PREDICTING THE OVERALL BUTTERFLY SPECIES RICHNESS IN A TROPICAL MONTANE RAIN FOREST IN THE COLOMBIAN CHOCÓ

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RESUMEN

El conocimiento faunistico que se posee actualmente del área biogeográfica del Chocó, asi como de la mayoria del neotrópico, es claramente insuficiente como para poder determinar, con un minimo de confianza, las áreas más ricas en número de especies animales y por tanto prioritarias a la hora de establecer programas de conservación. En este articulo se presenta el primer inventario de mariposas de la cabecera del valle Garrapatas, un área circunscrita en la región biogeográfica del Chocó. El inventario faunistico incluye citas de 375 [388] especies y 207 géneros incluidas dos de las especies de ninfálidos más raras de Colombia. El número total de especies de mariposas observadas en el área objeto de estudio se, comparó con una estimación del número total de mariposas que dicha área puede albergar. La estimación se obtuvo en base a dos métodos: curvas de acumulación de especies y el uso de Ithomiinae como grupo indicador. El método de curvas de acumulación predice un total de 403 especies para el área de estudio lo cual contrasta con una estimación de 386 especies si utilizamos Ithomiinae como grupo indicador del número total de especies de mariposas. Adicionalmente, se testó el poder predictivo de las diferentes familias y subfamilias de mariposas a la hora de estimar la riqueza total de especies de mariposas. El grupo indicador que presentó el indice de correlación más alto entre el valor estimado de riqueza especifica y el valor observado en campo fué de la familia Hesperiidae. Por último, se investigó la posibilidad de utilizar varias familias o subfamilias en combinación, en vez de un sólo grupo como Ithomiinae, a la hora de estimar el número total de mariposas. El valor de correlación más alto fué obtenido al usar las dos familias- Riodinidae/Lycaenidae en combinación.

ABSTRACT

In Chocó, as in most of the neotropics, faunistic knowledge is not yet sufficient to determine, with any degree of confidence, whlch areas harbour the highest number of species. This paper provides the first inventory of the bwtterfly species occurring in the upper Garrapatas valley, an arca of the Chocó biogeographical region which is particularly threatened by a number of impacts. The faunistic inventory includes records of 375 [388] species and 207 genera and two of Colombia's rarest nymphalid butterfly species. Two methods are used to predict the overall species richness of butterflies in the study area: species accumulation cuives and lthomiinae as indicators. The species accumulation curve method predicts a total of 403 species for the upper Garrapatas in contrast with an estimate of 386 by using lthomiines as indicators for total butterfly diversity. We also test how well different butterfly families and subfamilies predict the overall species richness for 27 Neotropical sites. The highest correlation coefficient for the estimated species richness and total measured species richness is achieved by the Hesperiidae. Lastly, the use of multiple predictor species is investigated through a pair-wise, analysis of butterfly family proportions. The highest correlation coefficient was obtained by the pair of indicators: Riodinidae/Lycaenidae. Aspects of butterfly conservation in the region are also discussed.

Key words: Predicting butterfly species richness- lthomiinae as indicator group; confidence intervals, species accumulation curves; conservation of Colombian Chocó.

INTRODUCTION

Colombia is considered one of the 12 most biodiverse countries in the world. Together these "megadiversity countries" (MITTERMEIER & WERNER, 1990) hold up to 70% of the world's species diversity in vertebrales, higher plants and swallowtail butterflies (MCNEELY *et al.*, 1990).

The Chocó biogeographic region (GENTRY, 1982) is considered to barbour some of the richest, most important, yet least studied ecosystems in Colombia (FASSL, 1909; HERING & HOPP,1925; LELLINGER, 1975; GENTRY, 1986, 1993; FORERO & GENTRY, 1989; McNEELY *et al.*, 1990; RANGEL & AGUILAR, 1995; GALEANO *et al.*, 1998). Much of the Colombian Chocó is still covered by rain forest. However, approximately 20% has been altered by a plethora of development-related pressures such as colonization, deforestation and cattle-ranching (ORTIZ, 1988). In some areas, such as Urabá (Riosucio, Acandi and Unguia), the scale and rate of environmental change brought about by both logging activities and cattle ranching have increased to the point where immediate action needs to be taken to protect its biodiversity (JIMENO *et al.*,1995).

Given the current impending loss of biodiversity due to deforestation, the pressing problems is how to conserve as much and as soon possible of this enormous variety of life. To attain this conservation goal, an urgent strategy needs to be set for identifying in situ networks of reserves to maximise biological diversity.

Faunistic lists remain an important tool to help conservation biologists to identify geographical spread and location of unique biodiverse areas with the highest conservation priority (LAMAS & GRADOS, 1997; LAMAS *et al.*,1996; LOPEZ-VAAMONDE & CÁRDENAS, 2001; CONSTANTINO *et al.*, 1993; PARRA *et al.*,2000) . Regrettably, there is neither the time nor the resources to carry out detailed inventorIes of all animals at alL places, upon whlch to decide what priority areas must be selected. Site selection will therefore depend on developing a cost-effective method of predicting overall diversity without a complete inventory being taken.

Indicator groups can provide insight into biodiversity patterns seeking positive correlation between the species richness of the chosen group and the richness of other groups for which information is not available (BECCALONI & GASTON, 1995; CARROLL & PEARSON, 1998).

