado,

numerosos estudiantes expresaron interés de asistir al simposio. Lamentablemente muchos de ellos estaban colaborando como voluntarios con el Comité Organizador del Congreso lo cual limitó su posibilidad de participación en el simposio mismo. No obstante, tuvieron muchas oportunidades para reunirse y discutir asuntos de su interés con los ponentes del simposio, durante otras sesiones o durante las actividades sociales del congreso. Asimismo, todos los participantes del simposio, incluyendo los visitantes patrocinados por la CONABIO, tuvieron la oportunidad de interactuar con los otros ponentes y con otros asistentes, nacionales y extranjeros, al congreso durante la duración del mismo.

En términos generales los participantes del simposio coincidieron que éste fue una reunión útil y fructífera para todos. Se recibieron comentarios en el mismo sentido por parte de otros asistentes al congreso.

### **Preparación de una publicación sobre el tema:**

Todos los participantes en el simposio estuvieron de acuerdo en la importancia de publicar conjuntamente los trabajos presentados. Se discutieron las ventajas y desventajas de publicar los trabajos en un libro o una sección especial en alguna revista arbitrada de distribución internacional, y se evaluaron las revistas probables. Se informó del interés del Dr. Gary Meffe, editor de la revista *Conservation Biology*, en publicar en su revista una sección especial sobre el tema del simposio (ver carta adjunta). Se explicaron las condiciones que había planteado el Dr. Meffe. para ello: 1) todos los trabajos pasarían por el proceso de arbitraje habitual, por lo que no hay garantías de aceptación para trabajo alguno; 2) dado que las secciones especiales en *Conservation Biology* no están cubiertas por el presupuesto normal. de la revista, habría cargos por página publicada (aproximadamente US \$150 por página), aunque hay disposición del Dr. Meffe para ayudarnos a reducir los costos. Se estuvo de acuerdo en que la opción mas conveniente era publicar los trabajos en una sección especial de esta revista, ya que su amplia y expedita distribución permitió a una gran audiencia. Se acordó que con el fin de hacer la publicación más completa y atractiva se incluyeran también los trabajos de personas que expresaron interés en el simposio pero que no pudieron asistir.

Se planteó tentativamente al 15 de diciembre de 1997 como fecha límite de entrega para los trabajos. Posteriormente se cambio ésta fecha al 28 de febrero de 1998. Después de esa fecha, cada trabajo será leído por dos de los participantes y los autores revisarán sus trabajos después de recibir los comentarios de estas personas. Paso seguido todos los manuscritos serán enviados al editor, para que estos se envíen a arbitraje. Será importante además que se identifiquen patrocinadores potenciales y que cada autor busque fondos para cubrir los costos de la publicación. En conjunto con el Dr. Meffe se están explorando mecanismos para reducir los costos. Actualmente los autores se encuentran preparando sus contribuciones. Se adjunta una lista de los trabajos que posiblemente se incluyan en la publicación.

### **Trabajo en colaboración con expertos visitantes:**

Se discutió tanto con el Dr. Gupta como el Dr. Boonratana las posibilidades de colaboración en trabajos relacionados a las áreas académicas y de conservación de interés común. Con el Dr. Gupta se habló sobre la posible realización conjunta de estudios comparativos sobre las implicaciones ecológicas y sociales de la agricultura migratoria de subsistencia en México y la India. Con el Dr. Boonratana se contempló la posibilidad de apoyar sus trabajos de investigación y conservación en la República Popular Democrática de Laos, con asistencia técnica en materia de evaluación y planificación para la conservación, y en especial apoyando con cursos de entrenamiento para guardaparques y otros técnicos (este país cuenta actualmente con muy escasos recursos humanos calificados en materia de conservación).

### **Actividades adicionales de los expertos visitantes:**

Los Drs. Gupta y Boonratana visitaron las instalaciones del Instituto de Ecología UNA M, en Ciudad Universitaria, en dos ocasiones. Durante estas visitas se reunieron con investigadores y estudiantes de licenciatura y postgrado. Conversaron sobre sus intereses de investigación y sobre los problemas y acciones de conservación en sus países y en México, y respondieron múltiples preguntas.

Realizamos unos breves recorridos de campo para observar algunos ecosistemas típicos de la región centro y suroccidente de México. Se observaron selva baja caducifolia, pinares, encinares, humedales, y ecosistemas costeros, así como algunos sistemas productivos, incluyendo agricultura de subsistencia.

También realizaron recorridos turísticos con el fin de familiarizarse con la cultura y las bellezas naturales y arquitectónicas de nuestro país. Estos recorridos se realizaron en Acapulco (sede del Congreso) y la Ciudad de México.

