

Lepidoptera diversity of an Ecuadorian lowland rain forest¹

(Lepidoptera: Papilionidae, Pieridae, Nymphalidae, Saturniidae, Sphingidae)

by

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Introduction

Faunistic lists are a very important tool for several fields in biological researches.

We must stress however that comparisons of faunistic lists of different sites are always difficult to be made due to differences in area size, to divergence in classification, and to the differences of the operators techniques. Therefore it is often uneasy to deal with sets of data and to compare the results. None the less, surveys and comparisons of butterflies in selected sites of the Neotropical realm seem to be very popular nowadays (LAMAS, 1983a, 1983b; LAMAS et al., 1991; RAGUSO & LLORENTE, 1991; AUSTIN et al., 1996; BALCAZAR, 1993). They are particularly aimed at gathering sets of data for conservation purposes and at identifying hotspots of endemism. Dramatic is the lacking of published long-term surveys on moths in limited areas of the Neotropics.

Unexpectedly, no recent faunistic lists of Ecuadorian butterflies have appeared except that of Maquipucuna Reserve on the western side of the country (RAGUSO & GLOSTER, 1996). Having observed butterflies, Saturniids and Hawkmoths for almost 15 years in Ecuador, as CLENCH (1979) suggests, the time is arrived to submit a survey of these taxa occurring in an Amazonian area of Ecuador. Further, we tried to reply to BROWN's (1984) question who was wondering whether there was a place in western Amazonia richer in butterflies than Jaru, Brazil and Tambopata, Peru (LAMAS, 1983c). Although human settlements are increasing and vast areas have been heavily deforested, none the less, Misahualli, the study-area has still many sites with primary forests. The finding of species, like "canopy-dwellers" *Agrias*, which are very susceptible to changes in the environment, could show hotspots for protection purposes. It is not unlike that most of the species reported here may be found in the Jatun Sacha protected area (NEILL, 1988) which lies next to the area surveyed.

Study area and methods

The study area

Two square plots of forest 9 sq kms each around Puerto Misahualli (Fig. 1 A) and around the confluence of Rio Puni (= Rio Punín, = Rio Puno) with Rio Arajuno (Fig. 1B) have been surveyed. These areas are located on opposite sides of the Rio Napo at altitudes between 350 m to 600 m.

The terrain NW of Misahualli 460 m, steeply arises at 800 m and it takes some aspects of a wet premontane rain forest. GRUBB et al. (1963) described the vegetation of the left bank of Rio Napo, properly Shinguipino 7 km SE of Tena, as a typical lowland rain forest. The right bank of the Rio Napo is characterized by a topographic variation from 350 to 515 m and then descending at 360 m at the confluence of Rio Puni with Rio Arajuno. The physiognomy of the areas is a typical lowland rain forest.

Meteorological data of two sites nearby the study area, i. e. Tena at an altitude of 527 m, located approx. 15 kms N of Misahualli, has a mean annual precipitation of 3880 mm and a mean annual temperature of 23.1 °C. Arajuno, located approx. 14 kms S of the study site on the right bank of the Rio Napo, at an altitude of 537 m shows a mean annual precipitation of 3699 mm, and a mean annual temperature of 23.7 °C. The driest months in the area are December and January, and the wettest June to August (CAÑADAS CRUZ, 1983; GOMEZ, 1989; TERAN, 1995).

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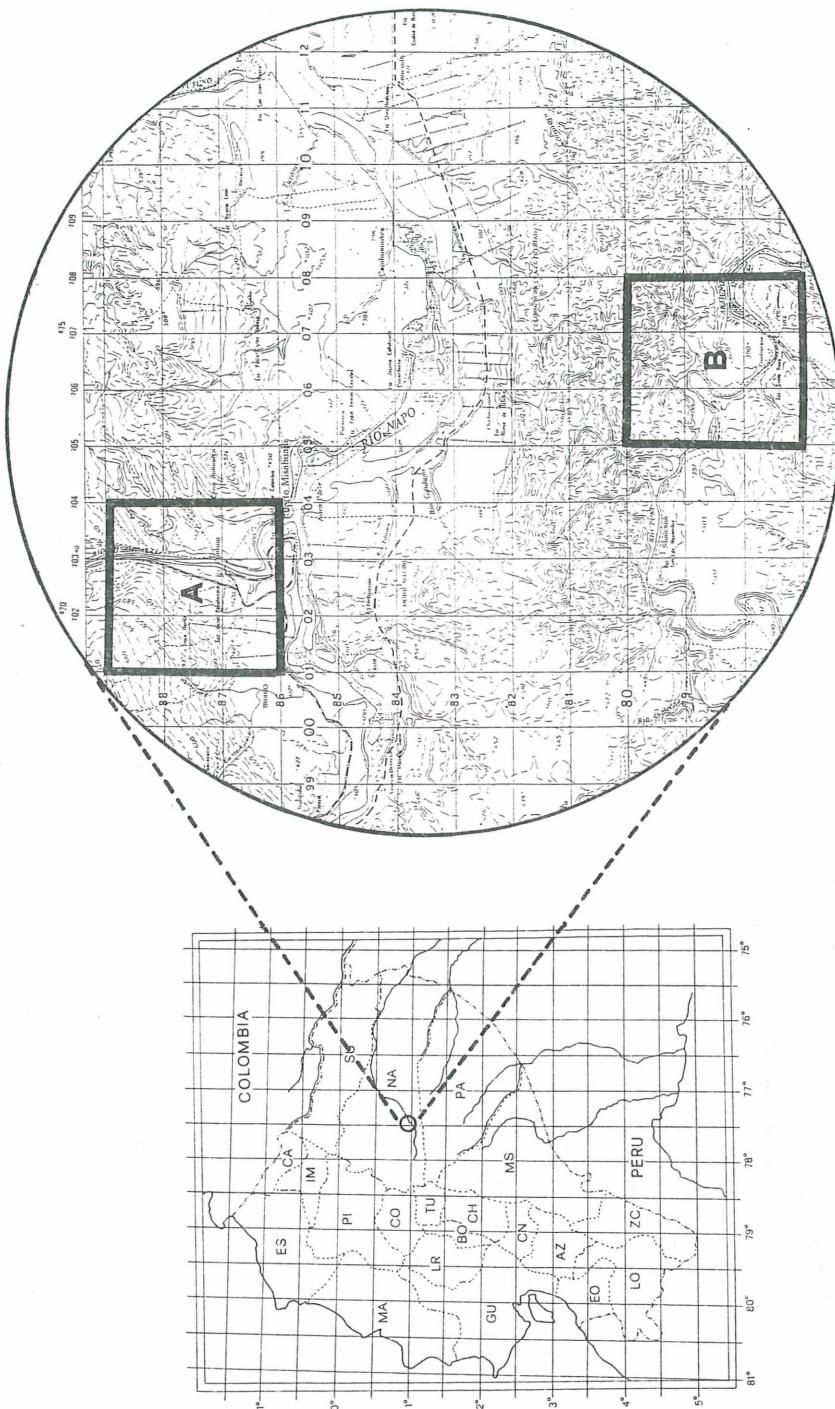


Fig. 1: Map of study sites.

Collecting methodology

Butterflies were netted, identified and released, observed at banana baits, and seldom attracted with the use of traps with rotten fruits, meat or fish. The traps were located between 2 and 20 m of height along trails especially on the left bank of Rio Napo.

The activity was made from 9 am to 4 pm spanning over a period of 15 non-consecutive years from 1983 to 1997, covering each month (tab. 1).

As far as moths are concerned, data on Saturniidae and Sphingidae came only from the Misahualli area. Moths have been collected with the method of light trap with Mercury vapour lamps. The survey has been limited to 52 nights during a period spanning from 1992 to 1997.

Tab. 1: Periods, cumulative hours/persons collecting, and cumulative number of species at the study sites.

Periods	hours/persons	N. species
12–22 Aug. 1983.	25	162
10 Jan–10 Feb 1985	100	201
18 Dec 1986–20 Jan 1987	150	230
15 Feb–15 March 1988	225	265
13 March–15 April 1990	295	280
15 June–15 July 1991	370	285
22 May–13 June 1992	425	320
16 April–6 May 1993	525	343
15 Oct–6 Nov 1993	695	360
11 Sept–8 Oct 1994	905	375
20 July–17 Aug 1996	1040	383
25 April–17 May 1997	1120	387

Results

A total of 387 species of butterflies are reported for the Misahualli and Arajuno areas (307 at each plot, see Appendix 1). This figure represents one of the highest number of species found in the Neotropics if we compare data of other sites. In detail, 36 species of Papilionidae, 34 species of Pieridae, and 317 of Nymphalidae have been found. For comparison, are reported the absolute figures and percentages of species of Papilionidae, Pieridae and Nymphalidae occurring in the Misahualli area and in other neotropical sites. Maquipucuna in western Ecuador, is the only Ecuadorian locality which has been studied, in recent times. Each subfamily or tribe of Nymphalidae has been considered for evaluation purposes (tab. 2). The cumulative curve of the number of species and the cumulative hours/persons collecting is shown in fig. 2.

Saturniidae of the area totalled 92 species, in comparison with 275 species reported for the whole country (tab. 3). Sphingidae, with 50 species, represent 1/3 of ecuadorian hawkmoths fauna

Discussion

Several topics may be discussed in the light of these preliminary studies. We focus on some example of phenological and distributional data as well as the diversity of butterflies and moths in the study areas. Some techniques for monitoring butterflies are discussed.