Birds, butterflies and mammals have been selected as the three most practicar and accurate choices for indicator taxa worldwide (but see RICKETTS *et al.*, 1999). Indeed, surveys of butterflies have commonly been used as indicators of environmental factors, site history and considered an accurate method to identify "hotspots" of endemicity in the Neotropics (RAGUSO & LLORENTE, 1991; LAMAS el al., 1996; AUSTIN *et al.*, 1996). However, butterflies have only recently been used as indicators of total species richness. BECCALONI & GASTON (1995) first reported the potential of the Ithomiinae as an indicator of overall butterfly richness. They found that some some groups presented relatively invariant relationships with overall butterfly species richness. These ratios were approximately constant among the different butterfly families and subfamilies compared. Their main conclusion was that the average proportion of Ithomiines found through the analysis of 21 areas (4.6%) could be used to predict the total butterfly richness of an area of mainland Neotropical rainforest for which the Ithomiinae total is known.

In the present study, we provide the first inventory of the butterfly species occurring in the upper Garrapatas valley, an area which belongs to the Chocó biogeographical region and is particularly threatened by a number of factors.

In this paper, we analyse our data for the upper Garrapatas valley and 26 other Neotropical sites to test the stability of the proportions found by BECCALONI & GASTON (1995). We also examine how well Ithomiines predict the overall species richness for our studied area and how to set confidence limits for the predicted overall species richness. Furthermore, the use of multiple predictor species is investigated through an exhaustive, pair-wise analysis of butterfly family proportions. We also compare the Garrapatas' census data sets with samples from two other Andean areas on the West slope of the Occidental Colombian Massif, San José del Palmar and Santa Cecilia to gain a wider picture of changes in faunistic composition. Some aspects of butterfly conservation in the region are discussed.

METHODS

Study area

Collecting sites are located in the department of Valle del Cauca on the Western slope of the Occidental Colombian Massif (Fig. l) but contain mostly elements of the Chocó zoogeographical region (LOCARNO & HENAO, 1996, CALVO & CÁRDENAS, 1998). The Garrapatas river (Fig. 2) is a swift narrow channelled river, rising in the "Cerro de los Galápagos" (Paraguas Mountains). It belongs to the Rio San Juan watershed and is 75 km. long. It carries substancial loads of Andean sediments. The landscape in the study area has a mean elevation of 700 m with steep relief. The dominant vegetation is secondary upland forests and narrow stretches of tall primary "lower mountane tropical moist forest" (HOLDRIDGE, 1967; FORERO, 1982). According to Thornthwaite's climate model this region has a moderately humid to superhumid climate with low water deficits. Average annual rainfall is around 4500 mm and the average temperatura 25oC. The choice of collecting points was made by taking into account the different forest communities and their state of conservation, seeking to include the largest possible number of biotopes. We finally selected four collecting sites: Rio Lindo, 600 m alt.(Fig. 3); Zabaletas, 750 m. alt.(Fig. 4); Playa Rica (quebrada Guadalejo), 550 m.a.s.I.(Fig. 5); Rio Dovio (Birmania, canyon), 700 m.a.s.l (Fig. 6). The two former sites have the transect route located largely along the edges of secondary rain forest with abandoned clearings. The third is situated within a fairly well preserved patch of mixed primary and secondary moist forest. A route through the forest was selected to include some of the better butterfly areas with moderately shaded rides. The fourth locality was a riverine forest located within a steep-sided canyon. The area surveyed covers a total of about 400 Ha.

Collecting Data

Six expeditions were organized to the region, three in 1996: one in early April (from the 1st to the 11th), a second in May (from the 15th to the 19th), a third in September (from the 10th to the 14th), a fourth in 3-8 March 1997., with the authors, Y.A.Calvo, E.R.Henao, and additional support of L.M.Constantino and L.C.Pardo, and another two trips in October (from 5 th to the 9 th 1998) and March of 1999 by J.A.Salazar and J.I.Vargas. Daily censuses were made, but some days were lost because of bad weather. The recording therefore comprised 19 days, during a one-year period.

Butterfly sampling was carried out by four recorders from 10:00 to 15.-00, these being the hours of maximum flight activity, although not for all species (95 hours per person, 380 hours in total). Each sample consistes of 5m* 1 km transects in which all butterfly species seen within the bounds of the transect were recorded. Special effort was made to spot any specimen which may have settled out of direct sight in dense vegetation. No attempt was made to measure changes in abundance over time. We only monitored the number of species along the transect.

Recording was carried out actively, by netting, catch-and-releasing and also passively by baited Van Someren-Rydon traps (RYDON, 1964). Adult butterflies were readily attracted by traps baited with fermented banana, set up along the rain forest margin, or in clearings inside the woodland.

Morphological species identification was made by using the reference collection housed at the Natural History Museum, Caldas University in Manizales, where most specimens were depositad, and the collection and library of the Natural History Museum, London.

Data analysis

Statistical analysis was performed using SYSTAT 6.0 for Windows (WILKINSON, 1996). The data were analysed in order to investigase the ability of single family/ subfamilies in the first instance, and combinations of two family/subfamilies in the second, to act as indicators of overall species richness. To this end, the proportion each butterfly family contributed to the total number of species at each site was calculated, The average of these was then taken and the value calculated used as a general indicator of total species richness in Neotropical areas. Thus, 4.7% is the average proportion the Ithominae contribute to the total number of butterfly species in the areas sampled (Tabla 3). These values were then used to calculate an estimate of total species richness at each site in the data set. This is calculated by multiplying the total number of each species in a family by 100/4.7 (in the case of the Ithominae). These estimated values were then compared to the actual total species richness figures recorded and the correlation between the two sets of figures calculated (Table 2). In the case of twin indicators, both the average proportion of of the total richness contributed by the two species and the results were calculated in a manner similar to before. There were two possible ways in wich the estimated total for the twin indicator species could have been calculated.