### **Aspectos administrativos y logísticos:**

Aparte de los aspectos propiamente académicos del simposio, la organización de la reunión implicó una multitud de aspectos administrativos y atención a asuntos logísticos diversos. Estos incluyeron, por ejemplo: la tramitación, adquisición y envío de boletos de avión; el apoyo en la tramitación de visas para ingresar a México; asistencia en la tramitación de reservaciones de hotel, en otras. Para esto se contó con el eficiente apoyo del personal del Instituto de Ecología, UNAM.

### **Aspectos financieros:**

El financiamiento proporcionado por la CONABIO (\$25,000 más IV A) sirvió para patrocinar la mayor parte del viaje de los Drs. Atul K. Gupta y Ramesh Boonratana desde sus países a la Ciudad de México. Se les apoyo con el pago del boleto de avión de los siguientes vuelos:

Dr. Atul K. Gupta Nueva-Delhi-México-Nueva Delhi (via Amsterdam)	\$18,255.43
Dr. Ramesh Boonratana Kuala Lumpur-México-Kuala Lumpur (via Taipei y Los Angeles)	\$10,487.75
Total	\$28,743.18

Adicionalmente, el Comité Organizador del ITC7 otorgó una beca de US \$500 para cubrir parte de los gastos del los Drs. Gupta y Boonratana. Esto sirvió particularmente para sufragar parte de los boletos de avión de los expertos visitantes desde sus lugares de residencia al puerto de salida internacional hacia México (Agartala-Nueva Delhi-Agartala, en el caso de Gupta, y Chiang Mai-Kuala Lumpur-Chiang Mai, para Boonratana). Los gastos de inscripción al congreso, transporte local y alimentación corrieron por cuenta del organizador del simposio y, en menor proporción, de los expertos visitantes. Cortesía de una organización privada anónima se contó con el uso de una casa donde se proporcionó alojamiento durante su estancia en Acapulco para el ITC7 a los Drs. Ramesh Boonratana, Atul K. Gupta, Ruth K. Laidlaw, Alfredo D. Cuarón, así como otros participantes del congreso. Además de esto, se consiguió la donación de un boleto de avión (Londres-México-Londres) para la Dra. Ruth K. Laidlaw. El resto de los ponentes del simposio cubrieron sus propios gastos para viajar a Acapulco y participar en este evento.

### **Agradecimientos**

Agradezco la colaboración de la Dra. Ruth K. Laidlaw en la organización del simposio. Al Dr. Rodrigo A. Medellín, Presidente del Comité Organizador del ITC7, y sus colaboradores, por la ayuda prestada en multitud de aspectos relacionados a la preparación del simposio. A los Drs. Daniel Piñero y Luis A. Bojórquez- Tapia por el apoyo prestado para la realización de este evento. Agradezco, asimismo, el invaluable apoyo logístico del Lic. Virgilio Lara y la Srita. Ruth Dibble. Por supuesto, y muy particularmente, el interés y gran entusiasmo de los participantes en el simposio, y el apoyo de la CONABIO (principalmente de la Mtra. Lilia Espinosa y el Dr. Jorge Soberón) y de los otros patrocinadores. Agradezco especialmente el apoyo desinteresado del Sr. Alfonso Cuarón, que hizo que la vida fuera más fácil cuando la organización del simposio pasaba momentos difíciles.

**PROGRAMA DEL SIMPOSIO**

**"HABITAT DISTURBANCE AND TROPICAL MAMMALS: A GLOBAL PERSPECTIVE"**

## **SYMPOSIUM**

### **HABITAT DISTURBANCE AND TROPICAL MAMMALS: A GLOBAL PERSPECTIVE**

(Co-conveners Alfredo D. Cuarón and Ruth K. Laidlaw)

## **INTRODUCTION**

### **SHIFTING CULTIVATION AND WILDLIFE CONSERVATION IN TRIPURA, NORTH-EAST INDIA**

Atul K. Gupta

### **EFFECTS OF HABITAT LOSS AND HUNTING ON MEGAHERBIVORES OF TROPICAL BORNEO**

Rarnesh Boonratana

### **WHEN GRAZING COWS CAN BENEFIT WILDLIFE : A CASE FOR BOKO ISLAND**

John E. Fa (canceló)

### **CACERIA DE SUBSISTENCIA POR TRES GRUPOS ETNICOS EN EL SUR DE CAMPECHE**

Carlos Galindo-Leal, Miguel Sosa, Mauro Sanvicente, and Alfredo Escamilla

### **EFFECTS OF TIMBER EXTRACTION ON SMALL MAMMAL DIVERSITY IN A LOWLAND RAINFOREST OF THE VENEZUELAN GUAYANA REGION**

José Ochoa G.

