

## Comparing the butterfly faunas of Pakitza and Tambopata, Madre de Dios, Peru, or why is Peru such a mega-diverse country?

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**Abstract.** Between 1989 and 1991, 1307 butterfly species have been recorded at Pakitza, a biological station in the protected zone of Parque Nacional del Manu, Madre de Dios, Peru. This is the largest number of butterfly species that have been documented at one site anywhere in the world. At Tambopata, another protected reserve in Madre de Dios, 235 km southeast of Pakitza, at a similar elevation, 1251 species have been recorded since 1979. Of the 1588 species recorded for Pakitza and Tambopata, 970 (61.1 %) occur at both sites. Out of approximately 7000 species of butterflies found in the Neotropics, over 3500 are definitely known to occur in Peru, almost 50 % of the latter having been recorded at Pakitza and Tambopata. It is argued that the extraordinary butterfly species richness of Peru is the result of current (ecological) and past (historical) factors.

**Key words.** Butterflies, Lepidoptera, diversity, Peru.

The butterfly fauna found at Pakitza, a biological station in Manu National Park, Peru (site description in Erwin 1991), is the richest documented community in the world. My colleagues and I have recorded 1307 species (Table 1) in a sampled area <4000 ha there, on five field trips with a duration of 97 days, totalling 1311 person-hours of recording. Attesting to the richness of the place, a four-person surveying team recorded 1063 species in just 23 days in 1991 (details in Robbins et al. 1996). At Tambopata, another protected area in Peru, situated 235 km southeast of Pakitza, at a similar elevation (details in Lamas 1981), 1251 species have been recorded since 1979 (Table 1). Although both places are similar in topography, climate and forest physiognomy, only 970 (61.1 %) out of a total 1588 species are found at both sites. The taxonomic composition at both reserves is quite similar. The HesperIIDae comprise one third of the species richness, the Lycaenidae + Riodinidae another third, and the Papilionidae + Pieridae + Nymphalidae the remaining third, a partition of species richness often found in Neotropical lowland butterfly communities. In contrast, sites above 1500 m are quite poor in species of Lycaenidae + Riodinidae.

Table 1: The butterfly faunas of Tambopata and Pakitza, Peru, compared.

Taxon	Tambopata	Pakitza	Shared	Both
Heliconiinae	25	24	21	28
Nymphalinae	19	13	12	20
Limnithidinae	99	99	82	116
Charaxinae	27	28	23	32
Apaturinae	6	6	6	6
Morphinae	12	9	8	13
Brassolinae	22	23	20	25
Satyrinae	85	103	70	118
Danainae	3	4	3	4
Ithomiinae	43	62	41	64
Libytheinae	1	1	1	1
Riodinidae	242	250	176	316
Lycaenidae	173	181	126	228
Pieridae	27	31	25	33
Papilionidae	26	25	21	30
Pyrrhopyginae	27	26	18	35
Pyrginae	193	197	149	241
Hesperiinae	221	225	168	278
Totals	1,251	1,307	970	1,588

It is my contention that Peru has the highest butterfly species richness in the world, as a glance to Table 2 will demonstrate. The richness in Pakitza and Tambopata supports that notion, but another example will reinforce it: As currently understood (Lamas in prep.) the Neotropical subfamily Ithomiinae (Nymphalidae) comprises 315 species, 208 (66 %) of which definitely occur in Peru. At Chanchamayo valley in central-eastern Peru, an elevational transect between 500 and 2200 m has been sampled, and 138 species were found there (10 more than in the whole of Brazil). At a single spot less than 100 m long on a trail through cloud forest at 2100 m elevation, 64 species were recorded, two more than in the rich lowland community of Pakitza. Similar patterns of species richness are found across many animal and plant groups, in several areas of Peru.

I believe such megadiversity is due to the following reasons:

1. Peru is a large country (1,285,216 square kilometres), lying within the tropics in its whole, and with 60 % of its territory still covered with tropical rain-forests.
2. The main geomorphological feature of Peru, the geologically young Andes, effectively divides the territory in three main areas: the narrow, depauperate (but with interesting endemisms) Pacific coast, the Andes proper (with many high altitude endemics), and the extremely diverse Amazonian lowlands (particularly so at the base of the eastern chain of the Andes).