The first, that the average of the two estimates of total species richness based on the single indicators was taken. This was not favoured as the average of all the individual estimates of species richness would not necessarily approach the true value even if many more than two families were used. One would hope that a method that reduces the effort involved in calculating some value would be scaleable such that if resources were available for the total enumeration of that value, the extension of the method used would provide the true value.

The second method (the one that was chosen) involved the calculation of the total species richness from the summed proportion of the two indicator species (Table 3). The use of this method was justified as it was considered to be a more scaleable method. Consider the extended case of recording all but one of the families of butterflies at a Neotropical site. The two approaches would be as follows. The first approach would derive estimates of the total number of species from each individual indicator's precalculated proportions from a test data set, such as the one included in this paper. These separate estimations (calculated identically as in the single indicator case) would then be averaged and that value given as the total. The second approach would be to calculate the sum of all the species counted and consider this as a single proportion of the total for the test data set. The sum of the average proportions of each family in the test data set would then be used. with the value of the total of all but one of the butterfly familles to calculase an estimate of the total. It is assumed that the second method is more likely to give a closer estimate of the true number of species than the first.

The means by wich multiple indicators are included in estimations of total species richness are varied. Two approaches have been outlined here but others are possible. Estimations based on the geometric mean rather than the arithmetic mean could be tried for example. This is an area that could benefit from further study and analysis. . .

RESULTS

Faunistic composition

The total number of species found in the study area is shown in Appendix 1. The presently known butterfly fauna of the upper Garrapatas valley includes 388 species distributed as follows (Table 1): Hesperiidae (16.3%), Papilionidae (4.7%), Pieridae (4.3%), Lycaenidae (9.1%), Riodinidae (14.7%), Libytheinae (0.3%), Nymphalinae (17%), Satyrinae (6.4%), Brassolinae (2.9%), Morphinae (1.9%), Heliconiinae (5.3%), Acraeinae (1.1%), Danainae (0.8%),Ithomiinace (4.7%). Comparing these proportions with those of other neotropical sites, heliconiines are greatly overrepresented whereas hesperids are underrepresented (Table l).

The Chocó biogeographical region of Westem Colombia has long been regarded as highly endemic (GENTRY, 1986). Using our inventory as the basis for critical fauna evaluation and examining endemism in Garrapatas butterfly communities, we found that of the 375 species recorded from the studied area, 55 species and subspecies (14.7%) are endemic to the Chocó region. The remaining 320 also have a distribution elsewhere but 20 are almost entirely restricted to the Occidental Colombian Massif.

Two of Colombia's rarest nymphalid butterfly species (*Prepona werneri*, and *Annagrapha elina*) were recorded for the area. Almost nothing is known about their ecological requirements, partly because of their rarity. *P. werneri* is only known from 11 specimens deposited in museum collections around the world, and a handful of small sites in West and Eastern Colombia (JOHNSON & DESCIMON, 1988, SALAZAR, 1993). We compared our census data of the upper Garrapatas pluvial forests with those of two other mountainous Chocó area forests, San José del Palmar and Santa Cecilia. The Garrapatas Valley faunistic composition is remarkably similar, at the species level, with the assemblage found in Santa Cecilia (Table 4). 296 species (78.9%) present in Garrapatas are shared with Santa Cecilia while San José shares 129 (34.4%) with Garrapatas.

Habitat association

Table 5 shows the number of butterfly species recorded in each of the six principal habitats in the study area.

The highest number of butterfly species (37.3%) was found in fallow fields and second growth forest. In the 1970s the witches' broom disease (*Crinipellis perniciosa*) heavily attacked cocoa plantations forcing many settlers to leave the Garrapatas valley. The forest as now reclaimed most of the cleared land and developed a rough grassland and low growing scrub dominated by *Lantana camara*. In contrast to the forest rare butterflies,such land seems to provide adequate habitats to the commoner and widespread flower-feeding hesperids, one of the most speciose group at the family level in the region with more than 40% of total species. Indeed, 34% of hesperid species were recorded in those transect routes including sections through floristically rich open areas of agricultural land that were taken out of cultivation.

The second most productive habitat, in terms of numbers of butterfly species, was edge habitats with 28 % of the total butterfly species recorded. rain forest margins are particularly rich in terms of butterfly species due to high exposure to sunshine (BROWN,1972) making forest edges a favourable to find nectar sources. At Rio Lindo and Zabaletas the transect route was located largely along the edges of the adjoining secondary rain forest with abandoned clearings. The edge- visiting species assemblage was dominated by *Parides sesotris tarquinius, Heraclides torquatus jeani,* and *Heliconius melpomene vulcanus.* (Fig. 4).

Primary rain forest was the next richest habitat with 24.7% of butterfly species recorded along the transect which ran mostly through heavily shaded primary upland forest. Overall, primary stands had abundant ground understorey vegetation in which few butterflies were seen, mostly shade-tolerant Satyrinae and lthomiinae. These understorey butterfly species tend to follow flight paths along densely shaded forest tracks flying inconspicuously near the ground and often concentrating in a belt of vegetation at the ride edges.

Hill summits and ridges are excellent places for observan aggregations of both males and receptive-females of some species. This tendency known as hill-topping is widely known and used to advantage by collectors particularly to catch rare females. At our third collecting point, Playa Rica (quebrada Guadalejo), a hill-top overlooking the Garrapatas liver, a route through the wood was selected to take into account areas which included hill-topping species. This habitat was strongly dorminated by Riodinidae, Nymphalinae and Charaxinae (Fig. 5). Interesting stenotopic riodinids were observed including *Argyrogrammana* and *Symmachia* species, all of which are rare and localizad.

