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THE TROPICAL RAIN FOREST BUTTERFLY FAUNA OF RONDONIA, BRAZIL: SPECIES DIVERSITY AND CONSERVATION

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ABSTRACT.— The state of Rondonia in west central Brazil apparently has the highest reported butterfly diversity in the world, with an estimated 1,500-1,600 species living within several square kilometers in the central part of that state. A preliminary checklist of over 800 identified species is given, and some of the factors contributing to this diversity are described. The tropical rain forest in this area is being rapidly cleared for development and the creation of one or more inviolate biological preserves is urgently needed in order to save a living sample of the incredibly diverse fauna and flora for study by future generations.

KEY WORDS: Amazon Basin, butterfly faunas, Hesperiidae, Lycaenidae, Nymphalidae, Papilionidae, Pieridae, rain forest, Riodinidae.

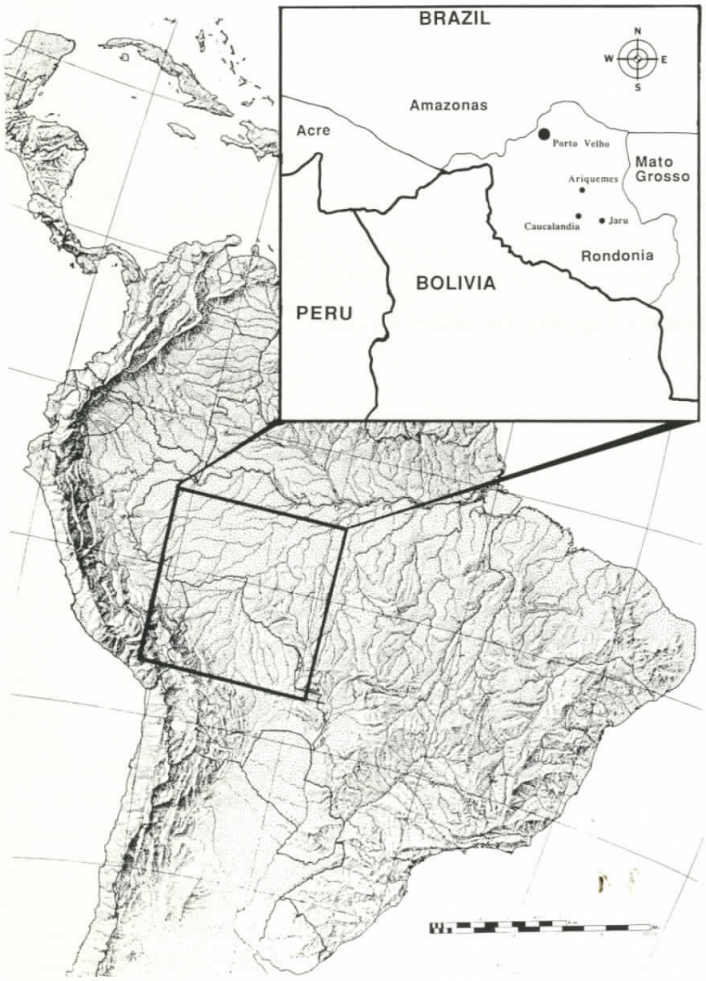

Fig. 1. Map of the Rondonia area of Brazil, with the inset showing major towns and cities of Rondonia mentioned in the text.

Rondonia, one of the newest states in western central Brazil, occupies some 93,840 square miles (243,044 sq km) in the southwestern part of the Amazon Basin of South America. This territory, which borders Bolivia to the south and west, was formerly a part of the state of Amazonas and until the last two decades, was primarily important to Brazil's economy only during the Amazon rubber boom, which collapsed in 1912. In 1943, the area was established as Guapore. The territory was renamed Rondonia in 1956, after Marshal Camdido Mariano da Silva Rondon, Brazil's famous explorer, and was made a state in 1981.

The rain forest here was sparsely inhabited by Indians, rubber tappers, and former railroad workers until the then-military regime of the central Brazilian government began pushing the development of the Amazon in the 1960's. Thus in 1966,

Fig. 2. Aerial view of the Rondonia rain forest (near Porto Velho), showing highway BR364 across the lower right corner and nearby pastures. (© T. C. Emmel; this photograph and all following photographs)

Fig. 3. Interior view of the lush and diverse lowland tropical rain forest at Fazenda Rancho Grande, near Caucalandia, Rondonia.

Fig. 4. *Nessaea obrinus* (Nymphalidae) on rotting papaya fruit.

Fig. 5. *Morpho achilles* (Nymphalidae) sunning itself momentarily on a moss-covered palm frond.

Fig. 6. *Prepona* sp. (Nymphalidae) feeding at fermenting sap as it oozes from a wound in tree bark.