### **EFFECTS OF SELECTIVE LOGGING ON MAMMALS IN A HILL DIPTEROCARP FOREST OF SARAWAK, MALAYSIA**

Zainuddin Dahaban (no se presentó)

### **MALAYSIAN MAMMALS, VIRGIN JUNGLE RESERVES (VJR)s, HABITAT FRAGMENTATION, COMMERCIAL LOGGING AND PLANTATIONS**

Ruth K. Laidlaw

### **MAMMAL COMMUNITY STRUCTURE OF ATLANTIC FOREST FRAGMENTS OF SOUTH-EASTERN BRAZIL**

Adriano G. Chiarello (canceló)

### **RESPONSES OF TROPICAL MAMMALS TO HABITAT FRAGMENTATION: A COMPARISON OF THREE CONTINENTS**

William F. Laurance, Anthony J. Laynám, and Jay R. Malcolm (canceló)

### **COMMUNITY COMPOSITION OF SMALL MAMMALS IN THE BRAZILIAN ATLANTIC RAINFOREST: SUCCESSIONAL STAGES, HABITAT DISTURBANCE, AND VARIATION AMONG HABITATS (CARTEL)**

Alexandre R.T. Palma and Emerson M. Vieira

**BATS IN PASTURES AND THEIR IMPORTANCE IN TROPICAL FOREST RESTORATION IN  
LOS TUXTLAS, MEXICO**

Jorge Galindo-González

**EFFECTS OF LAND-COVER CHANGES ON MAMMALS IN MESOAMERICA**

Alfredo D. Cuarón

**DISCUSSION**



## **RESUMENES DE LOS TRABAJOS**

## SHIFTING CULTIVATION AND WILDLIFE CONSERVATION IN TRIPURA,

NORTH-EAST INDIA A. K. Gupta, Indian Forest Service, C/O  
Principal Chief Conservator of Forests, Forest Department, Govt.  
Of Tripura, P.O. Kunjaban, Agartala 799 006, Tripura (W), India

The process and dynamics of shifting cultivation in Tripura with reference to the socio-economic and socio-cultural needs of the local people, and regeneration status in forest fallows of different years following cultivation with reference to the needs of three primate groups and local people are examined in Ibis study. Information on basic principles of shifting cultivation (locally called *jhooming*) were recorded by interviewing *jhumia* families in Sepahijala Wildlife Sanctuary (SWLS) using a questionnaire. Data on population of *jhumias*, history of *jhooming*, past and present land-use patterns were collected from official records and informal interviews. Ten plots of 10x10 m in each of 1,2,4,5,7,10,14, and 19 years' fallows were assessed for regeneration status. Number and species of regenerating species through root coppicing, shooting and seed germination were recorded. Number and species of unfelled trees in cultivation plots (mature trees) were also recorded. Presence and absence of wildlife species in these forest fallows was also recorded either by actual sightings or indirect signs (dung, pellet counts). Human disturbance was assessed in terms of livestock population, and collection of various forest products.

Shifting cultivation is practiced by 17 out of a total of 19 tribal communities in Tripura, besides some non-tribal families in absence of viable alternate means of livelihood. Out of 95 tribal families interviewed, only about 45% were engaged in *jhooming*, and the rest 55% had shunned Ibis because of non-availability of suitable land for *jhooming*. Per capita available land for *jhooming* varied between 0.4 to 1.5 ha. Secondary forests were the most preferred sites for *jhooming*. Paddy (rice) is the main crop, besides vegetables, fruits and fibre crops on a 2 to 3 years cultivation cycle. Although about 82% families sold surplus vegetables and fibre crop in the local markets, but they had to buy paddy to make up for the short fall in its production for their own consumption. All families showed willingness to opt for some other more sustainable means of livelihood.

A total of 727 seedlings/trees were counted inside different forest fallows, including 93 mature trees left unfelled at the time of *jhooming*. Most regeneration was from root sprouting (40.9%), followed by shooting (35.9%), and seed germination (10.4%). Regeneration of some species was through more than one way. Number of trees and species increased during successive years after cultivation, and number of trees was significantly correlated with the year-after cultivation. Significant positive correlation was also found between number of regenerating trees and their height categories. Out of a total of 56 regenerating species, 26 were also the food species for Phayre's langur, and these accounted for about 45% of total time spent feeding on all species. Five regenerating species were, among the top-ten food species for langurs which accounted for 46% of total time spent feeding. Eleven regenerating species were also used by local people for various needs.

Cattle grazing and collection of forest products was observed in forest fallows of all age-group. No primate groups were seen in the first and second years *jhoom* plots. Only rhesus macaque groups were seen in forest fallow of 4, 5, and 7 years. Four primate species (rhesus macaque, pig-tailed macaque, Phayre's langur, and capped langur) were recorded from 10 and 14 years' fallows, and hoolock gibbon were recorded from 19 years' fallows. Direct sightings of only barking deer, sambar deer, and wild boar were made in all the fallow plots. Indirect signs for wild dogs, small cat species, bear, and binturong were recorded from only 14 and 19 years' fallow.