The collecting period coincided with the blossom of Inga trees which offered rich nectaring, thereby attracting and concentrating many species of swallowtails. Indeed, more than half of the papilionid species were found visiting mostly *Inga* and *Lantana* (Fig. 5).

Species accumulation curves

Faunistic inventores show that as the collecting time spent in a given area increases, the number of new species recorded decreases asymptotically (CLENCH, 1979).

In figure 2a and b we plot number of species of ithomiine already collected against the subsequent rate of their collection (increase in number of species divided by increase in sampling effort) to predict the total number of butterfly species expected in the upper

Garrapatas valley. Given the highly unrealistic assumption that all Ithomiines are roughly equally easy to collect because of their similarity in size, conspicuousness, flight-patterns, a linear relationship (Table 2a) is expected between species number and collection rate rather than between number of species and log (rate of collection) (Table 2b), as would be the case if the ease of collection differed significantly from species to species. The goodness of fit in a linear plot ($r2=0.685$) is also better than that of the log plot ($r2=0.577$). If we extrapolate until the rate of collection reaches zero, using the line of best fit equation $y= -0.191x + 77.084$ the final predicted number of species present would be 403.

Predicting overall species richness. Ithomiines as indicators

a) Single indicators.

Table 1 shows the proportions of species in the families and subfamilies recorded from each locality including our study area. The inclusion of updated figures and additional data to Beccaloni and Gaston's data set sllghtly changed the average proportion of Ithomiinae from 4.6% to 4.7%. 95% of sites had an ithomiine percentage which ranged between 4. 1 % and 5.3% with a mean of 4.7%. Therefore, the upper Garrapatas valley with 18 species of Ithomiines will have an estimated butterfly species richness of 386.

The correlation between the estimated and the actual total species richness for all the localities studied should give us an idea of how good an indicator is a particular group. The group with the highest correlation coefficient would represent the most accurate estimate of richness. Table 4 shows the different groups of butterflies ranked according to their correlation coefficients across all sites with Hesperiidae, Riodinidae and Lycaenidae at the top of the list.

Table 1 shows the prediction of the total butterfly species richness of the study area based on the average proportions for each butterfly group. It is interesting to note that some groups (Libytheidae, Morphinae, Heliconiinae) greatly overestimate and some others (Hesperiidae) understimate the observed value (375 species for the Garrapatas valley). They would therefore be considered as poor indicators. On the other hand, using Ithomiines as surrogates for total butterfly diversity give us a predicted value of total species richness of 388, very close to the observed 375 species.

b) Twin indicators.

Using Ithomiinae as a single indicator seems to be a quite accurate method of predicting total butterfly species richness in neotropical rainforest (as long as you don't work in drier places). However, It would be interesting to see how the estimate increases in

Riodinidae shows the highest correlation coefficient for the estimated species richness and total measured species richness.

Which two indicators give a better combined estimate than one individual one? For the case of Ithomiinae, only two out of the 13 possible pairwise comparisons (Heliconiinae and Danainae) gave a poorer value Table 6 than using lthomiinae as a single indicator. Among the rest, the pairing of lthomiinae and Lycaenidae gave the highest correlation coefficient.

DISCUSSION

On predicting overall species richness

According to our results Hesperiidae, Riodinidae and Lycaenidae show the highest correlation between the estimated and the observed total species richness for all the localities. However, BECCALONI & GASTON (1995) showed that the proportions of Lycenidae and Riodinidae increase with total species richness. Only groups that show an invariant relationship between their proportions and overall species richness, such as Hesperids or Ithomiines, are considered reliable indicators.

Hesperids seem to be the most informative and accurate indicator taxon. However, they are, taxonomically poorly understood and not easily sampled. Indeed, when considering strategies for estimating overall species richness from indicator species, the practical aspects must be borne in mind before any conclusions are made regarding the use of the most accurate indicators (RICKETTS *et al.*, 1999).

If we look at our estimated species richness for the upper Garrapatas valley using Ithomiinae as indicator we see a value of 388 butterfly species wich compared with the observed (375 species) and extrapolated (403 species) values, seems to be a reasonable estimate for that area. The performance of Ithomiinae throughout the whole data set is quite good with a correlation coefficient among the highest (0,927).

Ithomiines seem to be an accurate indicator group, but are they reliable? If we are currently at that stage of sampling where the rate of discovery of new Ithomiines has decreased to below average because almost ail have been found, then we would expect the proportion to fluctuate less between sites than in other taxa. To Illustrate this with an extreme example, suppose that after X days of collection, all Ithomiine species are expected to have been recorded several times, whereas in other taxa, roughly half the species are expected to be still unrecorded. With a certain amount of variance between sites attached to these figures, we would expect:

(a) the Ithomiines to almost always have been completely inventoried

(b) the proportions contribuyed by other taxa to vary with normal distribution within a certain range.

(c) the total number of species recorded from each site to be roughly equivalent Without any other confounding effects, these three factors alone will lead to the Ithomiines representing a more consistent percentage of overall species richness than other taxa.

Indeed, based on a dual requirement of accuracy and practicality It seems reasonable to accept Ithomiines as the most practicar choice for predicting overall butterfly diversity in Neotropical areas. However, the use of Ithomiines as proxy for overall butterfly biodiversity patterns is limited to forested, mainland areas!. In islands the roportions seasonal forested and non-forested sites should be gathered to see how invariant the relationship between proportions and overall species richness is. RACHELI & RACHELI (1998) suggest the combined use of Papilionidae, Pieridae and Nymphalidae as better indicator taxa for non-forested sites.