SUDAM, the Superintendency for the Development of the Amazon, was created as an agency to oversee the planned occupation of the Amazon forest with "civilization." Lucrative incentives were offered for industrial and agricultural projects, particularly the development of cattle ranches to supply cheap beef for the Brazilian people (relatively little of this beef was to ever be exported to the American fast-food industry, unlike the situation in Central America). Great amounts of valuable timber were cleared during those years and merely left to be burned during the annual dry season, in order to produce large amounts of pasture. Millions of acres of public land in the eastern and northern Amazon were occupied along the new highways being put in, especially along the Belem-Brasilia Highway. By 1970 most of the settlers had abandoned their developments after discovering that the underlying soils were too poor to sustain agriculture (Revkin, 1990). Wide variations in Amazonian soil quality have consistently defeated attempted settlement. Grasses quickly use up the essential minerals left behind after burning of the native forest vegetation (whose biomass formerly held most of the minerals and other nutrients), and inedible weed species and brush then invaded the fields incessantly. Thus pasture that once supported one head of cattle for every 2.5 acres (a relatively poor ratio to begin with) dropped to supporting one head of cattle for every 10 acres, and the maintenance costs and large land areas required for livestock made it unworthwhile to continue ranching.

The federal government's other major plan to attract people to the Amazon (aside from encouraging private development) was to build a vast network of roads. In order to move people away from the overpopulated lands in the southeastern Amazon, the government completed the extension of federal highway BR-364 from the capital of Mato Grosso (Cuiaba) to Porto Velho, the capital of the new state of Rondonia. Channeling immigrants into the state, this road extension, though not paved completely until 1984, created most of the destruction in Rondonia throughout the 1970's as the population of the area grew at a tremendous pace (Ellis, 1988). In those ten years, there was an explosion of new arrivals coming from the southwest. Between 1970 and 1985, the population of Rondonia increased from less than 100,000 to more

Fig. 7. *Hamadryas* sp. (Nymphalidae) feeding at tree sap.
Fig. 8. *Anaea (Zaretis) itys* (Nymphalidae) drinking human perspiration that had dripped onto dead leaves in the forest floor litter.
Fig. 9. *Heliconius doris* (blue and red forms) and other *Heliconius* (Nymphalidae) drinking at a urine-soaked sand bank.
Fig. 10. *Panacea divalis* (Nymphalidae) attracted to sweat on a net handle.
Fig. 11. *Diaethria* nr. *neglecta* (Nymphalidae) perched on a leaf.
Fig. 12. *Callicore* sp. (Nymphalidae) feeding at fermenting tree sap.

Fig. 13. *Caligo brasiliensis* (Nymphalidae: Brassolinae) feeding at fermenting tree sap.

than 730,000 people. Side roads were built and families were given titles to 250-acre lots of rain forest as long as they cleared half of their plot of land for agriculture. More than 70,000 square miles of Amazonian forest were being burned annually, and a sizeable proportion was located in the state of Rondonia. As the settlers cleared and farmed the rolling hills of this area, the little soil on those hillsides quickly washed away. In order to continue farming or obtain useful land for cattle, the settlers had to clear new tracts of land. By 1987, American weather satellite pictures of Rondonia showed Brazilian ecologists that more than 100,000 fires were burning at once in the state during the dry season, and that the rain forest was being cleared at a rate far beyond what anyone had suspected. An urgent worldwide interest immediately developed (e.g., Linden, 1989) in preserving this and other rain forests of the Amazon Basin because of the already alarming extent of global warming being increased by the release of large amounts of CO_2 from the burning of these forests, the role of the forest in the natural oxygen cycle and hydrolic cycles of the western hemisphere itself, and the fact that self-sustainable uses could be made of the rain forests that would be more profitable to Brazil than the past policy of clearing the forest and planting grass for cattle.

Fig. 14. *Hypothyris euclea* (Nymphalidae: Ithomiinae) drinking pyrrolizidine alkaloids from the stems of a decaying *Heliotropium* plant (Boraginaceae).

Fig. 15. A diurnal *Urania* moth (Uraniidae) drinking water at a river bank.

During the last several years, our joint interests in tropical butterfly diversity have centered on this area of Brazil. The senior author has led expeditions of groups of lepidopterists to these extraordinarily productive tropical rain forests in March 1987, March 1989, and November 1989; the junior author has accompanied him on the latter two field trips, with other joint visits planned for November and December 1990, and March 1991. Our sampling in these areas has confirmed that central Rondonia may be the most diverse area in the world for butterflies. Because of the accelerated human development of this general region, it is probable that there will be virtually nothing left of the original rain forest habitat for these butterflies by early in the next century — only a decade away — unless one or more large preserves are set aside now.

SAMPLING AREA IN RONDONIA

We have concentrated our sampling efforts in the area south of Ariquemes, a town located 199km south of Porto Velho. Some 62km south of Ariquemes lies the small village of Caucalandia, and near there is the Fazenda Rancho Grande, a 750-ha tract owned by the Harald Schmitz family who have been extremely kind in providing accommodations and other logistical support for our surveys. Fazenda Rancho Grande lies 22km west of highway BR 364, or about 5km west off road B-65 on cross-road C-20.