Over the years, *jhooming* has led to the fragmentation of large tracts of evergreen dense primary forests into mosaics of small habitat islands of degraded primary forests, secondary forests, low-quality bamboo forests, shrubs and grasslands. These changes in habitat have caused depletion in plant and animal diversity. Wildlife species requiring year-round supply of fruits and seeds from a variety of plant species may be worst affected as the plant diversity declines in secondary forests regenerating after *jhooming*. Phayre's langurs being generalist and able to switch over to the diets on colonising species, have survived so far, and may face no danger of extinction so long as the regeneration of forest fallows are allowed to regenerate resources for up to about 15-20 years.

Efforts to control shifting cultivation are under-way in the State since 1953. and recently use of two species of cash crop, rubber and oranges have been found to be good economic substitutes for *jhooming*. Various direct and indirect measures have been listed which can be adopted to control *jhooming*. A minimum of about 10-15 years of regeneration period in the forest fallows may be sufficient to support a viable population density of langurs in the State.

## **EFFECTS OF HABITAT LOSS AND HUNTING ON MEGAHERBIVORES OF TROPICAL BORNEO**

Ramesh Boonratana. Wildlife Conservation Society, 185th Street and Southern Blvd., Bronx, NY 10460, USA.

A two-year state-wide survey to estimate the density of the Sumatran rhinoceros (*Dicerorhinus sumatrensis*), the Asian elephant (*Elephas maximus*) and the banteng (*Bos javanicus*), was carried out in Sabah, Malaysia. Surveys were mainly focused on large contiguous tracts of forest. Techniques used to census the three megaherbivores depended on sighting indirect evidence of their presence. This is a practical method of assessing the densities of elusive, large mammals in dense tropical rainforests. Surveying the Sumatran rhinoceros involved intensively and extensively patrolling all existing mammal trails, in particular ridges and waterways, i.e. areas which this species reportedly frequents. Strait line transects were used to search for dung; in order to determine densities of the Asian elephant and the banteng. The effects of habitat loss and hunting on these megaherbivores of tropical Borneo result in all three megaherbivores existing at low densities and/or in isolation. Furthermore, densities from different sites varied with different levels of habitat disturbance. All three species suffer from a dire loss and fragmentation of habitat, in particular the Asian elephant. The major threat, however, facing the Sumatran rhinoceros and the banteng is hunting. The importance of waterways and their associated habitats is highlighted, not only for these three megaherbivores, but also for a variety of wild fauna. Immediate action needed to prevent the extirpation of the Sumatran rhinoceros and the banteng is to focus all available resources on anti-poaching and law enforcement activities. Simultaneously, efforts should be made to secure additional totally protected areas to prevent further loss of viable habitats and also to prevent animals or small groups of animals from existing in isolation.

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## **WHEN GRAZING COWS CAN BENEFIT WILDLIFE : A CASE FOR BOKO ISLAND**

John E. Fa. Jersey Wildlife Preservation Trust, Les Augres Manor, Trinity, Jersey JE3 BF, United Kingdom. Email : itc@itl.net.

Uncontrolled, extensive ranching has no doubt accelerated the clearing of forest land to provide animal protein. Thus, the idea of introducing this practice to save wildlife is anathema. In situations where the human population relies on wild protein sources, biologists have either invoked the implementation of sustainable hunting practices or suggested the rearing of undomesticated wild species. In West Africa, sustainable production of forest rodents, such as the African giant rat (*Cricetomys* spp.) or the grasscutter (*Thrynomys swinderianus*), or duikers (*Cephalophus* spp.) has been held as a panacea to the African food problem since the early 1960s. Yet, there is no evidence available to suggest that these can meet the current demand for protein in the larger cities or towns of the region. If the supply of alternative protein to urban populations can divert attention from wild meats, this may be possible with highly productive agrosystems. The sensible rearing of livestock (cattle, pigs etc.) may hence be the only immediate way of complementing the management of forest lands for sustainable yields. This paper describes the present and potential use of forest mammals in Boko island, West Africa, and examines the feasibility of rearing domestic livestock as a solution to the protein crisis on the island. This option is contrasted against the rearing of wild species.

## **CACERÍA DE SUBSISTENCIA POR TRES GRUPOS ÉTNICOS EN EL SUR DE CAMPECHE**

Carlos Galindo- Leal (1), Miguel Sosa (2), Mauro Sanvicente (2) y Alfredo Escamilla (2) (1) Center for Conservation Biology, Stanford University, Stanford California; 94305-5020, y (2) Consejo Agro-silvopecuario y de Servicios de X-Pujil, Zoh-Laguna, Campeche, México.