In the investigation of two indicator groups a large overall increase in the accuracy of the estimations is not generally found. This may be a somewhat surprising result because one would expect to obtain a better idea of the total number when measuring a greater proportion of the total. As we have little idea as to what controls these proportions there is actually no way to identify whether or not this approach is a valid one. What can be said is that the approach does seem to work quite well and in most cases the addition of more indicators should lead to an increase in the accuracy of the result. Whether or not this increase is deemed to be worth the extra effort in collecting is down to individual collectors.

From our investigation, the accuracy of an indicator was determined by the correlation 11 between the estimate of total richness and the true value. A better approach might be to investigase how often a more accurate result is obtained. In our case, a high correlation between estimated and true values may be accidental. The distribution of these accurate results might indicate how much better a double (or, more generally, a multiple) indicator approach is than a single indicator. This may be an approach worth investigating further. The accuracy of the estimation of unknown species richness values depends upon the is still a long way to go before we understand the mechanisms that determine the number of species in an area and generate invariant ratios among different higher taxa.

The use of species accumulation curves and the use of indicator groups both seem to be accurate methods of predicting total species richness. Given the current limit of time and resources, studies on the utility of different groups of organisms as indicators of oveúall species richness should be given priority.

As regards habitat association, setting aside elear stenotopic species which live in distinctive biotopes, butterflies are highly dispersive organisms making any comparativa biocenological study difficult. However, our preliminary results show that distributions of adult hesperids could be used as good bioindicators of local anthropogenic disturbance and changes in plant community structure.

On values and conservation

There are very few areas in the Chocó for which butterfly faunistic composition is even relatively well known (PRIETO *et al.*, 1997). We still have much to leam about Chocoan butterfly communities, levels of endemism and threat. Many species and subspecies remain to be named and much work on chorology, bionomy and autecology is still to be . done. Our explorations have barely begun. As a result it is very hard to select which parts of the Chocó to protect in order to include the greatest species richness.

On the basis of species richness data found in the Upper Garrapatas along with the sighting of rare indicator butterfly species such as *Prepona werneri* and *Annagrapha elina*, it seems clear that the Garrapatas valley could be categorized as an area with excepcional biological importance, that stlll houses a remarkable biological richness. However, human impact on the Garrapatas river may have irreversible long-term effects on the biology of its neotropical forest ecosystems if protection measures are not taken shortly.

Considerable colonization, overlogging and subsequent fragmentation of the landscape is currently taking place in the study area. Naturally rare and sought after for exportation, highly valued hardwood species such as Cedars (*Cedrela angustifolia* Sessé and Mocino, Meliaceae, and *Juglans neotropica* Diels., Juglandaceae) have been rapidly overlogged. Agriculture is presently restricted to small plantations of lulo (*Solanum quitoense*, Solanaceac), coffee (*Coffea caneophora*, Rubiaceae) and cocoa (*Theobroma cacao*, Sterculiaceae). Plans for the damming of the river for the production of hydroelectric power could lead to the destruction of large traets of lowland. The main constraint to agricultural expansion is the completion of a road which will link Rio Dovio to the villages downriver. The road, currently stopped because of lack of funds, will bring more settlers, cattle ranching, speculators, and large-scale agricultural projects to the region.

Given the searcity of faunistie data for most insect orders in Chocó and the impending loss of species as a result of human environmental disruption, gathering basic information on species richness must be a constant effort. The maintenance of Chocó butterfly diversity will require protection of representativa areas with differences in physiognomy of plant communities and microclimatic conditions found in cach part of the Chocó . A region. Chocoan tropical rain forest has been neglected in planning of native reserves and its plight only recently acknowledged. The faunistic and ecological data contained in this paper is rare for the Chocó region and represents an important source of information that should guide conservation decisions. Further additions will be made to the preliminary place and inevitably alter river systems and their biota, is the continuation of scientific investigations on butterfly faunistic composition downriver in the lowland arcas, where anthropogenic landscape disturbance is less intense. Further studies assessing the biodiversity of the Garrapatas valley should be extended to other well-known indicator insect orders.

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BIBLIOGRAPHY

AUSTIN, G. T., HADDAD, N. M., MENDEZ, C., SISK, T. D., MURPHY, D. D., LAUNER, A. E. & EHRLICH, P. R.,1996.- Annotated checkllst of the butterflies of the Tikal National park area of Guatemala. *Trop. Lepid.*, 7: 21-37.

BECCALONI, G.W. & GASTON, K.J., 1995. Predicting the species richness of Neotropical forest butterflies: Ithomiinae (Lepidoptera: Nymphalidae) as indicators. *Biological Conserv.*, 71: 77-86.

BROWN, Jr., K.S.,1972.- Maximizing daily butterfly counts. *J Lepid. Soc.* 26- 183-196.

_______., 1977, Centros de evolucao, refugios quaternarios e conservacao de patrimonios geneticos na regiao neotropical: padroes de diferenciacao em lthomiinae (Lepidoptera: Nymphalidae). *Acta Amazonica* 7: 75-137.

_______., 1997. Diversity, disturbarince and sustainable use of Neotropical forests: insects as indicators for conservation monitoring. J Insect Conserv., l: 25-42.

CALVO, Y.A. & CARDENAS, E.A. 1998.- Lista preliminar y algunas observaciones sobre la avifauna del alto rio Garrapatas (Valle -Chocó). *Bol. Mus. Hist. Nat. U. de Caldas* 2: 29-35

CARROLL, S. S. & PEARSON, D. L.,1998.- Spatial modelling of butterfly species richness using tiger beetles (Cicindelidae) as a bioindicator taxon. *Ecological Appl,* 8:531-43.

CLENCH, H. 1 979.- How to make regional lists of butterflies: some thoughts. *J Lepid.* Soc. 33: 215-231.

FASSL, A.H., 1909.- Eine Sammeltour nach Choco Gebiet in West-Columbien. Ent. Zeits.23.