Fig. 16. *Euptychia* sp. (Nymphalidae) perched on a rain forest leaf.

The area has been sampled for about 10km in all directions around the Fazenda, which lies at latitude 10° 32'S and longitude 62° 48'W. The terrain is typically low rolling hills or flat plains covered with wet tropical rain forest, except in areas of human disturbance.

The general elevation in the area ranges from 160-350m; the Fazenda Rancho Grande ranch house is 187m (540ft) above sea level. East-west "C"-numbered roads (e.g., C-20) have been constructed every five kilometers running south from Ariquemes; there are also north-south "B"-numbered roads (e.g., B-65) every 20km that cut perpendicularly across these east-west roads. This has created rectangular blocks whose edges are largely cleared by homesteaders and ranchers, but whose interiors (perhaps 3.5 x 18 or more km) are still largely uncut forest in most places. The general region is located about 750km from the nearest high mountains to the west. The forest has a relatively open canopy in places, including many palms and bamboos, with some dense hill and alluvial forests.

Fig. 17. *Consul fabius* (Nymphalidae) perched on a rain forest leaf near cow manure, which attracted this butterfly to the ground to feed.

Rainfall and temperature records at Fazenda Rancho Grande have been kept since 1984 by Harald Schmitz, and he has kindly shared these data with us. The annual dry season here extends from May to September. At its severe peak, in June, July and August, monthly rainfall drops to 10-20mm, and no rain at all may fall for one or two months annually. At this time the forest dries out enough to allow large-scale burning. The wet season starts in October and continues to late April. Annual rainfall averages around 2200mm, with the rainiest months being in January (the annual peak, with often around 440mm), February, and March. The recorded temperature extremes range from 9°C (11 Jun 1985) to 43°C (27 Sep and 5 Oct 1987), but normally the temperatures are more moderate. During the dry season in 1987, for example, the average minimum was 18.7°C and the average maximum was 34.1°C in August (coolest month of the year). During the wet season of that same year, the warmest temperatures were reached in October (24.9°C average minimum and 38.9°C average maximum). During the rainy season, there are many strongly flowing streams in the area and standing ponds along roadsides and in depressions in the hilly terrain.

PRELIMINARY LIST OF THE RONDONIA BUTTERFLY FAUNA

In visits during 1975 and 1977, Keith S. Brown (1976, 1984) estimated that the species diversity in the area near Jaru (latitude 10°26'S, longitude 62°27'W), about 50km to the east of the Fazenda Rancho Grande, supported a butterfly fauna of 1,100-1,300 species. In those years, he accumulated normal daily species lists of over 300 species, and had maximum daily lists of up to 429 species (by one person on 5 Oct 1975) and of 462 species (by two persons on 2 Oct 1975). Today, the Jaru area is cleared for agriculture and no sustantial tracts of rain forest remain there. We will never know the total butterfly fauna originally present in that rich Jaru site.

In the area near the Fazenda Rancho Grande, vicinity of Caucalandia, we have now accumulated a list of over 840 species. These are only the species that have been identified at least to genus so far. The fact that we are now at 200 species of metalmarks (Riodinidae) alone suggests from comparative faunal surveys elsewhere in the Neotropics (e.g., 193 riodinids at Tambopata, Peru) that the grand total number of species will be in the vicinity of 1,500-1,600 species of butterflies (including skippers) when the survey is completed. In the meantime, we offer this preliminary list.

All determinations are very tentative due to time constraints and the fact that taxonomic revisions are needed among many of

Fig. 18-21. Rondonia Riodinidae: 18. Male *Amarynthis meneria* sunning and perching on a forest leaf (upper left); 19. *Caria* sp. drinking animal urine on a forest trail (lower left); 20. *Lasaia* sp. drinking animal urine on a forest trail (upper right); 21. *Rhetus* sp. drinking human urine on a trail (lower right).

the species groups involved. Those names of the Papilionidae, Pieridae, and Nymphalidae are mostly after D'Abrera (1981; 1984; 1987a, b; 1986), those of Hesperiidae are after Evans (1951, 1952, 1953, 1955). The Lycaenidae were determined by Robert K. Robbins (March 1989 sample) and the Riodinidae were determined by Donald Harvey (March 1989 sample); the remainder of the names are mostly from Lewis (1973). *Morpho* species were determined by George E. Martinez. Several riodinids were also identified by Curtis J. Callaghan from color photographs taken by George O. Krizek. Thus while this list is provisional in nature, it will still offer a preliminary idea of the species diversity found in this tropical rain forest site. It should not be used as a source of data for distributional or taxonomic studies of particular species. Most specimens on which these preliminary determinations were made are housed at the University of Florida (Gainesville), the Nevada State Museum (Las Vegas), or the Allyn Museum of Entomology (Sarasota, Florida) for further study.