1. The temporal and spatial composition of species in the Misahualli-Arajuno areas, is similar to the results obtained by ORR & HÄUSER (1996) for a lowland tropical rainforest site in Sabah, Malaysia.

Tab. 2: Total butterfly species richness and percentages for individual taxon at Misahualli and other neotropical sites.

	M %	P %	T %	R %	J %	VC %	TK %	MQ %
Papilionidae	36 9.30	8 3.52	25 7.14	18 5.61	23 5.87	14 9.59	18 9.83	5 3.52
Pieridae	34 8.78	18 7.93	25 7.14	29 9.03	26 6.63	19 13.01	23 12.57	21 14.78
Nymphalidae	317 81.92	201 88.55	300 85.72	274 85.36	343 87.50	113 77.40	142 77.60	116 81.70
Total	387	227	350	321	392	146	183	142
Nymphalidae	M %	P %	T %	R %	J %	VC %	TK %	MQ %
Danainae	4 1.27	1 0.50	3 1.0	3 1.10	2 0.58	3 2.66	4 2.82	1 0.86
Ithomiinae	65 20.50	44 21.89	40 13.33	46 16.79	57 16.62	13 11.50	9 6.34	14 12.07
Brassolini	20 6.31	9 4.48	21 7.0	8 2.92	23 6.71	5 4.42	6 4.23	4 3.45
Morphiinae	9 2.84	4 1.99	11 3.67	11 4.01	8 2.33	2 1.77	3 2.11	2 1.72
Acræini	2 0.63	1 0.50	1 0.33	0 0	1 0.29	1 0.89	1 0.70	3 2.59
Heliconiini	19 5.99	15 7.46	24 8.0	25 9.12	24 7.00	13 11.50	11 7.75	9 7.76
Libytheinae	1 0.32	0 0	1 0.33	0 0	1 0.29	0 0	1 0.70	0 0
Satyrinae	35 11.04	58 28.85	74 24.67	55 20.07	95 27.70	10 8.85	21 14.79	34 29.31
Nymphalinae	123 38.80	57 28.36	97 32.33	104 37.96	46 40.71	62 43.66	39 33.62	
Charaxinae	31 9.78	11 5.47	22 7.33	21 7.66	132 38.48	19 16.81	21 14.79	10 8.62
Apaturinae	8 2.52	1 0.50	6 2.0	1 0.37	1 0.89	3 2.11	0 0	
Total	317	201	300	274	343	113	142	116

M = Ecuador, Misahualli-Arajuno (present study); P = Peru, Pakitzá (LAMAS et al. 1991); T = Peru, Tambopata (LAMAS, 1981, 1983a, 1983b, 1985a); R = Brazil, Rondonia, Cacaulândia (EMMEL & AUSTIN, 1990); J = Brazil, Rondonia, Jaru (BROWN, 1984; Nymphalinae includes Charaxinae and Apaturinae); VC = Mexico, Vera Cruz, Erbitrolotu (RAGUSO & LLORENTE, 1991); TK = Guatemala, Tikal (AUSTIN et al., 1996); MQ = Ecuador, Maquipucuna (RAGUSO & GLOSTER, 1996).

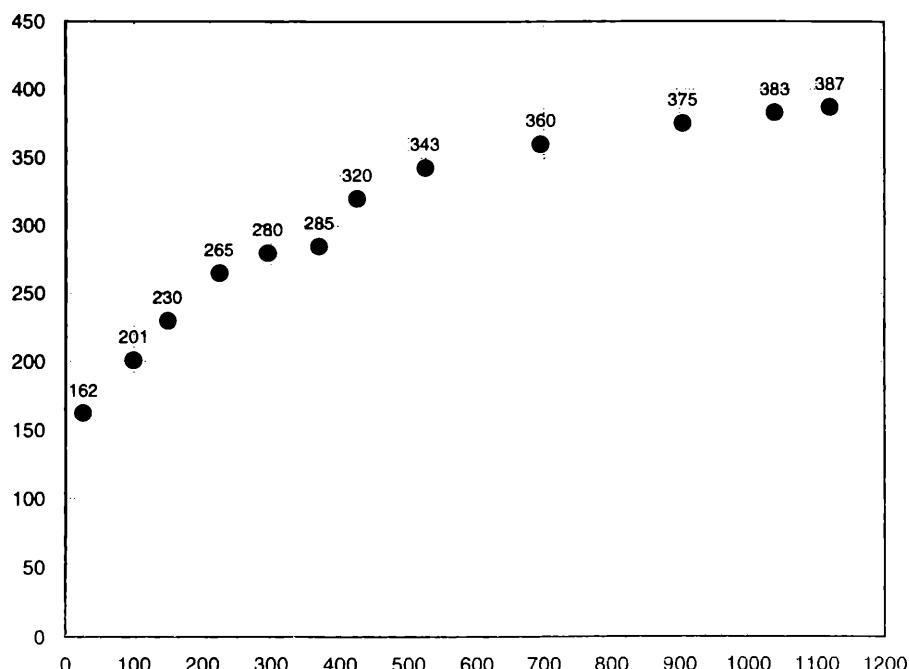


Fig. 2: Cumulative number of species/collecting vs hours/persons.

These authors observed at Kuala Belalong an unpredictable species phenology as well as an extreme localisation for some species. We must underline that daily climatic conditions in Misahualli area are very different only a few kilometers, if not hundreds of meters, apart.

As an example, the Papilionid *Parides* species show peculiar temporal and spatial characteristics. *Parides childrenae* (GRAY, 1832) and *P. cutorina* (STAUDINGER, 1898) have been found only once in two different sites in the Misahualli area. *P. orellana* (HEWITSON, 1852) and *P. chabrias* (HEWITSON, 1852) were rarely seen only inside the Arajuno area. *P. aeneas* (LINNAEUS, 1758), *P. lysander* (CRAMER, 1775), *P. neophilus* (GEYER, [1837]), *P. sesostris* (CRAMER, 1780), *P. vertumnus* (CRAMER, 1780), and *P. anchises drucei* (BUTLER, 1874) are present, although phenologically separated, in both areas. *P. sesostris*, *P. aeneas*, and *P. vertumnus* are more abundant during December and January, while *P. erithalion guillerminae* (PISCHEDDA & RACHELI, 1986), although extremely local in the Misahualli area, is on the wings during March–May.

Other species such as *Mimoides xynias* (HEWITSON, 1875), *M. trapeza* (ROTHSCHILD & JORDAN, 1906), *M. ariarathes* (ESPER, 1788) and *M. pausanias* (HEWITSON, 1852), involved in a possible Batesian mimicry system, are widespread in both areas. *M. xynias* and *M. trapeza* are synchronic and syntopic during March–May, the former less abundant, *M. ariarathes* and *M. pausanias* can be found all the year round but very local and scarce. During March–April 1990 and April–May 1997 there was a conspicuous decrease in the number of species and individuals of both *Parides* and *Mimoides* species. This phenomenon involved also many other species of butterflies and moths and it is not unlikely related to the relative low precipitations during these seasons.

2. The Saturniid fauna of Misahualli, 92 species recorded (Appendix 2), constitutes the 33% of the total Ecuadorian fauna. Only at Lumbaquí, Sucumbios province, the total number of species shows higher figures, 120 species according to LEMAIRE & VENEDICTOFF (1989) (tab. 3).

During April–May 1993 54 species were collected, while during the same months in 1997 only 10 species were found. Species such as *Arsenura mossi* JORDAN, 1922, *Arsenura b. batesii* (FELDER & ROGENHOFER, 1874), *Titaea timur* (FASSL, 1915) and *Automeris jucunda* (CRAMER, 1779) were collected during July–August 1994. During the same months in 1996 these species were absent. None the less, RACHELI & RACHELI (1997) reported new records to the fauna of Misahualli, including rare and elusive species such as *Automeris larra* (WALKER, 1855), *Automeris heppneri* LEMAIRE, 1982, *Leucanella apollinairei* (DOGNIN, 1923) and *Leucanella maasseni* (MÖSCHLER, 1872). This latter species was predicted to occur in a list of 8 possible species for this area (RACHELI, 1995b).

With some confidence, we could predict 10–15 additional species for the fauna of Misahualli, especially of Hemileucinae species, although it is unlikely to reach a diversity comparable to that of Lumbaquí.

Tab. 3: Number of Saturniidae at Misahualli and total number of species occurring in Ecuador. (LEMAIRE & VENEDICTOFF, 1898; RACHELI, 1995a, 1995b).

	Total no of species and percentages at Misahualli	Total no of species and percentages for Ecuador	Fauna of Misahualli on total ecuadorian species
Arsenurinae	12	13.04%	43%
Ceratocampinae	18	19.57%	36%
Hemileucinae	56	60.87%	31%
Saturniinae	6	6.52%	33%
Total	92	100%	33%

3. The Sphingids of Misahualli, with 50 species (Appendix 3), are approx. 1/3 of the total Ecuadorian fauna, if the estimate of 155–160 species is realistic.

Sphingidae of a western Amazonian locality, Tambopata in SE Peru, totalled 47 species, and only 18 of these are in common to both Ecuadorian and Peruvian localities (LAMAS, 1985b, 1989).

Two closely related species of *Callionima*, i. e., *pan* and *denticulata*, often considered as two subspecies, coexist in the study area during the same month. The genus *Xylophanes* counts a total of 10 species while the genus *Manduca* 9 species, including also three undetermined species. Four species of the genus *Enyo* are present out of a total of six recorded for Ecuador.