El objetivo del presente estudio es determinar las diferencias en los patrones de cacería de subsistencia entre tres grupos étnicos que se han asentado en la región del sur de Campeche en los últimos 30 años. El trabajo se llevó a cabo entre mayo de 1992 a junio de 1994 en 3 ejidos, con colonizadores provenientes de Tabasco, Chiapas y de la zona maya de Campeche. Se documentaron los animales silvestres aprovechados cada mes en los ejidos. Además se establecieron 3 transectos de 3000 m de longitud en cada ejido. Los transectos se recorrieron una vez al mes durante la tarde y durante la madrugada para registrar la abundancia de las diversas presas.

En cuanto a la cacería se obtuvieron 668 registros de 5 especies de aves y de 13 especies de mamíferos, con pesos para 322 individuos (Cuadro 1). Cinco especies constituyeron el 78% del total, incluyendo al tepezcuintle (30 %), temazate (13 %), faisán (13 %), puerco de monte (12 %) y venado cola blanca (10 %). Considerando el peso promedio de los animales registrados, la importancia relativa cambia al siguiente orden: venado cola blanca, temazate, puerco de monte, tepezcuintle y finalmente faisán. Las presas mayores constituyeron entre 26 y el 44 % del total de individuos para los tres ejidos. Los venados constituyeron un porcentaje similar de aproximadamente 10 % en los tres ejido. Las jabalinas fueron importantes solo en un ejido. El promedio mensual de individuos cazados fue mucho mayor en el ejido Maya ( $x=21.3$ ,  $ee=3.36$ ,  $n=17$ ), seguido por el de Tabasco ( $x=13.6$ ,  $ee=3.10$ ,  $n=14$ ). En promedio en el ejido de Chiapas fue muy bajo ( $x=3.7$ ,  $ee=0.87$ ,  $n=17$ ). LA diferencia fue altamente significativa' (ANOVA  $F=11.91$ ,  $df=2,45$ ,  $p<6.001$ ). Se comparan los resultados de la cacería con la disponibilidad de presas en los ejidos. Se discute las deficiencias y similitudes con estudios similares en Quintana Roo y en Petén, Guatemala.

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## **EFFECTS OF TIMBER EXTRACTION ON SMALL MAMMAL DIVERSITY IN A LOWLAND RAINFOREST OF THE VENEZUELAN GUAYANA REGION**

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The responses of small mammal communities to habitat disturbances as a consequence of logging, were evaluated. The study was located at the Imataca Forest Reserve (north-eastern portion of the Venezuelan Guayana Region, Bolívar State), where vegetation is dominated by lowland evergreen rainforests (140-260 m). Field analysis embraced the inventory of those species included in the orders Didelphimorphia and Chiroptera, in addition to the families Sciuridae, Muridae and Echimyidae (Rodentia). The following sampling methods were used: 1) mist nets; 2) traps in 2.4 ha grids (each one with 120 stations: 60 at the ground level and 60 in arboreal elements); and 3) diurnal and nocturnal surveys. Total sampling efforts were: 1,904 hr-net, 10,320 traps-night, and 567 hr of direct observations. At least 83 species (grouped in 10 families) inhabit forest ecosystems of the study area, of which 74.7% corresponds to Chiroptera; 15.7% of these taxa were recorded only in primary forests. In logged forests, communities of small mammals were characterized by: 1) lower proportion of carnivorous and gleaning insectivorous bats; 2) increase in the relative abundances of frugivorous, bats related with colonizer plants; 3) higher proportion of aerial insectivorous (Molossidae) at the lowest levels of the forest; 4). simplification in trophic structure of non-volant species (where predators-omnivorous and frugivorous-omnivorous with terrestrial or semiarboreal habits are the dominant components); and 5) reduction in the relative abundance of mainly canopy-associated species. These results are explained by: 1) lower availability of some resources associated with arboreal elements (e.g. holes in tree trunks and branches, fruits, seeds, and mobility strata); 2) higher abundances of other resources, such as terrestrial invertebrates, saprofitic plants, and roosts under fallen free punks; 3) modification of microclimatic conditions at the understory level, as a consequence of a higher sunlight incidence after logging; and 4) increase in density of those plants related with first regeneration stages. The implications of these aspects for the management of wood producer forests, in addition to some alternatives to conserve biodiversity in Forest Reserves of the Venezuelan Guayana Region, are discussed.