To summarize these data by family and subfamily, we have the following species diversity present in the initially identified samples of butterflies from this region of Rondonia:

HESPERIIDAE 231
- Pyrrhopyginae 3
- Pyrginae 135
- Hesperiinae 93

PAPILIONIDAE 18

PIERIDAE 29

RIODINIDAE 203

LYCAENIDAE 87
- Polyommatinae 2
- Theclinae 85

NYMPHALIDAE 275
- Nymphalinae 126
- Satyrinae 56
- Brassolinae 8
- Morphinae 11
- Heliconiinae 25
- Danainae 3
- Ithomiinae 46

TOTAL species: 843

HESPERIIDAE

HESPERIINAE

Aides aegita
Aides epitus
Anthoptus epictetus
Anthoptus insignis
Apaustus menes
Aroma aroma
Arotis sp. (nr. *bryna*)
Callimormus corades
Callimormus juventus
Callimormus radiola radiola
Callimormus saturnus
Carystoides cathaea
Carystoides noseda
Carystoides sicania orbius
Carystus phorcus
Cobalopsis nero
Cobalus calvina
Cobalus virbius virbius
Conga chydaea
Corticea corticea noctis
Corticea lysias potex
Cymaenes alumna
Cymaenes chela (?)
Cymaenes laza
Cymaenes uruba group
Cymaenes sp. (nr. *uruba/tabori*)
Cymaenes sp.
Cynea bistrigula
Cynea corisana
Dalla diraspes
Damus clavus
Decinea lucifer
Dubiella dubius
Enosis angularis angularis
Euphyes peneia
Mellana angra
Mellana barbara
Mellana clavus
Methionopsis sp.
Mnasilus allubitus
Mnasitheus chrysophrys
Moeros moeros
Morys compta compta
Morys geisa geisa
Neoxeniades braesia braesia
Neoxeniades cincia
Niconiades xanthaphes
Panoquina sylvicola
Papias proximus
Papias subcostulata
Papias sp.
Paracarystus menestries
Parphorus storax storax
Peba striata
Perichares philetes philetes
Phanes aletes
Phanes almoda
Phlebodes pertinax
Phlebodes sp.
Pompeius pompeius
Quinta cannae
Saliana antoninus
Saliana esperi
Saturnus tiberius tiberius
Sodalia sodalis
Styriodes quadrinotata
Synapte infusco
Synapte silius
Talides sinois sinois
Thargella caura caura
Thespieus dalman
Thracides quarta
Thracides smaragdulus
Tigasis akurus
Turesis basta
Turesis lucas
Vacerra bonfilius bonfilius
Vehilius inca
Vehilius putus
Vehilius retus
Vehilius stictomenes stictomenes
Vehilius vetula
Vehilius vetus
Venas evans
Vettius marcus
Vettius phyllus phyllus
Vettius richardi (?)
Vettius triangularis
Virga virginius
Wallengrenia premnas
Zariaspes mys
Unidentified species (3)

PYRGINAE

Ablepsis azines
Achlyodes busirus rioja
Achlyodes thraso
Aethilla echina
Aguna asander asander
Aguna claxon
Aguna coelus
Aguna hypozonius
Aguna metophis
Anastrus obscurus narva
Anastrus sempiternus simplicior
Anastrus tolimus robigus
Anisochoria pedaliodina pedaliodina
Antigonus erosus
Antigonus liborius liborius
Antigonus nearchus
Astraptes alardus alardus
Astraptes anaphus anaphus
Astraptes apastus apastus
Astraptes azul
Astraptes enotrus
Astraptes fulgerator
Autochton longipennis
Autochton neis
Autochton zarex
Bolla atahuallpai
Bolla cupreiceps
Bungalotis astylos
Cabirus procas junta
Camptopleura auxo
Camptopleura impressus
Carrhenes bamba
Carrhenes canescens leada
Celaenorrhinus astrigera
Celaenorrhinus jao
Celaenorrhinus shema ochra
Celaenorrhinus similis group
Celaenorrhinus sp.
Chioides catillus catillus
Chrysoplectrum pervivax
Cogia calchas
Conognathus platon
Cycloglypha thrasibulus thrasibulus
Cycloglypha tisias
Diaeus lacaena variegata
Dyscophellus euribates euribates
Ebrietas evanidus
Ebrietas infanda
Entheus gentius
Entheus pralina
Entheus telemus
Epargyreus sp.
Eracon paulinus
Gorgopas trochilus
Gorgythion begga begga
Gorgythion beggina escalophoides
Gorgythion plautia
Grais stigmaticus stigmaticus
Helias phalaenoides palpalis
Heliopetes alana
Heliopetes arsalte arsalte
Heliopetes omrina
Heliopetes petrus
Hyalothyrus infernalis
Hyalothyrus leucomelas
Hyalothyrus neleus neleus
Marela tamyris
Marela tamyroides
Mictris crispus crispus
Milanion hemes hemes
Milanion pilumnus
Morvina fissimacula rema
Morvina morvus cyclopa
Mylon cajus cajus
Mylon exstincta (?)
Myrinia santa monka
Narcosius colossus granadensis
Narcosius samson
Nisoniades bessus bessus
Nisoniades borra
Nisoniades brazia
Nisoniades castolus
Nisoniades macarius
Nisoniades maura
Nisoniades mimas
Ouleus fridericus fridericus
Ouleus matria matria
Paches exosa
Paramimus scurra herberti
Pellicia meno