The highest number of species of Sphingidae was collected in April (28 species), and August (27 species) while the lowest in November with only two records.

Five to ten species more can be added because species such as *Cocytius antaeus medor* and *Erinnyis ello*, two of the commonest Ecuadorian species, have been collected very close to the study area.

4. The pooled data of butterflies obtained in the two plots on both banks of Napo river have been compared with other Neotropical sites which presumably have a well known butterfly fauna (tab. 2). Western Amazonian localities like Pakitzá and Tambopata have similar figures for Pieridae but not for Papilionidae and Nymphalidae. The Papilionidae of Pakitzá probably have not been investigated thoroughly. In fact, LAMAS et al. (1991) report that ca 68% of the entire fauna has been surveyed. On the other hand, Misahualli data for Nymphalidae may be underestimated especially for Satyrinae (11% vs 28.85% of Pakitzá, vs 27.69% of Jaru).

The high overall species richness of the three butterfly taxa recorded in the present study mirrors the high species richness of plants in the area. Misahualli and surroundings lie on an ecotonal zone between lowland rain forest and premontane rain forest, being close to the foot of the Andes, approx. 35 km. Similar geographical features are shared with Tambobata, in Peru. The number of plant species in premontane forests is certainly very high, although not substantiated with precise data, in comparison with that of lowland rainforests. RENNER et al. (1990) report 3104 species of flowering plants below 600 m on Amazonian Ecuador. BALSLEV (1988) estimates that between 900 and 3000 m half the Ecuadorian species is present (cf BALSLEV & RENNER, 1989; ULLOA & JORGENSEN, 1995).

The number of human settlements around Misahualli may enhance the number of microhabitats suitable for "common species", although they represent only a small fraction of the entire fauna. The more structured forests of Arajuno is home for elusive and forestal species.

5. BECCALONI & GASTON (1995) claimed that it is possible to use the species total of a single taxon to predict the overall species richness in a given area (% species of a taxon/total number of species). Ithomiinae butterflies, perhaps one of the best known group in the Neotropics, have been selected as an indicator group. The mean proportion for this taxon in 21 analysed areas corresponds to 4.6%. A roughly estimate of the total butterfly fauna of Misahualli, including Lycaenids, Riodinids and Skippers, may count 1300–1400 species. The indicator figure for Ithomiids given by BECCALONI & GASTON (1995) fits with our presumptive data (5% and 4.6%, respectively) but not with our actual data.

Because the composition of a butterfly neotropical fauna is sustained mainly by Riodinids, Lycaenids and Hesperiids which are taxa biosystematically less known than other groups (BROWN, 1991), it would be better not include these figures in the total number of species, and to focus on better known groups. Total number of species of a single taxon (e. g. Papilionidae, Heliconiini etc) may be accurate alone but not so if compared and pooled with the total number of species in a given area.

As first step one can adopt the "overall classification" of BROWN (1987), surveying Papilionidae, Pieridae, and Nymphalidae at each locality and pooling these data. The percentage of species collected, for example during two weeks in different months on the same spot, can give a fair estimate of the species richness. As it was suggested by BECCALONI & GASTON (1995) Ithomiids are good indicators of forested areas only, to have informations on non-forested sites, other taxa should be selected and pooling the above three taxa seems to constitute a better estimate (SPARROW et al., 1994).

6. The total number of species found in both areas is 387 and we failed to reply to BROWN's question (1984) in finding the richest place in western Amazonia. Our data however suggest that the Misahualli-Arajuno areas may potentially host more species than those actually reported. The very low but constant increase of species added each year confirms this hypothesis (fig. 2). The high number

of Papilionidae and Nymphalinae which were particularly "cured", contrasts with the low figure found in Satyrinae. One of the main reason for the underestimation of this taxon lies on the scarce use of bait-traps while collecting along the right bank of Rio Napo.

Conclusions

It is predicted that the number of butterfly species still to be found in Ecuador, Sw Brazil and Peru will flatten the accumulative curves of the butterfly of western Amazonia, and their plateaux will eventually converge.

The estimate of ca 1070 species for the three butterfly taxa under consideration likely to occur in Ecuador makes the Misahualli area the reservoir for 1/3 of the entire fauna. This figure corresponds to the same estimate for both Saturniidae and Sphingidae.

Although it is possible that butterflies cannot be compared with moths for many reasons (ecological, ethological, geographical, etc.), and especially because neotropical moths are poorly known, all the same the presence of 1/3 of the total Ecuadorian fauna of the five taxa surveyed, makes Misahualli area one of the richest site of western Amazonia.

It is perhaps not due to chance alone that also the Bornean locality surveyed by ORR & HÄUSER (1996) hosts 1/3 of the total butterfly fauna.

This is a preliminary study of this area and we hope this list will stimulate other researchers to investigate in the same or different Ecuadorian areas, so as these data will be refined for a better knowledge of the composition and species richness of Lepidoptera in Neotropical forests.

References

- AUSTIN, G. T., HADDAD, N. M., MENDEZ, C., SISK, T. D., MURPHY, D. D., LAUNER, A. E. & P. R. EHRLICH (1996): Annotated checklist of the butterflies of the Tikal National Park area of Guatemala. – *Trop. Lepid.* **7**: 21–37.
- BALCAZAR, L. M. A. (1993): Butterflies of Pedernales, Michoacán, Mexico, with notes on seasonality and faunistic affinities (Lepidoptera: Papilioidea and Hesperioidea). – *Trop. Lepid.* **4**: 93–105.
- BALSLEV, H. (1988): Distribution patterns of Ecuadorean plant species. – *Taxon* **37**: 567–577.
- BALSLEV, H. & S. S. RENNER (1989): The diversity of the Ecuadorean forest east of the Andes. pp. 287–295. In L. B. HOLM-NIELSEN, I. NIELSEN & H. BALSLEV (eds.). *Tropical forests: Botanical dynamics, Speciation and Diversity*. – Academic Press, London.
- BECCALONI, G. W. & K. J. GASTON (1995): Predicting the species richness of neotropical forest butterflies: Ithomiinae (Lepidoptera: Nymphalidae) as indicators. – *Biol. Cons.* **71**: 77–86.
- BROWN, K. S. Jr. (1984): Species diversity and abundance in Jaru, Rondonia (Brazil). – *News Lepid. Soc.* **1984** (3): 45–47.
- BROWN, K. S. Jr. (1987): Biogeography and evolution of neotropical butterflies. pp. 66–104. In T. C. WHITMORE & G. T. PRANCE (eds), *Biogeography and quaternary history in Tropical America*. – Clarendon Press, Oxford.
- BROWN, K. S. Jr. (1991): Conservation of Neotropical environments: Insects as indicators. pp. 349–404. In N. M. COLLINS & J. A. THOMAS (eds) *The Conservation of insects and their habitats*. – Academic Press, London.
- CAÑADAS CRUZ, L. (1983): El mapa bioclimático y ecológico del Ecuador. – Banco Central del Ecuador, Quito, 210 pp.
- CLENCH, H. K. (1979.): How to make regional lists of butterflies: some thoughts. – *J. Lepid. Soc.* **33**: 215–231
- EMMEL, T. C. & G. T. AUSTIN (1990): The tropical rain forest butterfly fauna of Rondonia, Brazil: species diversity and Conservation. – *Trop. Lepid.* **1**: 1–12.