FORERO, E. 1982.- La flora y vegetación del Chocó y sus relaciones fitogeograficas. *Colombia geogr.,* 10: 77-90.

FORERO, E. & GENTRY, A.H., 1989. - *Lista anotada de las plantas del departamento del Choco, Colombia.* Biblioteca José Jerónimo Triana, 10. Instituto de Ciencias Naturales. Museo de Historia Natural, Bogotá.

GALEANO, G., SUÁREZ, S. & BALSLEV, H., 1998.- Vascular plant species count in a wet forest in the Chocó area on the Pacific coast of Colombia. *Biodiv. Conserv.*, 7: 1563-75.

GENTRY, A.H. 1986.-Species richness and floristic composition of Chocó Region plant communities. *Caldasia* 15: 71- 91.

______., 1986. Riqueza de especies y composición floristica de las comunidades de plantas de la región del Chocó: una actualización. *In Colombia Pacifico.* Tomo 1 (P. Leyva, cd.) pp. 201-19. Bogotá: Fondo FEN-COLOMBIA.

HERING,R.M. & HOPP, W.E., 1925.- Eine sammelausbeute der Herrn Werner Hopaus dem Chocó Kolumbiens.- *Deutsch.Ent.Zitschr., "iris"* 39(4): 181-207.

HOLDRIDGE, L., 1967. -Ecologia basada en zonas de vida. Instituto Interamericano de ciencias agricolas. Costa Rica.

JIMENO, M., SOTOMAYOR, M.L. & VALDERRAMA, L. M.,1995.- Chocó. Diversidad cultural y medio ambiente. Fondo para la protección del Medio Ambiente José Celestino Mutis. Bogotá

JOHNSON, K & DESCIMON, H.,1988.- Systematie status and distribution of the little known Charaxine *Prepona werneri* Hering and Hopp., J *Lep. Soc.* 42, 269-275.

LAMAS, G. & GRADOS, J.,1996.- Mariposas de la Cordillera del Sira, Perú (Lepidoptera: Papilionoidea y Hesperioidea). *Rev. per. Ent.* 39: 55-61.

LAMAS, G., ROBBINS, R. K- & HARVEY, D. J., 1996. - Mariposas del alto rio Napo, Loreto, Perú (Lepidoptera: Papilionoidea y Hesperioidea). *Rev. per. Ent.* 39: 63-74.

LAMAS, G., 1 997. - Comparing the butterfly faunas of Pakitza and Tambopata, Madre de Dios, Perú or why is Perú such a mega-diverse country? In *Tropical biodiversity and systematics.* (H. Ulrich, ed.) Proceedings of the Biodiversity and systematies in tropical ecosystems, Zoologisches Forschungsinstitut Museum Alexander Koenig, Bonn.

LELLINGER, D. B.,1975.-A phytogeographic analysis of Chocó pteridophytes. *I,ern. Gaz.* 11, 105-14.

LOCARNO, L.C. & HENAO, E.R., 1996.- Noticia y prioridades investigativas de los escarabajos Col. Esc.) del ecotono selvático Rio Dovio, Chocó biogeográfico, Valle. Col. *Cespedesia*, 21 (68): 133-146.

McNEELY, J.A., MILLER, K.A., REID, W.V., MITTERMEIER, R.A. WERNER, T.B.,1990.- Conserving the World's Biological Diversity. Gland, Switzerland-. IUCN, WRI, CI, WWF-US and The World Bank.

MITTERMEIER, R.A. & WERNER, T.B.,1990.~ Wealth of plants and animals unities "megadiversity" countries. *Tropicus,* 4: 4-5.

ORTIZ, M. N., 1988.- Diagnóstico de los bosques naturales. Plan de acción Forestal para Colombia. Los bosques naturales y plantados en Colombia. Posibilidades comerciales de nuevas especies maderables, Departamento Nacional de Planeación, Bogotá.

PARRA, M.L.,VARGAS, J.I. & TABARES, M.,2000.- Mariposas de Manizales: 117 pp-Contr.Gen.Mun.lnst.p.Cienc.,Tizan,Manizales.

PRIETO, M.A.V. CONSTANTINO, L.M. & CHACON, U.P.,1997.-Mariposas (Lep. Rhopalocera) del Bajo Anchicayá-Rio Tatabro (Valle), contribución al conocimiento de su historia natural. In *Sociedad colombiana de Entomología XXIV Congreso. Resumenes. "Entomología, Biodiversidad y Desarrollo sostenible*" pp. 74-75. Pereira. Colombia.

RACHELI, T. & RACHELI, L.,1998.- Lepidoptera diversity of an Ecuadorian lowland rain forest (Lepidoptera: Papilionidae, Pieridae, Nymphalidae, Saturniidae, Sphingidae). In XI *European Congress of Lepidopterology,* pp. 95-117. Malle, Belgium.

RAGUSO, R. A. & LLORENTE, J.,1991.- The butterflies (Lepidoptera) of the Tuxtlas Mts., Veracruz, México, revisited-. species richness and habitat disturbance. *J. Res. Lepid.* 29, 105-33

RANGEL, J.O., & AGUILAR, M.,1995.- Areas de reserva y centros de concentracion de especies. In *Colombia, diversidad biotica* l. (J.O Rangel ed.), pp. 77-81. Colombia: Universidad Nacional de Colombia.

RICKETTS, T. H., DINERSTEIN, E., OLSON, D. M. & LOUCKS, C., 1999.- Who's where in North America? Patterns of species richness and the utility of indicator taxa for conservation, *Bioscience* 49: 369-381.