Pellicia nema
Phanus marshallii
Phanus obscurior prestoni
Phareas coeleste
Plumbago plumbago
Polyctor polyctor polyctor
Polygonus manueli manueli
Polythrix minvanes
Polythrix octomaculata
Pyrdalus corbulo corbulo
Pyrgus oileus
Pythonides grandis assecla
Pythonides jovianus fabricii
Quadrus contubernalis contubernalis
Quadrus deyrollei
Sostrata pusilla pusilla
Spathilepia clonius
Spioniades artemides
Staphylus epicaste epicaste
Staphylus lizeri
Staphylus minor
Staphylus putumayo putumayo
Telemiades antiope tosca
Telemiades delalande
Timochreon satyrus satyrus
Trina geometrina geometrina
Typhedanus optica goya
Typhedanus undulatus
Urbanus albimargo rica
Urbanus carmelita
Urbanus chalco
Urbanus dorantes dorantes
Urbanus doryssus doryssus
Urbanus esta
Urbanus pronta
Urbanus proteus
Urbanus reductus
Urbanus simplicius
Urbanus tanna
Urbanus teleus
Urbanus virescens
Xenophanes tryxus
Unidentified species (3)

PYRRHOPYGINAE

Aspitha aspitha rufescens
Oxynetra confusa
Pyrrhopyge phidias group

RIODINIDAE

Adelotypa nr. *alector*
Adelotypa hemileuca
Adelotypa nr. *huebneri*
Adelotypa spp. (2)
Adelotypa aminias catenifera
Adelotypa aristus (?)
Adelotypa leucocyana
Adelotypa leucophaea
Adelotypa senta
Alesa amesis
Alesa nr. *telephae*
Amarynthis meneria
Ancyluris colubra
Anteros nr. *bracteata*
Anteros nr. *carausius*
Anteros renaldus
Argyrogrammana nr. *perone*
Audre albimaculata
Calephelis argyrodines
Calospila nr. *emyliana*
Calospila emylius crispinella
Calospila parthaon
Calospila sp.
Calydna catana
Calydna chaseba
Calydna thersander
Calydna sp.
Caria mantinea
Caria nr. *chrysame*
Caria nr. *trochilus*
Chalodeta nr. *lypera*
Chamaelimnas sp. (*pansa* or *tircis*)
Charis nr. *anius*
Charis jessa
Charis sp.
Charis caryatis
Charis cleonus
Charis zama
Chorinea amazon
Chorinea sp. (*faunus* or *batesi*)
Cremna actoris
Cremna nr. *beltiana*
Cremna meleagris
Crocozona caecias
Emesis nr. *emesia*
Emesis lucinda
Emesis mandana
Emesis ocypore
Emesis temesa
Emesis spp. (3)
Eunogyra satyrus
Eurybia nr. *dardus*
Eurybia nr. *elvina*
Eurybia nr. *franciscana*
Eurybia halimede
Eurybia hyacinthina
Eurybia nicaeus
Euselasia nr. *arbas*
Euselasia nr. *brevicauda*
Euselasia calligramma
Euselasia chrysippe
Euselasia clithra
Euselasia nr. *crotopus*
Euselasia eubages
Euselasia eugeon (?)
Euselasia nr. *eulione*
Euselasia eunaeus
Euselasia euodias
Euselasia euryone
Euselasia nr. *eustachis*
Euselasia eutychus
Euselasia labdacus
Euselasia melaphaea
Euselasia orfita
Euselasia tarinta
Euselasia toppini
Euselasia nr. *uria*
Euselasia spp. (5)
Exoplisa cadmeis
Hyphilaria nicia
Hyphilaria parthenis
Ithomeis astrea
Ithomiola nr. *floralis*
Juditha lamis
Juditha molpe
Lasaia agesilas agesilas
Lasaia arsis
Lemonias zygia
Lepricornis spp. (2)
Leucochimona hyphaea
Leucochimona matisca
Melanis nr. *andania*
Melanis seleutia
Melanis smithiae
Melanis nr. *stenotaenia*
Mesene epaphus sertata
Mesene hya
Mesene nr. *nola*
Mesene phareus
Mesophthalma idotea
Mesosemia nr. *anceps*
Mesosemia nr. *calypso*
Mesosemia cippus
Mesosemia eumene
Mesosemia furia
Mesosemia judicialis
Mesosemia nr. *levis*
Mesosemia nr. *maeotis*
Mesosemia marcella
Mesosemia melaene
Mesosemia nr. *minos*
Mesosemia nr. *nesti*
Mesosemia olivencia
Mesosemia philocles
Mesosemia sifia (?)
Mesosemia nr. *tenebricosus*
Mesosemia spp. (2)
Metacharis lucius
Metacharis regalis
Monethe sp. (*albertus* or *rudolphus*)
Napaea nepos
Notheme erota
Nymphidium nr. *acherois*
Nymphidium baoetia
Nymphidium caricae
Nymphidium chione
Nymphidium fulminans
Nymphidium galactina
Nymphidium leucosia (?)
Nymphidium nr. *lisimon*
Nymphidium manicorensis
Nymphidium mantus
Nymphidium minuta
Nymphidium niveum
Nymphidium nr. *baoetia*
Nymphidium olinda