## **EFFECTS OF SELECTIVE LOGGING ON MAMMALS IN A HILL DIPTEROCARP FOREST OF SARAWAK, MALAYSIA**

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The effects of selective timber extraction on mammal communities were studied in a hill dipterocarp forest at Nanga Gaat in Sarawak. The main study area was systematically surveyed for one year before it was logged and for another year immediately after logging. Logging activity in the area resulted in almost 54% free loss with another 13% being damaged. Species composition of the forest was almost unchanged, but tree density was reduced by more than half. The changes in the diversity and density of primates and some other mammals following logging were documented some species declined in number or became locally extinct, some remained relatively stable while others increased. The general trend is for the edge or coloniser species to replace those species which depend on undisturbed forest and which cannot survive elsewhere. All the primates present in the major study area declined in density after logging.. The Bornean gibbons not only decline in density but also in average number of individuals in the group. Three squirrel species declined in density immediately after logging while four other species increased one year after logging. The density of two tree shrew species and three ungulate species also declined after logging. Small sample sizes and the effect of hunting might have contributed to the observed results. While guidelines are being drawn by the government authorities towards sustainable logging, it is believed that a system of totally protected areas and large undisturbed areas within logging concessions are needed to ensure continued survival of the fauna.

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## **MALAYSIAN MAMMALS, VIRGIN JUNGLE RESERVES (VJRs), HABITAT FRAGMENTATION, COMMERCIAL LOGGING AND PLANTATIONS**

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In this study I compare compact (70 ha to 304 ha) samples of protected natural forest (Virgin Jungle Reserves - VJRs) and samples of the vegetation (including commercially logged forest, commercial plantations and agricultural smallholdings) adjacent to these VJRs, in seven areas in Peninsular Malaysia. Specifically, differences in diversity (presence/assumed absence) of the mammal communities were considered in order to examine the effects on such communities when a VJR is part of a landscape dominated by commercial logging and/or fragmented by plantations and smallholdings. Taking all fourteen sites together, 46 species of mammal were recorded. The rates of encounter of three species of Artiodactyla were also compared in all sites. Among the various effects on mammal communities recorded in this study, size of the surviving area of natural forest was the most important factor affecting the mammal communities in all seven forested areas. A loss of large herbivores and carnivores, in particular, was apparent between areas of natural forest 310,000 ha and 6,551 ha; perhaps related to the absence of large carnivores, the rate of encounters with mouse-deer (*Tragulus* spp.) was considerably greater in Jengka Forest Reserve (6,551 ha) than in all other study- areas. The size of the area of natural forest in which a VJR is located largely determines the mammal diversity and composition in the VJR. Differences in habitat quality between VJRs, which were on the whole relatively undisturbed, and their adjoining vegetation (*e.g.* logged forest, plantations or small holdings) are considered to account for differences in diversity found between those VJRs and their adjoining forests. When considering the smaller areas of natural forest, size continued to be critical, and, a sharp loss in diversity of mammal species was apparent between 164 ha and 70 ha. Some of the most widespread, abundant, smaller and/or flexible species were recorded in all areas of natural forest, and also in the adjoining converted areas. The rarer, less abundant and/or less flexible species were only recorded in the largest areas of natural forest and never in the converted areas. In conclusion, the preservation of such small protected areas as VJRs can be effective to enhance certain mammal communities in managed (*i. e.* logged) natural forest.

Ultimately, however, the survival of certain mammal species including the largest carnivores and herbivores will be determined not by the presence of such areas but by the area of surviving natural forest as a whole. A positive management strategy would be to retain continuous areas of natural forest, wherever possible in preference to permitting fragmentation of areas of natural forest to occur; and also build on the existing VJR system within Peninsular Malaysia.

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## MAMMAL COMMUNITY STRUCTURE OF ATLANTIC FOREST FRAGMENTS OF SOUTH-EASTERN BRAZIL

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Six Atlantic forest reserves, two large (*ca* 20,000 ha each), two medium-sized (*ca* 2,000 ha each) and two small (*ca* 200 ha each), located in northern Espírito Santo, south-eastern Brazil were studied from October 1994 to April 1996. The main objective was to analyze both their mammal community structure and the degree to which these forests have been disturbed by the effects of fragmentation. Diurnal and nocturnal line-transect sampling was used for censusing mammals and the species relative abundance in the six fragments were compared using the rate of encounter per 10 km of census. A total of 460 km of trails was sampled, resulting in 602 encounters with 26 mammal species in the six fragments. The forest structure was studied in 264 quadrants along transects located in the edge and in the interior of the fragments, totalling 1.9 ha of forest area sampled.