RYDON, A. H.B.,1964.- Notes on the use of butterfly traps in East Africa. *Jour. Lep. Soc.* 18: 51-58.

SALAZAR, J. A.,1993.- Una lista comentada de algunas especies de mariposas de distribucion restringida o locales en Colombia, *SHILAP, Revta. Lepid.* 21: 33-46.

SOKAL, R. R. & ROHLF, F. J.,1995.- Biometry. Freeman Press.

WILKINSON, L.,1996.- SYSTAT 6.0 for Windows-. statistics. SPSS Inc.

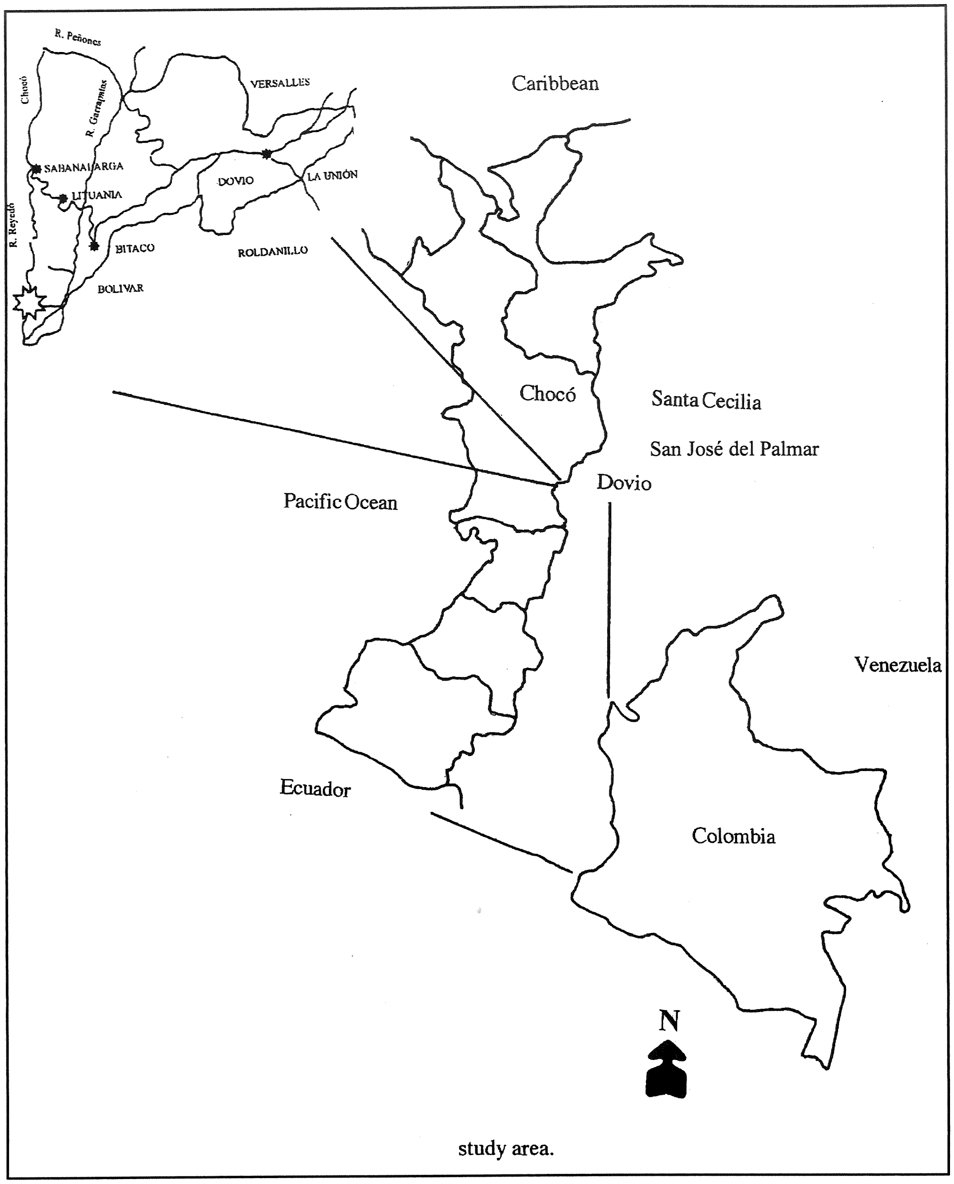

Figure 1. Map of the study area.

Figure 2. Garrapatas River, Valle (Foto J.A. Salazar).

Figure 3. Río Lindo, 600 mts. (Foto E. Henao).