Nymphidium omois (?)
Nymphidium/Juditha spp. (5)
Nymula gela
Nymula ochra
Orimba butleri
Orimba flammula
Orimba pythionides
Orimba sp.
Panara phereclus
Parcella amarynthina
Parnes nycteis
Parnes philotes
Phaenochitonia eanes
Phaenochitonia sophistes
Rhetus arcius
Rhetus dysonii
Sarota gyas
Sarota chrysus
Semomesia nr. *capanea*
Semomesia macaria
Semomesia semiatra
Stalachtis calliope
Stalachtis phlegia
Symmachia rubina
Symmachia nr. *praxila*
Symmachia sp.
Synargis orestes
Synargis tytia
Synargis sp.
Syrmatia dorilas
Tharops trotschi
Themone pais
Theope foliorum
Theope pedias
Theope thestias
Theope sp.
Thisbe irenea
Thisbe molela
Thysanota galena
Unknown species (15)

LYCAENIDAE

POLYOMMATINAE

Hemiargus sp.
Leptotes cassius

THECLINAE

Arawacus separata
Arcas imperialis
Calycopis spp. (2)
Cyanophrys spp. (2)
Cycnus phaleros
Evenus gabriela
Iaspis sp.
Lamprospilus genius
Ministrymon phrutus
Mithras nautes
Ocaria ocrisia
Panthiades bitias bitias
Panthiades pelion
Pseudolycaena marsyas
Rekoa meton
Rekoa palegon
Strymon cestri
Strymon mulucha
Thecla celmus
Thecla cupentus
Thecla halciones
Thecla hisbon
Thecla malvina
Thecla pholeus
Thecla terentia
Thecla spp., etc. (53)
Theclopsis lydus
Theclopsis nr. *epidius*
Theritas hemon
Theritas mavors
Tmolus mutina

NYMPHALIDAE

BRASSOLINAE

Caligo brasiliensis
Caligo eurilochus
Caligo idomeneus
Caligo illioneus
Catoblepia berecynthia
Catoblepia soranus
Opsiphanes invirae (?)
Selenophanes cassiope

DANAINAE

Ituna ilione
Lycorea cleobaea
Lycorea pasinuntia pasinuntia

HELICONIINAE

Agraulis vanillae
Dione juno
Dryadula phaetusa
Dryas julia
Eueides aliphera
Eueides isabella
Eueides lampeto
Eueides lybia
Eueides tales pythagoras
Eueides vibilia
Heliconius aoede
Heliconius burneyi
Heliconius demeter
Heliconius doris (2 forms)
Heliconius elevatus
Heliconius erato
Heliconius ethilla
Heliconius hecale
Heliconius leucadia
Heliconius melpomene
Heliconius metharme
Heliconius numata (3 forms)
Heliconius sara
Heliconius wallacei
Philaethria dido

ITHOMIINAE

Aeria elara
Aeria eurimedia
Athyrtis mechanitis salvini
Callithomia lenea
Ceratinia poecila
Ceratinia sp.
Dircenna dero
Forbestra equicola equicoloides
Godyris zavaleta (?)
Heterosais giulia
Hypoleria oreas
Hypoleria mirza
Hypoleria proxima
Hypothyris daphnis daphnis
Hypothyris euclea barii
Hypothyris fluonia (?)
Hypothyris leprieuri ninyas
Hypothyris mamercus
Hypothyris ninonia neimyi
Hypothyris semifulva (?)
Ithomia agnosia
Mechanitis egaensis
Mechanitis lysimnia
Mechanitis mazaeus
Mechanitis polymnia
Melinaea maenius maenius
Melinaea marsaeus marsaeus
Melinaea menophilus
Methona grandior
Methona megisto
Napeogenes aethra
Napeogenes inachia
Napeogenes pheranthes
Napeogenes stella jamariensis
Napeogenes sylphis
Oleria aquata
Oleria astraea (?)
Oleria nr. *assimilis*
Oleria egra
Oleria nr. *manora*
Pseudoscada genityllus
Rhodussa cantobrica
Scada reckia
Scada theaphia
Thyridia psidii
Tithorea harmonia