- GOMEZ, E. N. (1989.): Elementos de Geografia del Ecuador: el hombre y el medio. – Ediguias, Quito, 130 pp.
- GRUBB, P. J., LLOYD, J. R., PENNINGTON, T. D. & WHITMORE, T. C. (1963): A comparison of montane and lowland rain forest in Ecuador I. The forest structure, physiognomy, and floristics. – *J. Ecol.* **51**: 567–601.
- LAMAS, G. (1981): La fauna de mariposas de la Reserva de Tambopata, Madre de Dios, Peru (Lepidoptera, Papilioidea y Hesperioidea). – *Rev. Soc. mex. Lepid.* **6**: 23–40.
- LAMAS, G. (1983a): Adiciones y correcciones a la lista de mariposa de la Reserva de Tambopata. – *News Lepid. Soc* **1983** (4): 53–55
- LAMAS, G. (1983b): Adiciones y correcciones a la lista de mariposas de la Reserva de Tambopata, Peru. – *Rev. Soc. mex. Lepid.* **8**: 13–24.
- LAMAS, G. (1983c): How many butterflies species in your backyard? – *News Lepid. Soc.* **1983** (4): 53–55.
- LAMAS, G. (1985a): Los Papilioidea (Lepidoptera) de la zona reservada de Tambopata, Madre de Dios, Peru. I: Papilionidae, Pieridae y Nymphalidae (en parte). – *Revta peruana Ent.* **27**: 59–73.
- LAMAS, G. (1985b): The Castniidae and Sphingidae (Lepidoptera) of the Tambopata reserved zone, Madre de Dios, Peru: a preliminary list. – *Revta peruana Ent.* **27**: 55–58.
- LAMAS, G. (1989): Lista preliminar de los Saturniidae, Oxytenidae, Uraniidae y Sematuridae (Lepidoptera) de la Zona Reservada de Tambopata, Madre de Dios, Peru. – *Revta peruana Ent.* **31**: 57–60.
- LAMAS, G., ROBBINS, R. K. & D. J. HARVEY (1991): A preliminary survey of the butterflies fauna of Pakitza, Parque Nacional del Manu, Peru, with an estimate of its species richness. – *Publ. Mus. Hist. nat. UNMSM (A)* **40**: 1–19.
- LEMAIRE, C. & N. VENEDICTOFF (1989): Catalogue and biogeography of the Lepidoptera of Ecuador. I Saturniidae. With description of a new species of *Meroleuca* PACKARD. – *Bull. Allyn Mus.* **129**: 1–60.
- NEILL, D. A. (1988): Jatun Sacha biological station, amazonian Ecuador: an invitation to tropical biologists. – *Biotropica* **20**: 59.
- ORR, A. G. & C. L. HÄUSER (1996): Temporal and spatial patterns of butterfly diversity in a lowland tropical rainforest. pp. 125–138. In EDWARDS, D. S., BOOTH, W. E. & S. C. CHOI (eds), Tropical Rainforest Research – Current Issues. – Kluwer Academic Publishers, Dordrecht-Boston-London.
- RACHELI, L. (1995a): Contributo alla conoscenza dei Saturnidi dell' Ecuador (Lepidoptera, Saturniidae). – *Frag. entomol.* **26** (2): 253–258.
- RACHELI, L. (1995b): Lista preliminare dei Saturnidi di Misahualli, Napo, Ecuador. – *Frag. entomol.* **27** (1): 117–144.
- RACHELI, L. & T. RACHELI (1997): Further notes on the Saturniidae of Ecuador (Lepidoptera, Saturniidae). – *Nachr. entomol. Ver. Apollo, N.F.* **18** (2–3): 173–180.
- RAGUSO, R. A. & O. GLOSTER (1996): Preliminary checklist and field observations of the butterflies of the Maquipucuna field station (Pichincha Province, Ecuador). – *J. Res. Lepid.* **32** (1993): 135–161.
- RAGUSO, R. A. & J. LLORENTE (1991): The butterflies (Lepidoptera) of the Tuxtlas Mts., Veracruz, Mexico, revisited: species-richness and habitat disturbance. – *J. Res. Lepid.* **29**: 105–133.
- RENNER, S. S., BALSLEV, H. & L. B. HOLM-NIELSEN (1990): Flowering plants of Amazonian Ecuador – a checklist. AAU Reports 24. – Botanical Institute Aarhus University & Pontificia Universidad Católica de l'Ecuador, Quito, 241 pp.
- SPARROW, H. R., SICK, T. D., EHRLICH, P. R. & D. D. MURPHY (1994): Techniques and guidelines for monitoring neotropical butterflies. – *Cons. Biol.* **8**: 800–809.
- TERAN, F. (1995): Geografia del Ecuador. Octava edición. – Libresa, Quito 466 pp.
- ULLOA, U. C. & P. M. JORGENSEN (1995): Arboles y Arbustos de los Andes del Ecuador. Segunda edición. – Abya-Yala, Quito, xxi + 329 pp.

Appendix 1

	Misahualli	Arajuno
Papilionidae		
Papilioninae		
Troidini		
<i>Battus polydamas</i> LINNAEUS, 1758	+	+
<i>Battus belus varus</i> KOLLAR, 1850		+
<i>Battus ingenuus</i> DYAR, 1907	+	+
<i>Battus lycidas</i> CRAMER, 1777		+
<i>Battus crassus</i> CRAMER, 1777		+
<i>Parides chabrias chabrias</i> HEWITSON, 1852		+
<i>Parides orellana</i> HEWITSON, 1852		+
<i>Parides aeneas bolivar</i> HEWITSON, 1850	+	+
<i>Parides lysander brissonius</i> HÜBNER, 1819	+	+
<i>Parides neophilus olivencius</i> BATES, 1861	+	+
<i>Parides sesostris sesostris</i> CRAMER, 1779	+	+
<i>Parides childrenae unimacula</i> JOICEY & TALBOT, 1922	+	
<i>Parides cutorina</i> STAUDINGER, 1898	+	
<i>Parides vertumnus bogotanus</i> FELDER & FELDER, 1864	+	+
<i>Parides erithalion guillerminae</i> PISCHEDDA & RACHELI, 1986	+	
<i>Parides anchises drucei</i> BUTLER, 1874	+	+
Graphiini		
<i>Protopraphium agesilaus autosilaus</i> BATES, 1861	+	+
<i>Protopraphium thyastes thyastinus</i> OBERTHÜR, 1879	+	
<i>Eurytides serville</i> GODART, [1824]	+	+
<i>Eurytides dolicaon deileon</i> FELDER & FELDER, 1865	+	+
<i>Protesilaus telesilaus</i> FELDER & FELDER, 1864	+	+
<i>Protesilaus protesilaus</i> LINNAEUS, 1758	+	+
<i>Protesilaus glaucoalaus</i> BATES, 1864	+	+
<i>Mimoides xynias</i> HEWITSON, 1875	+	+
<i>Mimoides trapeza</i> ROTHSCHILD & JORDAN, 1906	+	+
<i>Mimoides ariarathes</i> ESPER, 1788	+	+
<i>Mimoides pausaniae</i> HEWITSON, 1852	+	+
Papilionini		
<i>Heraclides (Priamides) chiensiades</i> WESTWOOD, 1872		+
<i>Heraclides (Priamides) anchisiades</i> ESPER, 1788	+	+
<i>Heraclides (Troilides) hypason</i> CRAMER, 1776	+	+
<i>Heraclides (Troilides) torquatus</i> CRAMER, 1777	+	+
<i>Heraclides (Calaides) astyalus phanias</i> ROTHSCHILD & JORDAN, 1906	+	+
<i>Heraclides (Calaides) androgeus</i> CRAMER, 1776	+	+
<i>Heraclides (Heraclides) thoas cyniras</i> MÉNÉTRIÉS, 1857	+	+
<i>Pterourus (Pyrrosticta) menatius ctesiades</i> ROTHSCHILD & JORDAN, 1906	+	+
<i>Pterourus (Pyrrosticta) zagueus</i> DOUBLEDAY, 1847	+	+

	Misahualli	Arajuno
Pieridae		
Dismorphiinae		
<i>Pseudopieris nehemia</i> BOISDUVAL, 1836		
<i>Enantia melite</i> JOHANSSON, 1763	+	+
<i>Enantia licinia</i> CRAMER, [1777]	+	+
<i>Dismorphia amphiona</i> CRAMER, [1779]	+	+
<i>Dismorphia lysis</i> HEWITSON, 1869		+
<i>Dismorphia ithomia</i> HEWITSON, 1867	+	+
<i>Dismorphia pithaeus ela</i> HEWITSON, 1877	+	
<i>Dismorphia theucarila</i> DOUBLEDAY, 1848		+
Pierinae		
<i>Hesperocharis nera</i> HEWITSON, 1852	+	+
<i>Hesperocharis hirlanda</i> STOLL, [1790]	+	+
<i>Charonias eurytele</i> HEWITSON, 1852	+	+
<i>Archonias negrina</i> FELDER & FELDER, 1862	+	
<i>Catasticta sisamnus</i> FABRICIUS, 1793	+	
<i>Leptophobia cinerea</i> HEWITSON, 1867	+	+
<i>Itaballia demophile</i> LINNAEUS, 1767	+	+
<i>Itaballia pandosia</i> HEWITSON, 1853	+	
<i>Pieriballia viardi</i> BOISDUVAL, 1836	+	+
<i>Perrybris pamela</i> CRAMER, 1782	+	+
<i>Perrybris lorena</i> HEWITSON, 1852	+	+
<i>Melete lycimnia</i> CRAMER, [1777]	+	+
<i>Melete leucanthe</i> FELDER & FELDER, 1861	+	+
<i>Melete leucadia</i> FELDER & FELDER, 1862	+	+
<i>Appias drusilla</i> CRAMER, [1777]	+	
Coliadinae		
<i>Phoebeis argante</i> FABRICIUS, 1775	+	+
<i>Phoebeis neocyparis</i> HÜBNER, 1823	+	
<i>Phoebeis philea</i> LINNAEUS, 1763	+	
<i>Phoebeis trite</i> LINNAEUS, 1758	+	+
<i>Aphrissa statira</i> CRAMER, [1777]	+	+
<i>Eurema (Sphaenogona) fabiola</i> FELDER & FELDER, 1861	+	
<i>Eurema daira phoenicia</i> FELDER & FELDER, 1865	+	
<i>Eurema albula</i> CRAMER, 1776	+	+
<i>Eurema venusta</i> BOISDUVAL, 1836	+	
<i>Eurema leuce</i> BOISDUVAL, 1836	+	
<i>Leucidia brephos</i> HÜBNER, [1816]	+	+
Nymphalidae		
Heliconiinae		
Acraeini		
<i>Altinote alcione</i> HEWITSON, 1852	+	