Overall, both the number of encounter and encounter rate/species were highest in the two largest reserves; intermediate in the medium-sized ones and lowest in the two small fragments. A cluster analysis indicated the mammal community structure of both large and mid-sized reserves were more similar to each other than to the two smallest fragments. Rodentia and Primates were the most abundant orders in the large and mid-sized reserves, while xenarthrans, and rodents were most abundant in the smallest fragments. As regards dietary categories, frugivores such as squirrel, agouti and capuchin, monkey dominated the community of large and mid-sized reserves, while herbivores (mainly sloths) had a higher relative density in the two smallest reserves. A positive regression was found between the log-transformed forest area and number of mammal species found during census ( $r^2 = 0.960$ ;  $p = 0.006$ ). Top predators such as jaguars and pumas, as well as large terrestrial frugivores such as tapirs and two peccary species are still surviving in the largest reserves, but these species, although originally present, no longer exist in the two smallest fragments. The two mid-sized reserves have an apparently very small population of tapirs and only one species of peccary was recorded in each one of them. These faunistic results were mirrored by the study of forest structure, which showed a higher degree of disturbance in the two smallest fragments. A discriminant function analysis clearly separated the two smallest fragments from the other four larger reserves. The variable which explained most of the between site variation, the number of dead trees, particularly of large diameter ( $> 40$  cm DBH), was negatively regressed on the log-transformed forest area ( $r^2 = 0.927$ ;  $p = 0.002$ ). Additionally, logistic regression analysis showed that the edge effects can penetrate up to, 200 m from the forest edge, indicating that reserves 200 ha in area or smaller, having higher perimeter/area ratios, are much more intensely affected by external factors, possibly hot air currents and strong winds, than larger size reserves. These results indicate that the few mammal species surviving in small fragments have to adapt to higher degrees of disturbances and as a result, in the long term their community will show a structure considerably different from the ones surviving in larger, but unfortunately less abundant, Atlantic forest reserves.

## RESPONSES OF TROPICAL MAMMALS TO HABITAT FRAGMENTATION: A COMPARISON OF THREE CONTINENTS

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We synthesize studies of the responses of small- and medium-sized mammal communities to rainforest fragmentation in tropical Australia, Thailand, and Amazonia. The diversity, structure, and biomass of mammal assemblages differed among the three regions but there were patterns that appeared universally applicable. First, mammal assemblages were strongly influenced by the matrix of modified habitats surrounding fragments. Species that tolerated or exploited the matrix were usually far less vulnerable to fragmentation than those that avoided modified habitats. Second, ecological changes in fragments, such as elevated rates of wind disturbance and fire, had a substantial influence on mammal assemblages. Some implications of these patterns for the management of fragmented landscapes will be discussed.

## COMMUNITY COMPOSITION OF SMALL MAMMALS IN THE BRAZILIAN ATLANTIC RAINFOREST: SUCCESSIONAL STAGES, HABITAT DISTURBANCE, AND VARIATION AMONG HABITATS

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The Brazilian Atlantic Rainforest (BAR) is now reduced to 5% of its original area of 1,000,000 km<sup>2</sup>. The remaining areas are mainly fragments scattered distributed throughout eastern Brazil. These fragments range, in size from very small areas (0.1 to 0.5 km<sup>2</sup>) to those considered as continuous Atlantic rainforest areas (more than 100 km<sup>2</sup>). These areas are subject to different degrees of environmental disturbances and subsequent secondary succession, leading to changes in resource availability and physical habitat structure. Both these factors are likely to induce changes in small mammal communities. The present study provides a descriptive overall view on the variation in the composition of small mammal communities of the BAR. We addressed two questions. (1) How do these communities differ in their species composition? (2) Do different disturbances or changes in habitat lead to different patterns of species composition? We analyzed data from published studies on small mammals in the BAR domain (including also open formations and disturbed habitats), as well as our own unpublished data. We used genera as organizational taxonomic units, considering preferentially number in the community. We run a species-centered Principal Component Analysis to summarize information in two sets of sites: one including all sites in Atlantic rainforest domain (overall analysis on 39 sites) and another using only sites located in non-montane mesic forest (lowland forests analysis on 25 sites). Overall analysis showed four major community types in different habitats. Communities in hydric forest were dominated by *Nectomys*. Montane forest and open areas were dominated by marsupials (*Marmosops*, *Micoureus*, *Didelphis*, and *Metachirus*). Hydric forest and habitats tended to show smaller alpha-diversity than lowland forests. Direction of faunal changes accompanying secondary succession suggests a substitution of rodents (mainly *Akodon*) by marsupials. Lowland forests analysis also showed four major community types in different habitats. In primary forests of large reserves, marsupials (*Metachirus*, *Marmosops*, and *Micoureus*) were important members. Late secondary forests in large reserves also had marsupials as important members. Early secondary forests are dominated by rodents (*Akodon* and *Oligoryzomys*). Forest fragments (80-860 ha) had marsupials (*Didelphis* and *Marmosops*) and rodents (*Proechymys* and *Oecomys*) as characteristic genera. A gradient from early secondary forests, through late secondary forests to primary forests, was associated to reduction of *Akodon* and *Oligoryzomys* and to the increase of marsupials (*Marmosops*, *Micoureus*, and *Metachirus*). Faunal changes following fragmentation or burning run in roughly opposite directions. Primary forests and forest fragments tended to show smaller alpha-diversity than secondary forests in large reserves.