MORPHINAE

Antirrhea murena
Caerois chorinaeus
Morpho achilles (3 forms: *helena, amazonica, patrochus*)
Morpho adonis
Morpho anaxibia
Morpho cisseis phanodemus
Morpho deidamia
Morpho helenor helenor

Morpho telemachus
Morpho menelaus (3 forms: *mattogrossensis, occidentalis, melacheilus*
Morpho rhetenor

NYMPHALINAE

Adelpha aethalia
Adelpha boeotia
Adelpha cocala
Adelpha cytherea
Adelpha delphicola
Adelpha epione
Adelpha erotia
Adelpha fufia (?)
Adelpha fugela
Adelpha iphiclus
Adelpha mesentina
Adelpha paraena
Adelpha phylaca
Adelpha plesaure
Adelpha pollina (?)
Adelpha serpa
Adelpha sichaeus
Adelpha thesprotia
Agrias claudina sardanapalus
Anartia amathea
Antigonis pharsalia felderi
Archaeoprepona amphimachus amphimachus
Archaeoprepona demophon demophon
Asterope markii
Baeotus amazonicus
Batesia hypochlora
Biblis hyperia
Callicore astarte
Callicore cyllene
Callicore cynosura
Callicore eunomia (2 forms)
Callicore hesperis
Callicore hystaspes
Castilia angusta
Catonephele acontius
Catonephele antinoe
Catonephele salacia
Colobura dirce
Consul fabius
Dagon fontus (?)
Diaethria clymena
Diaethria nr. *neglecta*
Doxocopa agathina agathina
Dynamine agacles core
Dynamine arene
Dynamine artemisia
Dynamine athemon niveata
Dynamine chryseis
Dynamine coenus leucothea
Dynamine ines ines
Dynamine mylitta
Dynamine myrson
Dynamine racidula
Dynamine theseus
Ectima thecla
Eresia clara
Eresia eunice (2 forms)
Eresia plagiata
Eunica alpais alpais
Eunica concordia
Eunica eurota eurota
Eunica malvina
Eunica margarita
Eunica orphise
Eunica sophonisba
Eunica sydonia
Euptoieta hegisa
Fountainea ryphea ryphea
Haematera pyramus pyramus
Hamadryas amphinome amphinome
Hamadryas arinome arinome
Hamadryas chloe chloe
Hamadryas februa februa
Hamadryas feronia feronia
Hamadryas iphthime iphthime
Hamadryas laodamia laodamia
Hamadryas velutina
Historius odius orion
Hypanartia lethe
Hypna clytemnestra clytemnestra
Marpesia berania
Marpesia chiron
Marpesia crethon
Marpesia egina
Marpesia hermione
Marpesia livius
Marpesia norica
Marpesia orsilochus
Marpesia petreus
Memphis basilia
Memphis glauce
Memphis glaucone
Memphis lemnos (?)
Memphis leonida
Memphis morvus
Memphis oenomais
Memphis philumena
Memphis vicinia
Memphis xenocles (?)
Memphis sp.
Myscelia capenas
Napeocles jucunda
Nessaea obrinus
Nica flavilla
Ortilia gentina
Panacea divalis
Paulogramma peristera
Peria lamis
Precis evarete
Prepona gnorima
Prepona pheridamus
Prepona rothschildi
Pyrrhogyra amphiro
Pyrrhogyra crameri nautaca
Pyrrhogyra otalais
Smyrna blomfildia
Tegosa fragilis
Tegosa infrequens
Tegosa similis
Telenassa burchelli
Temenis laothoe
Temenis pulchra
Tigridia acesta
Victorina stelenes
Vila semistalachtis
Zaretis itys