	Misahualli	Arajuno
<i>Actinote pellenea</i> HÜBNER, 1821	+	
Heliconiini		
<i>Philaethria dido</i> LINNAEUS, 1763	+	+
<i>Agraulis vanillae lucina</i> FELDER & FELDER, 1862	+	+
<i>Dione juno</i> CRAMER, [1779]	+	+
<i>Dryas iulia</i> FABRICIUS, 1775	+	+
<i>Dryadula phaetusa</i> LINNAEUS, 1758	+	+
<i>Eueides vibilia unifasciata</i> BUTLER, 1873	+	
<i>Eueides aliphera</i> GODART, 1819	+	+
<i>Eueides isabella margaritifera</i> STICHEL, 1903	+	+
<i>Eueides tales</i> CRAMER, [1775]	+	+
<i>Neruda aoede auca</i> NEUKIRCHEN, 1997		+
<i>Laparus doris</i> LINNAEUS, 1771	+	+
<i>Heliconius xanthocles</i> BATES, 1862	+	+
<i>Heliconius wallacei</i> REAKIRT, 1866	+	+
<i>Heliconius numata aristiona</i> HEWITSON, 1853	+	+
<i>Heliconius hecale quitalenus</i> HEWITSON, 1853	+	+
<i>Heliconius elevatus willmotti</i> NEUKIRCHEN, 1997	+	
<i>Heliconius melpomene malleti</i> LAMAS, 1988	+	+
<i>Heliconius erato lativitta</i> BUTLER, 1877	+	+
<i>Heliconius sara thamar</i> HÜBNER, [1806]	+	+
Nymphalinae		
Nymphalini		
<i>Hypanartia lethe</i> FABRICIUS, 1793	+	+
Kallimini		
<i>Metamorpha elissa</i> HÜBNER, 1819	+	+
<i>Siproeta stelenes</i> LINNAEUS, 1758	+	+
<i>Anartia amathea</i> LINNAEUS, 1758	+	+
<i>Anartia jatrophae</i> LINNAEUS, 1863	+	+
<i>Junonia genoveva</i> CRAMER, 1782	+	+
Melitaeini		
<i>Telenassa teletusa burchelli</i> MOULTON, 1909	+	+
<i>Anthanassa drusilla alceta</i> HEWITSON, 1869	+	
<i>Dagon pusillus</i> SALVIN, 1869	+	
<i>Tegosa similis</i> HIGGINS, 1981	+	
<i>Tegosa pastazena</i> BATES, 1864	+	+
<i>Tegosa anieta</i> HEWITSON, 1864	+	
<i>Eresia clara</i> BATES, 1864	+	
<i>Eresia nauplius plagiata</i> RÖBER, 1913	+	+
<i>Eresia polina</i> HEWITSON, 1852	+	
<i>Eresia datis moesta</i> SALVIN & GODMAN, 1868	+	
<i>Eresia letitia</i> HEWITSON, 1869		+
<i>Eresia eunice esora</i> HEWITSON, 1857	+	+

	Misahualli	Arajuno
<i>Eresia pelonia</i> HEWITSON, 1852	+	+
<i>Eresia aveyrona mylitta</i> HEWITSON, 1869	+	+
<i>Castilia perilla</i> HEWITSON, 1852	+	+
<i>Castilia guaya</i> HALL, 1929		+
<i>Castilia angusta</i> HEWITSON, [1868]	+	
<i>Janatella leucodesma</i> FELDER & FELDER, 1861	+	+
<i>Mazia amazonica</i> BATES, 1864		+
Limenitidinae		
Coloburini		
<i>Historis odius dious</i> LAMAS, 1995	+	+
<i>Historis acheronta</i> FABRICIUS, 1775	+	+
<i>Pycina zamba</i> DOUBLEDAY, [1849]		+
<i>Smyrna blomfildia</i> FABRICIUS, 1782	+	+
<i>Colobura dirce</i> LINNAEUS, 1758	+	+
<i>Baeotus amazonicus</i> RILEY, 1919	+	+
<i>Baeotus jupiter</i> STAUDINGER, 1885	+	+
<i>Baeotus deucalion</i> FELDER & FELDER, 1860	+	+
<i>Tigridia acesta</i> LINNAEUS, 1758	+	+
Biblidini		
a) Bibliditi		
<i>Biblis hyperia</i> CRAMER, [1780]	+	+
b) Euryteliti		
<i>Vila cacica</i> STAUDINGER, 1885	+	+
<i>Vila emilia sinefascia</i> HALL, 1935		+
c) Ageroniiti		
<i>Batesia hypochlora hypoxantha</i> SALVIN & GODMAN, 1868		+
<i>Panacea prola amazonica</i> FRUHSTORFER, 1915	+	+
<i>Panacea procilla divalis</i> BATES, 1868	+	+
<i>Panacea regina</i> BATES, 1864	+	+
<i>Ectima iona</i> DOUBLEDAY [1848]		+
<i>Ectima lirides</i> STAUDINGER, [1886]	+	
<i>Hamadryas feronia</i> LINNAEUS, 1758		+
<i>Hamadryas fornax</i> HÜBNER, 1823		+
<i>Hamadryas alicia</i> BATES, 1865		+
<i>Hamadryas chloe</i> STOLL, [1787]	+	+
<i>Hamadryas amphinome</i> LINNAEUS, 1767	+	
<i>Hamadryas laodamia</i> CRAMER, [1777]	+	
<i>Hamadryas arinome</i> LUCAS, 1853	+	
d) Epicaliiti		
<i>Catonephele nyctimus</i> WESTWOOD, 1850	+	+
<i>Catonephele salambria</i> FELDER & FELDER, 1861	+	
<i>Catonephele salacia</i> HEWITSON, 1852	+	+
<i>Catonephele numilia</i> CRAMER, [1775]	+	+

	Misahualli	Arajuno
<i>Catonephele acontius</i> LINNAEUS, 1771	+	+
<i>Nessaea obrina lesoudieri</i> LE MOULT, 1933	+	+
<i>Nessaea hewitsonii</i> FELDER & FELDER, 1859	+	+
<i>Eunica caelina alycia</i> FRUHSTORFER, 1909	+	
<i>Eunica mygdonia</i> GODART, [1824]	+	+
<i>Eunica malvina malvina</i> BATES, 1864	+	+
<i>Eunica marsolia fasula</i> FRUHSTORFER, 1909	+	+
<i>Eunica clytia</i> HEWITSON, 1852	+	+
<i>Eunica orphise</i> CRAMER, [1775]	+	
<i>Eunica sydonia sydonia</i> GODART, [1824]		+
<i>Eunica sophonisba agele</i> SEITZ, 1925	+	
<i>Eunica norica occia</i> FRUHSTORFER, 1909	+	+
<i>Eunica volumina celma</i> HEWITSON, 1852	+	
<i>Eunica alpais alpais</i> GODART, [1824]	+	
<i>Eunica eurota eurota</i> CRAMER, [1775]	+	+
<i>Eunica alcmena flora</i> FELDER & FELDER, 1862	+	+
e) Epiphiliini		
<i>Asterope markii hewitsoni</i> STAUDINGER, 1886	+	+
<i>Asterope optima</i> BUTLER, 1869	+	
<i>Asterope degandii</i> HEWITSON, 1857	+	+
<i>Asterope buckleyi</i> HEWITSON, 1869		+
<i>Nica flavilla sylvestris</i> BATES, 1864	+	+
<i>Peria lamis</i> CRAMER, [1779]	+	+
<i>Temenis pulchra</i> HEWITSON, 1861	+	+
<i>Temenis laothoe</i> CRAMER, [1777]	+	+
<i>Pyrrhogrya otolais olivenca</i> FRUHSTORFER, 1908	+	+
<i>Pyrrhogrya crameri hagnedorus</i> FRUHSTORFER, 1908	+	+
<i>Pyrrhogrya neaerea amphiro</i> BATES, 1865	+	+
f) Dynamini		
<i>Dynamine athemon</i> LINNAEUS, 1758	+	
<i>Dynamine gisella peruviana</i> RÖBER, [1916]	+	+
<i>Dynamine ate</i> GODMAN & SALVIN, 1883	+	
<i>Dynamine chrysseis</i> BATES, 1865	+	
<i>Dynamine anubis</i> HEWITSON, 1859	+	+
<i>Dynamine racidula</i> HEWITSON, 1852	+	+
g) Catagrammiini		
<i>Haematera pyrame</i> HÜBNER, 1819	+	+
<i>Diathria neglecta</i> SALVIN, 1869	+	+
<i>Diathria eluina</i> HEWITSON, 1852	+	+
<i>Diathria clymene peruviana</i> GUENÉE, 1872	+	+
<i>Callicore atacama</i> HEWITSON, 1852	+	
<i>Callicore aegina</i> FELDER & FELDER, 1861	+	+
<i>Callicore hesperis</i> GUÉRIN, 1844	+	+