Table 2: The butterfly faunas of Peru, Brazil and the Neotropics compared.

Taxon	Peru			Brazil	Neotropics	
	Lamas, unpublished data: Confirmed	Estimated	MUSM <sup>1</sup>	Brown 1991	Lamas unpubl.	Heppner 1991
Acraeini	26	29	26	22	52	45
Heliconiini	52	61	49	} 295	82	65
Nymphalinae	60	76	56		178	} 1432 <sup>2</sup>
Limenitidinae	246	265	231		359	
Apaturinae	9	9	9		19	} 130
Charaxinae	65	72	62		108	
Morphinae	20	22	20	21	32	55
Brassolinae	39	41	36	49	69	81
Satyrinae	393	479	365	194	810	740
Danaeinae	6	6	6	6	12	9
Ithomiinae	208	239	206	128	315	298
Libytheinae	1	1	1	1	4	2
Riodinidae	606	735	494	720	>1253	1308
Lycaenidae	488	571	389	429	>1054	1303
Pieridae	189	206	175	59	338	323
Papilionidae	57	64	54	68	139	120
Pyrrhopyginae	84	96	69	70	154	179
Pyrginae	453	487	377	450	905	693
Hesperiinae	538	591	458	566	1198	1123
Megathyminae	0	0	0	0	30	21
Totals	3,540	4,050	3,083	3,130	>7,111	7,927

<sup>1</sup> numbers of species represented in the collections of the Museo de Historia Natural, Universidad Nacional Mayor de San Marcos, Lima

<sup>2</sup> obviously erroneous figure

3. The Pleistocene with its climatic, geological and hydrological vicissitudes certainly contributed to reshaping the distribution patterns of many (if not most) species, though its impact on species generation is highly debatable.
4. "Intermediate" disturbances (*sensu* Connell 1978) probably promote random population extinctions favouring transitory oversaturation with species in local communities. Species composition would change through (ecological and historical) time, but species richness may remain relatively constant, in a nonequilibrium state, in such communities. This could explain why two areas which are so similar to each other physiognomically and so close to each other geographically as are Pakitza and Tambopata, share only about 60 % of the total number of species recorded for both: That is, a certain species might occur synchronically in two sites, but its populations have been wiped out temporarily

in one of the sites where they have been replaced (again, transitorily) by one or more ecologically equivalent species. Such a dynamic system could provide "survival opportunities" for more species than the "normal" carrying capacity of a site in an equilibrium state. As shown by the work of Kalliola and coworkers (e.g. Puhakka et al. 1992, and references therein), local disturbances have been, and are, very common in Amazonian Peru, not to mention the periodical "El Niño Southern Oscillation" phenomenon.

### References

- Brown, K.S., Jr. (1991): Conservation of Neotropical environments: Insects as indicators. — In: Collins, N.M., & J.A. Thomas (eds.): The conservation of insects and their habitats, 349–404. — Academic Press, London.
- Connell, J.H. (1978): Diversity in tropical rain forests and coral reefs. — *Science* 199: 1302–1310.
- Erwin, T.L. (1991): Natural history of the carabid beetles at the BIOLAT biological station, Rio Manu, Pakitza, Peru. — *Rev. per. Entomol.* 33: 1–85.
- Heppner, J.B. (1991): Faunal regions and the diversity of Lepidoptera. — *Trop. Lepid.* 2 (Suppl. 1): 1–85.
- Lamas, G. (1981): La fauna de mariposas de la Reserva de Tambopata, Madre de Dios, Peru (Lepidoptera, Papilionoidea y Hesperioidea). — *Rev. Soc. mex. Lepid.* 6: 23–40.
- Puhakka, M., R. Kalliola, M. Rajasilta & J. Salo (1992): River types, site evolution and successional vegetation patterns in Peruvian Amazonia. — *J. Biogeogr.* 19: 651–665.
- Robbíns, R.K., G. Lamas, O.H.H. Mielke, D.J. Harvey & M.M. Casagrande (1996): Taxonomic composition and ecological structure of the species-rich butterfly community at Pakitza, Parque Nacional del Manu, Peru. — In: Wilson, D.E., & A. Sandoval (eds): *Manu. The biodiversity of southeastern Peru*, 217–252. — Smithsonian Institution, Washington, D.C.

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