SATYRINAE

Bia actorion
Cithaerias nr. *aurorina*
"Euptychia" analis
"Euptychia" antonoe
"Euptychia" arnaea
"Euptychia" ayaya
"Euptychia" batesii
"Euptychia" cephus
"Euptychia" confusa
"Euptychia" nr. *cyanites*
"Euptychia" erichtho
"Euptychia" nr. *gracilis*
"Euptychia" nr. *helle*
"Euptychia" hermes group spp. (2)
"Euptychia" herse
"Euptychia" hesionides
"Euptychia" hewitsoni
"Euptychia" nr. *lea*
"Euptychia" libye
"Euptychia" libyoidea
"Euptychia" nr. *myncea*
"Euptychia" nortia
"Euptychia" obscura
"Euptychia" ocirrhoe
"Euptychia" nr. *ocypete*
"Euptychia" nr. *pallerna*
"Euptychia" penelope
"Euptychia" perfuscata
"Euptychia" philippa
"Euptychia" nr. *picea*
"Euptychia" quadrina
"Euptychia" nr. *renata*
"Euptychia" nr. *salvini*
"Euptychia" nr. *tenera*
"Euptychia" terrestris
"Euptychia" nr. *terrestris*
"Euptychia" nr. *thobiei (?)*
"Euptychia" tolumnia
"Euptychia" tricolor
"Euptychia" nr. *umbrosa*
"Euptychia" sp.
Haetera piera
Pierella astyoche (?)
Pierella hyalinus
Pierella lamia
Pierella lena
Taygetis andromeda
Taygetis blanda
Taygetis celia
Taygetis echo

Taygetis mermeria
Taygetis penelea
Taygetis virgilia
Taygetis vrazi
Taygetis xenana

PAPILIONIDAE

Battus belus
Battus crassus
Eurytides ariarathes
Eurytides dolicaon
Eurytides pausanias
Papilio anchisiades
Papilio androgeus
Papilio garleppi
Papilio lycophron
Papilio thoas
Papilio torquatus
Parides aeneas
Parides neophilus consus
Parides phosphorus
Parides sesostris
Parides steinbachi (?)
Parides vertumnus
Parides zacynthus polymetus

PIERIDAE

Anteos menippe
Aphrissa statira
Appias drusilla
Ascia buniae phaloe
Ascia buniae pharetia
Daptoneura leucadia
Daptoneura lycimnia
Dismorphia pinthaeus proxima
Dismorphia theucarila
Enantia licinia
Enantia melite
Eurema agave
Eurema albula
Eurema deva pseudomorpha
Eurema elathea
Eurema leuce
Eurema phiale (?)
Eurema venusta
Itaballia demophile
Itaballia pisonis
Leptophobia aripa aripa
Leucidia brephos
Leucidia elvina
Perrhybris pyrrha
Phoebis argante argante
Phoebis philea
Phoebis sennae marcellina
Phoebis trite
Pseudopieris nehemia (?)

DISCUSSION

Until our recent work near Caucalandia in Rondonia, the world's richest sites for butterfly diversity were believed to be at Jaru in the same Brazilian state (Brown 1984) and at Tambopata Nature Reserve in the department of Madre de Dios, Peru (Lamas, 1981, 1983). Brown (1984) actually recorded 956 species at Jaru, Rondonia, and predicted 1,332 species to have occurred there at the time of his studies (prior to deforestation). Lamas (1983, and *in* Brown 1984) actually recorded 1,032 species at Tambopata, Peru, and Lamas predicted 1,624 species would eventually be found there. Brown (1984) considered the latter Tambopata estimate to be rather high. Both Jaru and Tambopata have complex microheterogeneity of the physical environment, with diverse soil types and frequent, unpredictable climatic disturbance by thunderstorms, winds, variably severe dry periods, and cold fronts that are fatal to many tropical butterflies. Man has invaded both areas with trails, small clearings, and tree removal by logging (and massive deforestation now in Rondonia). Both climatic and human disturbance maintain the already heterogeneous ecosystems of Tambopata and central Rondonia in a constant state of preclimax vegetation mixed with climax forest, with many secondary succession patches, as pointed out by Brown (1984). These conditions create an ideal mix of more mature and stable forest patches, with the diverse adult and larval resources and differing microclimates of the more open secondary-succession areas, just as still exists near Caucalandia today.

Tambopata and Rancho Grande may be approximately equal in eventually-determined levels of butterfly diversity (close to 1,600 species in several square kilometers), but the mixture of ecological and historical causes of species diversity is likely somewhat different at the two sites. Tambopata, for example, is undoubtedly influenced by the proximity of the Andes whose uplifted montane habitats start only 35 km to the west, and the potential for extensive movement of various sun-loving butterfly populations (especially Papilionidae and Pieridae) along the large rivercourses there, flying in from neighboring cleared and secondary-succession areas. These and other factors influencing species diversity will be addressed in detail in a later paper (Emmel and Austin, in preparation).

CONCLUSIONS

Surveys at Jaru and near Caucalandia in Rondonia, Brazil, show that this central Rondonian area may have the highest butterfly diversity in the world. In the limited field work to date, over 800 butterfly species at Fazenda Rancho Grande near Caucalandia have been identified, and that number is expected to reach approximately 1,500-1,600 species with further research there. From informal surveys to date, diversity among the birds, mammals, plants, and other organisms seems equally high. Because of the accelerated pace of deforestation and settlement in Rondonia, it seems essential to create as soon as possible one or more inviolate biological preserves of considerable size to save this fauna and flora for future generations to visit, study, and enjoy.

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