	Misahualli	Arajuno
<i>Callicore excelsior</i> HEWITSON, 1857	+	+
<i>Callicore eunomia eunomia</i> HEWITSON, 1853	+	+
<i>Callicore pygas cyllene</i> DOUBLEDAY, 1847	+	+
<i>Callicore astarte stratiotes</i> FELDER & FELDER, 1861	+	+
<i>Callicore maimuna</i> HEWITSON, 1858	+	+
<i>Callicore hystaspes zelphanta</i> HEWITSON, 1858	+	+
<i>Callicore tolima</i> HEWITSON, [1853]	+	+
<i>Paulogramma pyracmon peristera</i> HEWITSON, 1853	+	+
<i>Catacore kolyma</i> HEWITSON, 1852	+	+
Limenitidini		
<i>Adelpha mesentina chancha</i> STAUDINGER, 1886	+	+
<i>Adelpha cocala urraca</i> FELDER & FELDER, 1862	+	+
<i>Adelpha boeotia</i> FELDER & FELDER, 1865	+	
<i>Adelpha aethalia davisii</i> BUTLER, 1877	+	+
<i>Adelpha erotia</i> HEWITSON, 1847	+	+
<i>Adelpha melona</i> HEWITSON, 1847	+	
<i>Adelpha naxia</i> FELDER & FELDER, 1867	+	+
<i>Adelpha iphiclus</i> LINNAEUS, 1758	+	+
<i>Adelpha cytherea olbia</i> FELDER, 1867	+	+
<i>Adelpha jordani</i> FRUHSTORFER, 1915		+
<i>Adelpha serpa</i> BOISDUVAL, 1836	+	+
<i>Adelpha boreas</i> BUTLER, 1866	+	+
<i>Adelpha delinita</i> FRUHSTORFER, 1915	+	
<i>Adelpha alala erhardti</i> NEUBURGER, 1907	+	
<i>Adelpha thesprotia delphicola</i> FRUHSTORFER, 1909	+	
Cyrestidini		
<i>Marpesia zerynthia</i> HÜBNER, [1823]	+	+
<i>Marpesia petreus</i> CRAMER, [1776]	+	+
<i>Marpesia corinna</i> LATREILLE, [1813]	+	+
<i>Marpesia furcula oechalia</i> WESTWOOD, 1850	+	+
<i>Marpesia thermistocles norica</i> HEWITSON, 1852	+	
<i>Marpesia chiron marius</i> CRAMER, 1780	+	+
<i>Marpesia marcella</i> FELDER & FELDER, 1861	+	+
<i>Marpesia livius</i> KIRBY, 1871	+	
Charaxinae		
Preponini		
<i>Agrias claudina sara</i> FRUHSTORFER, 1902	+	+
<i>Agrias amydon zenodorus</i> HEWITSON, 1870		+
<i>Agrias beatifica</i> HEWITSON, 1869		+
<i>Archaeoprepona demophon muson</i> FRUHSTORFER, [1905]	+	+
<i>Archaeoprepona demophon andicola</i> FRUHSTORFER, 1904	+	+
<i>Archaeoprepona licomedes</i> CRAMER, [1777]	+	
<i>Prepona pylene</i> HEWITSON, 1853	+	

	Misahualli	Arajuno
<i>Prepona laertes ikarios</i> FRUHSTORFER, 1904	+	+
<i>Prepona idexamenus</i> HOPFFER, 1874	+	
<i>Prepona omphale</i> HÜBNER, 1819	+	
<i>Prepona pheridamas</i> CRAMER, 1777	+	
<i>Anaeomorpha splendida</i> ROTSCHILD, 1894		+
Anaeini		
<i>Consul fabius diffusus</i> BUTLER, 1875	+	+
<i>Fountainea euryptyle</i> FELDER & FELDER, 1862	+	+
<i>Fountainea ryphea</i> CRAMER, 1776	+	
<i>Polygrapha xenocrates</i> WESTWOOD, 1850	+	+
<i>Polygrapha cyanea</i> SALVIN & GODMAN, 1868	+	+
<i>Memphis xenocles</i> HEWITSON, 1850	+	+
<i>Memphis glauce felderii</i> RÖBER, 1916	+	+
<i>Anaea (Memphis) laertes psammis</i> FELDER & FELDER, 1867	+	+
<i>Anaea (Memphis) oenomaia</i> BOISDUVAL, 1870	+	
<i>Anaea (Memphis) polycarmes</i> FABRICIUS, 1775	+	+
<i>Anaea (Memphis) moruus morpheus</i> STAUDINGER, 1886	+	+
<i>Anaea (Memphis) polyxo</i> DRUCE, 1874	+	
<i>Anaea (Memphis) anna</i> STAUDINGER, 1897		+
<i>Hypna clytemnestra negra</i> FELDER & FELDER, 1862	+	+
<i>Coenophlebia archidona</i> HEWITSON, 1860	+	+
<i>Siderone marthesia vulcanus</i> FELDER & FELDER, 1862	+	+
<i>Siderone galanthis thebaica</i> FELDER & FELDER, 1862	+	+
<i>Zaretis itys</i> CRAMER, 1777	+	+
Apaturinae		
<i>Doxocopa laurentia</i> GODART, 1824	+	+
<i>Doxocopa seraphina</i> HÜBNER, 1825	+	+
<i>Doxocopa elis</i> FELDER & FELDER, 1861	+	
<i>Doxocopa cyane cyanippe</i> GODART, 1824	+	
<i>Doxocopa pavon</i> LATREILLE, [1809]	+	+
<i>Doxocopa agathina</i> CRAMER, 1777		+
<i>Doxocopa zunilda felderii</i> GODMAN & SALVIN, 1884	+	+
<i>Doxocopa linda</i> FELDER & FELDER, 1862	+	+
Brassolinae		
<i>Brassolis sophorae</i> LINNAEUS, 1758	+	+
<i>Narope anarta sarastro</i> STAUDINGER, 1886		+
<i>Narope cyllabarus</i> WESTWOOD, [1851]		+
<i>Opoopera aorsa</i> GODART, 1824		+
<i>Catobleplia xanthicles orientalis</i> BRISTOW, 1981		+
<i>Catobleplia xanthus rivalis</i> NIEPELT, 1911		+
<i>Catobleplia generosa</i> STICHEL, 1902		+
<i>Catobleplia berecynthia midas</i> STICHEL, 1908	+	+
<i>Catobleplia soranus</i> WESTWOOD, [1851]		+

	Misahualli	Arajuno
<i>Eryphanis zolzivora opimus</i> STAUDINGER, 1887		+
<i>Eryphanis automedon</i> CRAMER, 1775	+	
<i>Opsiphanes cassiae</i> LINNAEUS, 1758	+	+
<i>Opsiphanes cassina icassina</i> FELDER & FELDER, 1862	+	+
<i>Opsiphanes quiteria quaestor</i> STICHEL, [1902]	+	+
<i>Caligo illioneus praxsiodus</i> FRUHSTORFER, 1912	+	+
<i>Caligo eurilochus livius</i> STAUDINGER, 1886	+	
<i>Caligo idomeneus idomenides</i> FRUHSTORFER, 1903		+
<i>Caligo placidianus</i> STAUDINGER, 1887	+	
<i>Caligo prometheus</i> KOLLAR, 1850		+
Morphinae		
<i>Morpho cisseiis phanodemus</i> HEWITSON 1869	+	+
<i>Morpho telemachus foucheri</i> LE MOULT, 1926	+	+
<i>Morpho rhetenor cacica</i> STAUDINGER, 1875	+	+
<i>Morpho menelaus occidentalis</i> FELDER & FELDER, 1862	+	+
<i>Morpho adonis</i> CRAMER, [1775]	+	+
<i>Morpho achilles theodorus</i> FRUHSTORFER, 1907	+	+
<i>Morpho deidamia neoptolemus</i> WOOD, 1863	+	+
<i>Antirrhoea taygetina</i> BUTLER, 1868		+
<i>Antirrhoea philoctetes avernus</i> HOPFFER, 1874		+
Satyrinae		
Haeterini		
<i>Pierella lamia chalybaea</i> GODMAN, 1905	+	+
<i>Pierella hyrceta</i> HEWITSON, 1859	+	
<i>Pierella hortona</i> HEWITSON, 1854	+	+
<i>Pierella astyche lucia</i> WEYMER, 1885	+	+
<i>Pierella lena brasiliensis</i> FELDER & FELDER, 1862	+	+
<i>Haetera piera negra</i> FELDER & FELDER, 1862	+	+
<i>Cithaerias pireta aurorina</i> WEYMER, [1910]	+	+
Biini		
<i>Bia actorion rebeli</i> BRYK, 1953	+	+
Satyrini		
<i>Manataria hercyna</i> HÜBNER, 1821	+	+
<i>Pseudodebis valentina</i> CRAMER, 1779	+	+
<i>Taygetis echo koepckeae</i> FORSTER, 1964		+
<i>Taygetis xenana</i> BUTLER, 1870	+	
<i>Taygetis mermeria</i> CRAMER, [1776]	+	
<i>Taygetis larua</i> FELDER & FELDER, 1867	+	
<i>Taygetis virginilia</i> CRAMER, [1776]		+
<i>Taygetis thamyra cleopatra</i> FELDER & FELDER, 1862	+	
<i>Posttaygetis penelea</i> CRAMER, 1777		+
<i>Pareuptychia interjecta hesionides</i> FORSTER, 1964	+	+
<i>Megeuptychia antonoe</i> CRAMER, [1775]	+	+