## BATS IN PASTURES AND THEIR IMPORTANCE IN TROPICAL FOREST RESTORATION IN LOS TUXTLAS, MÉXICO

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The conversion of tropical rain forests to pastures and crops, has led to a local loss of species in nearly all cases. Some species become extinct, while others are able to adapt to the transformed and fragmented landscape. Bats are abundant and effective seed dispersers inside the jungle, but what happens where the forest is gone? this work was conducted on grazing pastures at Los Tuxtlas, Veracruz, Mexico, where tropical rain forest was the original vegetation. The aim was to respond to the following questions: Do bats visit isolated trees in pastures? If so, Do frugivorous bats transport seeds among the elements of the landscape through these pastures? And finally, Do frugivorous bats contribute to seed recruitment into the abandoned pastures and thus to vegetation restoration? During one year I collected 652 bats flying under isolated trees within pastures and along the riparian vegetation existing among pastures. I registered 20 species, which represent 54% of the reported Species for the rain forest at Los Tuxtlas. I found greater abundance and species richness in the riparian sites, than around the isolated trees. Site diversity and abundance decreases with distance from the nearest forest fragment. When comparing bat abundance in different environments (i.e. riparian, isolated trees of *Ficus*, and isolated control trees of *Cedrella* and *Ceiba*). I found that some species are only present in the riparian vegetation. Other bat species visited the isolated trees independent of tree species or tree phenology.

According to the feeding habits recorded, bats were frugivorous (81.5%), insectivorous (15%), nectarivorous-frugivorous (2%) and hematophagous (1.5%). The most abundant species were the frugivores: *Sturnina lilium* (40.3%), *Artibeus jamaicensis* (15.2%), *Carollia perspicillata* (10%) and *Dermanura tolteca* (8.9%), and the insectivore *Pteronotus parnellii* (9.8%). I recaptured 22 individuals of three frugivore species: *C. perspicillata*, *S. lilium* and *D. tolteca*. Some individuals were recaptured up to three times, (one even five times), which denotes certain loyalty to the foraging areas in the pasture. Most of the recaptures were obtained in different sites from the first capture site, indicating that bats visit several foraging areas in the pastures.

I obtained 256 fecal samples, containing seeds of at least 19 plant species in 5 families. These are consumed by bats year-around: Piperaceae with 7 species (48.46%), Moraceae with 2 subgenus (24.84%), Solanaceae with 6 species (11.96%), Cecropiaceae with 1 species (10.43%), and other 3 species (4.29%). Frugivorous bats dispersed 4-13 (mean 7.5±0.87) plant species per month. More than twenty-one percent (21.8%) of the samples contained at least two different seed species.

The riparian-pasture complex is a very important component of the landscape, with functions in the communication among forest fragments and in the maintenance of biodiversity. Frugivorous bats flying across the pastures might be a key element in vegetation restoration in abandoned pastures. They disperse great quantities of seeds of pioneer species and primary vegetation (trees, shrubs, herbs and epiphytes), and are, probably, the main elements in the beginning of a rapid primary succession and, consequently, in the restoration of the vegetation of disturbed areas in tropical humid forests.

## EFFECTS OF LAND-COVER CHANGES ON MAMMALS IN MESOAMERICA

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Land-cover changes are central to many of current environmental concerns, including the loss of biological diversity as a result of changes on habitat availability for species. It is therefore, of great importance to understand the patterns and processes of land cover change, and their ecological and social implications, and to integrate this information into the regional development and conservation planning process. In this study I analyze the effects of land-cover changes on habitat availability for 54 non-volant mammal species in northern Guatemala and southern Mexico, considering the regional variability of these changes and the effectiveness of protected areas. I use Landsat MSS satellite images to assess land-cover changes (1974-1986) in a 27,233 km<sup>2</sup> area, including portions of the Guatemalan department of El Petén and the Mexican states of Campeche, Tabasco, and protected areas (Parque Nacional Palenque and Reserva de la Biósfera Montes Azules) and non-protected areas in the state of Chiapas. Based on this analysis and on field data and information from the literature on mammal species habitat preferences, I estimate the effects of changes on habitat availability on wild mammal populations in the whole study area and in each of the subregions. Mammal species followed seven general trends in fluctuation of habitat availability in the entire study area: (1) opportunistic and highly adaptable species, occupying already most of the study area; (2) opportunistic, commensal species, with restricted range in the study area; (3), species with stable and moderate availability of habitat; (4) species with increasing habitat availability; (5) species with declining habitat availability; (6) species with sharply declining habitat availability; and (7) species with declining habitat availability and a restricted range in the study area. Habitat availability for 32 of the species (59%) declined during the study period. Each of the subregions studied represented different development and conservation scenarios which affected species differently. Based on these scenarios, Markovian models were used to assess the effects of changes on development and conservation trends on habitat availability for mammals in each subregion. These results highlight the land-use and development trends more negative and beneficial for mammals in the study area.

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