	Misahualli	Arajuno
<i>Cissia labe</i> BUTLER, 1870	+	+
<i>Cissia penelope</i> FABRICIUS, 1775	+	
<i>Cissia alcinoe</i> FELDER & FELDER, 1867	+	
<i>Euptychia francisca</i> BUTLER, [1870]		+
<i>Euptychia mollina</i> HÜBNER, 1816		+
<i>Euptychia meta</i> WEYMER, 1911		+
<i>Magneuptychia tricolor fulgora</i> BUTLER, 1869		+
<i>Caeuruleuptychia lobelia</i> BUTLER, 1870		+
<i>Caeuruleuptychia aetherialis</i> BUTLER, 1877		+
<i>Caeuruleuptychia coelica</i> HEWITSON, 1869		+
<i>Yphthimoides umbrosa</i> BUTLER, 1870	+	
<i>Yphthimoides maepius erigone</i> BUTLER, 1866	+	
<i>Yphthimoides benedicta</i> BUTLER, 1877	+	
<i>Harjesia obscura eremita</i> WEYMER, 1911	+	
<i>Chloreuptychia arnaca</i> FABRICIUS, 1776	+	+
<i>Chloreuptychia chloris</i> CRAMER, 1780		+
Libytheinae		
<i>Libytheana carinenta</i> CRAMER, 1777	+	
Danainae		
<i>Lycorea halia pales</i> FELDER & FELDER, 1862	+	
<i>Lycorea pasinuntia</i> CRAMER, 1780	+	+
<i>Danaus plexippus erippus</i> CRAMER, 1776	+	
<i>Danaus gilippus</i> CRAMER, [1776]	+	
Ithomiinae		
New Tribe (BROWN in litt.)		
<i>Aeria eurimedia negricola</i> FELDER & FELDER, 1862	+	+
<i>Roswellia acrisione</i> HEWITSON, 1869	+	
Tithoreini		
<i>Tithorea tarricina bonita</i> HAENSCH, 1903	+	
<i>Tithorea harmonia hermias</i> GODMAN & SALVIN, 1898	+	+
Melinaeini		
<i>Athyrtis mechanitis oberthueri</i> SRNKA, 1885		+
<i>Melinaea mnasias abitagua</i> BROWN, 1977	+	+
<i>Melinaea maelus maeonis</i> HEWITSON, 1869	+	+
<i>Melinaea marsaeus mothone</i> HEWITSON, 1860	+	+
<i>Melinaea menophilus cocana</i> HAENSCH, 1903	+	+
Methonini		
<i>Methona curvifascia</i> WEYMER, 1884	+	+
<i>Methona confusa psamathe</i> GODMAN & SALVIN, 1898	+	+
Mechanitini		
<i>Thyridia psidii</i> <i>ino</i> FELDER & FELDER, 1862	+	+
<i>Scada reckia ethica</i> HEWITSON, 1861	+	+
<i>Forbestra olivencia juntana</i> HAENSCH, 1903		+

	Misahualli	Arajuno
<i>Forbestra equicola equicoloides</i> GODMAN & SALVIN, 1898		+
<i>Mechanitis polymnia doryssides</i> STAUDINGER, 1884	+	+
<i>Mechanitis lysimnia elisa</i> GUERIN-MENEVILLE, 1844	+	+
<i>Mechanitis mazaeus</i> HEWITSON, 1860	+	+
<i>Mechanitis messenoides deceptor</i> BUTLER, 1873		+
Dircennini		
<i>Callithomia alexirrhoe butes</i> GODMAN & SALVIN, 1898	+	+
<i>Callithomia lenea zelia</i> GUERIN, 1844	+	+
<i>Dircenna loreta</i> HAENSCH, 1903	+	+
<i>Dircenna jemina varina</i> HEWITSON, 1869	+	
<i>Ceratinia tutia poecila</i> BATES, 1862	+	+
<i>Pteronymia vestilla sparsa</i> HAENSCH, 1903		+
<i>Ceratiscada hymen</i> HAENSCH, 1905		+
Ithomiini		
<i>Ithomia agnoscia</i> HEWITSON, 1854	+	+
<i>Ithomia salapia</i> HEWITSON, 1853		+
<i>Ithomia amarilla</i> HAENSCH, 1903		+
Napeogeninini		
<i>Napeogenes aethra</i> HEWITSON, 1869		+
<i>Napeogenes stella</i> HEWITSON, 1854	+	+
<i>Napeogenes achaea</i> HEWITSON, 1869		+
<i>Napeogenes duessa</i> HEWITSON, 1859	+	
<i>Napeogenes cranto</i> FELDER & FELDER, [1867]		+
<i>Napeogenes sylphis caucayaensis</i> FOX & REAL, 1971		+
<i>Napeogenes inachia avila</i> HAENSCH, 1903	+	+
<i>Napeogenes pheranthes crocodes</i> BATES, 1862		+
<i>Hyalyris coeno norellana</i> HAENSCH, 1903	+	+
<i>Hypothyris fluonia berna</i> HAENSCH, 1903		+
<i>Hypothyris semifulva saturata</i> HAENSCH, 1903	+	+
<i>Hypothyris euclae intermedia</i> BUTLER, 1873	+	+
<i>Hypothyris moebiusi</i> HAENSCH, 1903	+	+
<i>Hypothyris mamerucus mamerucus</i> HEWITSON, 1869	+	+
<i>Hypothyris anastasia bicolora</i> HAENSCH, 1903		+
Oleriini		
<i>Hyposcada anchiala ecuadorina</i> BRYK, 1953	+	+
<i>Hyposcada illinissa ida</i> HAENSCH, 1903	+	+
<i>Hyposcada kena</i> HEWITSON, 1872		+
<i>Oleria agarista</i> FELDER & FELDER, 1862		+
<i>Oleria assimilis</i> HAENSCH, 1903		+
<i>Oleria sexmaculata</i> HAENSCH, 1903		+
<i>Oleria lerda</i> HAENSCH, 1909		+
<i>Oleria gunilla iota</i> HEWITSON, 1872		+
<i>Oleria tigilla WEYMER,</i> 1899	+	

	Misahualli	Arajuno
Godyridini		
<i>Godyris zavaleta matronalis</i> WEYMER, 1883	+	+
<i>Dygoris dircenna pastazana</i> FOX, 1945	+	+
<i>Hypoleria lavinia chrysodonia</i> BATES, 1862	+	+
" <i>Hypoleria</i> " <i>orolina</i> HEWITSON, 1861		+
" <i>Hypoleria</i> " <i>seba oculata</i> HAENSCH, 1903		+
<i>Hypoleria sarepta aureliana</i> BATES, 1862	+	+
<i>Hypoleria virginia famina</i> HAENSCH, 1905	+	+
<i>Mcclungia cymo subtilis</i> HAENSCH, 1903	+	+
<i>Heterosais nephele nephele</i> BATES, 1862		+
<i>Pseudoscada florula egla</i> HEWITSON, 1872	+	+
<i>Pseudoscada timna</i> HEWITSON, 1854	+	+

Appendix 2

Systematic list of Saturniidae collected in the Misahualli area

Relative abundance: C = Common (20 to 30 specimens); O = Occasional (10 to 19 specimens); U = Uncommon (5 to 9 specimens); R = Rare (1 to 4 specimens); ? = Species reported by LEMAIRE & VENEDICTOFF (1989). Phenology: numbers refer to months.

	relative abundance	phenology
<i>Arsenura armida</i> (CRAMER, 1779)	C	4-6-7-10
<i>Arsenura mossi</i> JORDAN, 1922	R	7-8
<i>Arsenura ciocolatina</i> DRAUDT, 1930	O	4-7-8-10
<i>Arsenura albopicta</i> JORDAN, 1922	U	4-8-10
<i>Arsenura rebeli</i> GSCHwandner, 1920	C	4-5-7-8-10
<i>Arsenura batesii batesii</i> (FELDER & ROGENHOFER, 1874)	R	7-8
<i>Dysdaemonia boreas</i> (CRAMER, 1775)	U	4-7-10
<i>Titaea tamerlan amazonensis</i> LEMAIRE, 1980	U	7-8
<i>Titaea lemoulti</i> (SCHAUS, 1905)	R	7-8
<i>Titaea timur</i> (FASSL, 1915)	R	7
<i>Rhescyntis hippodamia hippodamia</i> (CRAMER, 1777)	O	7-8-10
<i>Paradaemonia platydesmia</i> (ROTHSCHILD, 1907)	U	4-6-7-10
<i>Eacles imperialis cacicus</i> (BOISDUVAL, 1868)	C	4-7-8-10
<i>Eacles penelope</i> (CRAMER, 1775)	C	4-7-8
<i>Eacles masoni fulvaster</i> ROTHSCILD, 1907	O	4-7-8
<i>Eacles ormondei peruviana</i> BOUVIER, 1927	U	4
<i>Citheronia hamifera hamifera</i> ROTHSCILD, 1907	O	4-7-8
<i>Citheronia aroa</i> SCHAUS, 1896	U	4-10
<i>Citheronia phoronea</i> (CRAMER, 1779)	R	10
<i>Othorene hodeva</i> (DRUCE, 1904)	R	12

	relative abundance	phenology
<i>Cicia pelota</i> (SCHAUS, 1905)	?	?
<i>Syssphinx molina</i> (CRAMER, 1780)	C	4-7-8-10
<i>Syssphinx amena</i> (TRAVASSOS, 1941)	R	4-10
<i>Adeloneivaia subangulata subangulata</i> (HERRICH-SCHÄFFER, [1855])	U	4
<i>Adeloneivaia acuta</i> (SCHAUS, 1896)	O	4-10
<i>Adeloneivaia catoxantha catoxantha</i> (ROTHSCHILD, 1907)	R	4
<i>Adeloneivaia pelias</i> (ROTHSCHILD, 1907)	O	4-10
<i>Adeloneivaia jason jason</i> (BOISDUVAL, 1872)	O	4-7
<i>Adelowlakeria plateada</i> (SCHAUS, 1905)	?	?
<i>Citioica anthonilis</i> (HERRICH-SCHÄFFER, [1854])	U	4-10
<i>Ptiloscola photophila</i> (ROTHSCHILD, 1907)	O	4-10
<i>Lonomia descimoni descimoni</i> (LEMAIRE, 1972)	C	4
<i>Lonomia achelous achelous</i> (CRAMER, 1777)	O	4-8
<i>Catacantha stramentalis</i> (DRAUDT, 1929)	U	4-12
<i>Automeris janus</i> (CRAMER, 1775)	U	4-6-8-10
<i>Automeris egeus</i> (CRAMER, 1775)	R	4
<i>Automeris larra</i> (WALKER, 1855)	R	7
<i>Automeris hamata</i> SCHAUS, 1906	C	4-8-10
<i>Automeris duchartrei</i> BOUVIER, 1936	O	7-8
<i>Automeris jucunda</i> (CRAMER, 1779)	R	8
<i>Automeris cinctistriga</i> (FELDER & ROGENHOFER, 1874)	R	7
<i>Automeris midea</i> (MAASSEN, 1885)	R	7
<i>Automeris liberia</i> (CRAMER, 1780)	C	7-8-10
<i>Automeris abdominalis</i> (FELDER & ROGENHOFER, 1874)	?	?
<i>Automeris curvilinea</i> SCHAUS, 1906	R	8
<i>Automeris denticulata</i> CONTE, 1906	R	8
<i>Automeris annulata annulata</i> SCHAUS, 1906	?	?
<i>Automeris styx</i> LEMAIRE, 1982	R	4
<i>Automeris schwartzii</i> LEMAIRE, 1967	R	4
<i>Automeris heppneri</i> LEMAIRE, 1982	R	8
<i>Leucanella apollinairei</i> (DOGNIN, 1923)	R	7
<i>Leucanella maasseni</i> (MÖSCHLER, 1872)	R	7
<i>Pseudautomeris irene armirene</i> (STRAND, 1920)	U	10
<i>Pseudautomeris lata</i> (CONTE, 1906)	?	?
<i>Gamelia abasia</i> (STOLL, 1781)	U	8-10
<i>Gamelia rindgei</i> LEMAIRE, 1967	R	7
<i>Hyperchiria nausica</i> (CRAMER, 1779)	O	4-8
<i>Automerina cypria</i> (GMELIN, 1790)	U	4
<i>Automerula auletes</i> (HERRICH-SCHÄFFER, [1854])	O	4-8
<i>Hylesia nanus</i> (WALKER, 1855)	R	4
<i>Hylesia coex rex</i> DYAR, 1913	R	8
<i>Hylesia canitia</i> (CRAMER, 1780)	O	4-8-10
<i>Hylesia olivenca</i> SCHAUS, 1927	?	?

	relative abundance	phenology
<i>Hylesia pauper</i> DYAR, 1913	U	4-8-10-12
<i>Hylesia murex</i> DYAR, 1913	R	4-12
<i>Hylesia umbrata</i> SCHAUS, 1911	O	4-8-10
<i>Hylesia tapareba</i> DYAR, 1913	?	?
<i>Hylesia subfasciata</i> DOGNIN, 1916	R	4-8-10
<i>Hylesia indurata</i> DYAR, 1910	R	10
<i>Hylesia praeda</i> DOGNIN, 1901	R	4
<i>Hylesia index</i> DYAR, 1913	R	10
<i>Hylesia melanostigma</i> (HERRICH-SCHÄFFER, [1855])	O	4-7-8
<i>Hylesia gyrex</i> DYAR, 1913	R	4
<i>Molippa nibasa</i> MAASEN, 1885	U	4
<i>Molippa latemedia</i> (DRUCE, 1890)	R	4-12
<i>Paradirphia oblita oblita</i> (LEMAIRE, 1976)	O	10
<i>Cerodirphia speciosa</i> (CRAMER, 1777)	U	10
<i>Cerodirphia brunnea brunnea</i> (DRAUDT, 1929)	R	
<i>Dirphia aculea</i> VUILLOT, 1892	R	7
<i>Dirphia avia</i> (STOLL, 1780)	O	8
<i>Dirphia panamensis panamensis</i> (SCHAUS, 1921)	C	4-7-8-10-12
<i>Dirphia fraterna fraterna</i> (FELDER & ROGENHOFER, 1874)	C	4-8-10
<i>Dirphia thliptophana thliptophana</i> (FELDER & ROGENHOFER, 1874)	C	4-7-8-10
<i>Periphoba hircia</i> (CRAMER, 1775)	R	4-7-8
<i>Pseudodirphia agis agis</i> (CRAMER, 1775)	O	4-10
<i>Pseudodirphia eumedoides</i> (VUILLOT, 1892)	U	4-8
<i>Copaxa decrescens</i> WALKER, 1855	U	4-7-8
<i>Copaxa cineracea</i> RODHSCHILD, 1895	R	4
<i>Rothschildia erycina erycina</i> (SHAW, [1796])	O	4-8-10
<i>Rothschildia hesperus hesperus</i> (LINNAEUS, 1758)	C	4-7-10
<i>Rothschildia arethusa rhodina</i> JORDAN, 1911	R	4-8
<i>Rothschildia aurota aurota</i> (CRAMER, 1775)	O	4-8

Appendix 3

Systematic list of Sphingidae collected in the Misahualli area

Relative abundance: C = Common (20 to 30 specimens); O = Occasional (10 to 19 specimens); U = Uncommon (5 to 9 specimens); R = Rare (1 to 4 specimens). Phenology: numbers refer to months.

	relative abundance	phenology
1. <i>Cocytius duponchel</i> (POEY, 1832)	O	4-6-7-8-10
2. <i>Neococytius cluentius</i> (CRAMER, 1775)	U	4-8-12
3. <i>Manduca diffissa tropicalis</i> (ROTHSCHILD & JORDAN, 1903)	C	4-7-8-12
4. <i>Manduca hannibal hannibal</i> (CRAMER, 1779)	U	4-8-10

	relative abundance	phenology
5. <i>Manduca perplexa</i> (ROTHSCHILD & JORDAN, 1910)	R	4
6. <i>Manduca</i> spec. 1	R	4
7. <i>Manduca rustica rustica</i> (FABRICIUS, 1775)	U	7-10
8. <i>Manduca albiplaga</i> (WALKER, 1856)	O	7-8-10
9. <i>Manduca dalica dalica</i> (KIRBY, 1877)	R	4
10. <i>Manduca</i> spec. 2	R	7-8
11. <i>Manduca</i> spec. 3	R	7
12. <i>Protambulyx goeldii</i> ROTHSCILD & JORDAN, 1903	R	4
13. <i>Adhemarius gannascus</i> (STOLL, 1790)	C	8-10
14. <i>Adhemarius ypsilon</i> (ROTHSCILD & JORDAN, 1903)	R	8
15. <i>Adhemarius palmeri</i> (BOISDUVAL, [1875])	R	7-8
16. <i>Isognathus scyron</i> (CRAMER, 1780)	R	8
17. <i>Erinnyis alope</i> (DRURY, 1770)	C	7-8
18. <i>Erinnyis lassauxii</i> (BOISDUVAL, 1859)	R	8
19. <i>Pachylia ficus</i> (LINNAEUS, 1758)	C	4-8
20. <i>Pachylia darceta</i> DRUCE, 1881	C	4-6-7-8-10-11
21. <i>Pachylloides resumens</i> (WALKER, 1856)	C	4-8
22. <i>Oryba kadeni</i> (SCHAUFUSS, 1870)	R	7
23. <i>Oryba achemenides</i> (CRAMER, 1779)	R	4-10
24. <i>Hemeroplanes triptolemus</i> (CRAMER, 1779)	R	4
25. <i>Callionima pan</i> (CRAMER, 1779)	R	8
26. <i>Callionima denticulata</i> (SCHAUS, 1895)	R	8
27. <i>Enyo lugubris lugubris</i> (LINNAEUS, 1771)	U	4-7
28. <i>Enyo ocypete</i> (LINNAEUS, 1758)	R	4
29. <i>Enyo gorgon</i> (CRAMER, 1777)	R	4
30. <i>Enyo cavifer</i> (ROTHSCILD & JORDAN, 1903)	R	4
31. <i>Nyceryx nictitans saturata</i> ROTHSCILD & JORDAN, 1903	R	8
32. <i>Perigonia stulta</i> HERRICH-SCHÄFFER, [1854]	U	10
33. <i>Aellopos ceculus</i> (CRAMER, 1777)	R	12
34. <i>Eumorpha anchemola</i> (CRAMER, [1779])	O	4-7-8
35. <i>Eumorpha triangulum</i> ROTHSCILD & JORDAN, 1903	O	4-8-10
36. <i>Eumorpha satellitia licaon</i> (CRAMER, 1776)	R	8
37. <i>Eumorpha obliqua obliqua</i> (ROTHSCILD & JORDAN, 1903)	R	8
38. <i>Eumorpha vitis vitis</i> (LINNAEUS, 1758)	O	4-11
39. <i>Eumorpha capronnieri</i> (BOISDUVAL, [1875])	R	4-7
40. <i>Eumorpha lambruscae</i> (LINNAEUS, 1758)	R	12
41. <i>Xylophanes schausi serenus</i> ROTHSCILD & JORDAN, 1910	R	8
42. <i>Xylophanes fusimacula</i> FELDER, 1874	U	4-7-8-10
43. <i>Xylophanes undata</i> ROTHSCILD & JORDAN, 1903	U	4-7-8
44. <i>Xylophanes media</i> ROTHSCILD & JORDAN, 1903	U	4-10
45. <i>Xylophanes anubus</i> (CRAMER, 1777)	R	4
46. <i>Xylophanes cosmius</i> ROTHSCILD & JORDAN, 1906	R	4-6
47. <i>Xylophanes tersa</i> (LINNAEUS, 1771)	R	8

	relative abundance	phenology
48. <i>Xylophanes dolius</i> ROTSCHILD & JORDAN, 1906	R	7
49. <i>Xylophanes libya</i> (DRUCE, 1878)	O	4-7-8
50. <i>Xylophanes thyelia</i> (LINNAEUS, 1758)	O	4-7-10

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