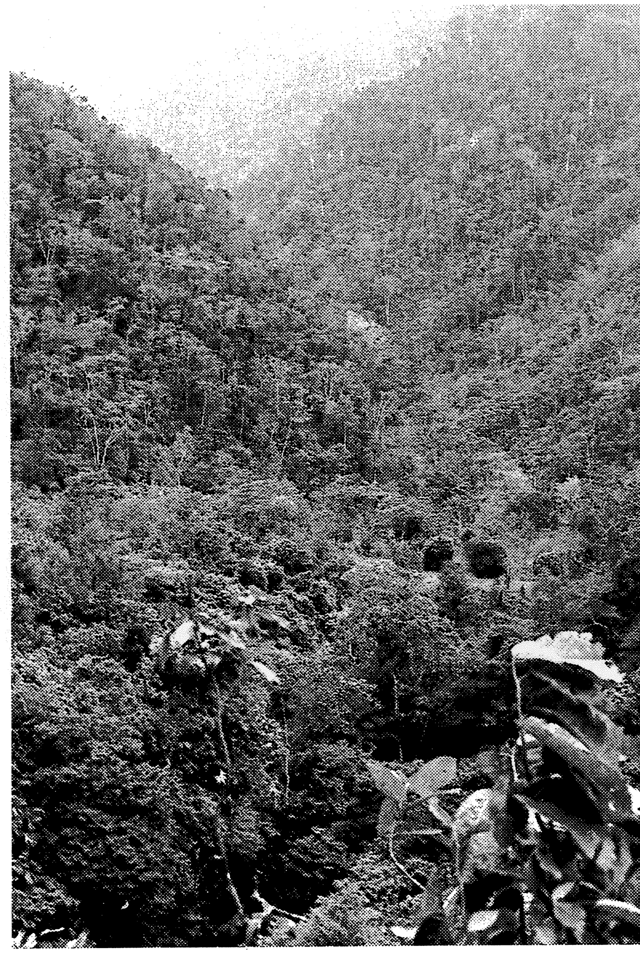

Figure 4. Río Lindo and Zabaletas. (foto C. López)

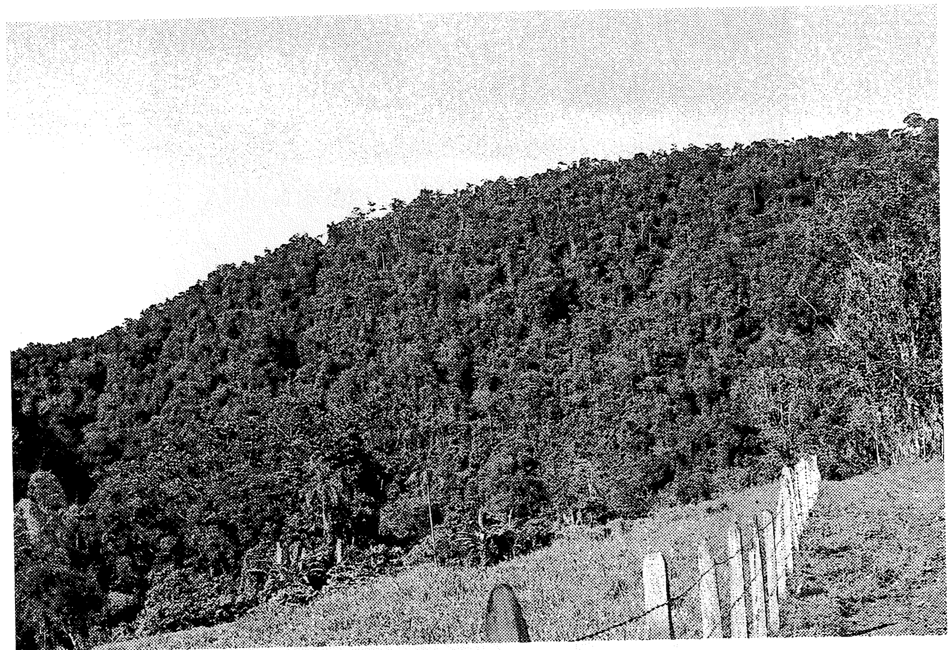

Figure 5. Playa Rica. Q. Guadualejo, 500 mts. (Foto J.A. Salazar).

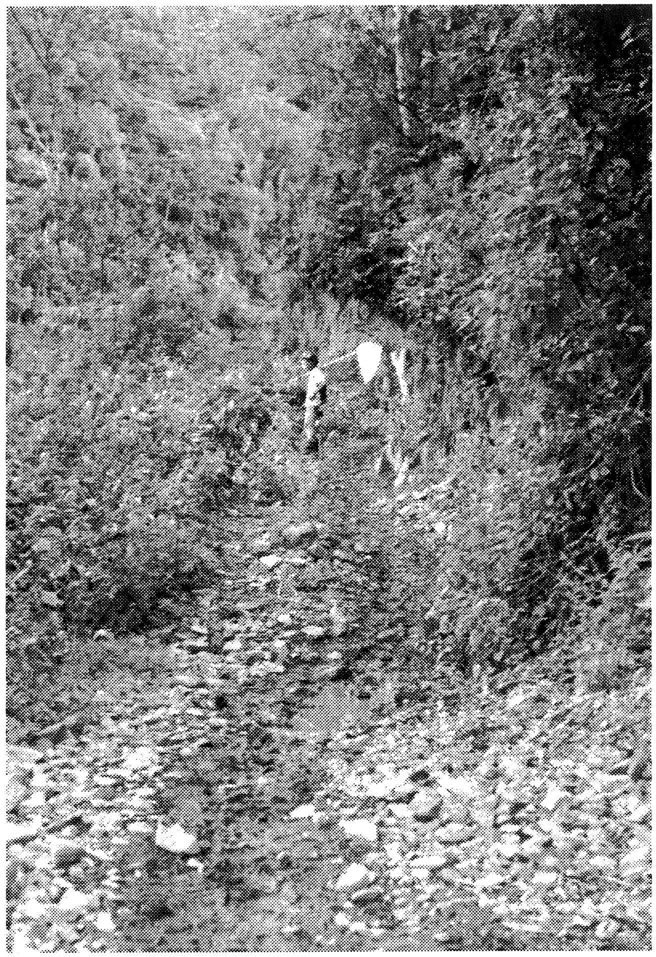

Figure 6. Canyon of Birmania toward Garrapatas Road. (Foto J.A. Salazar E.).

Table 1. Estimated species richness of the Garrapatas based on average the proportion of species in the families and subfamilies recorded from that area.

Hesperiidae	210
Papilionidae	594
Pieridae	339
Lycaenidae	280
Riodinidae	363
Libytheidae	918
Nymphalidae	417
Satyrinae	358
Brassolinae	589
Morphinae	754
Heliconiinae	731
Acraeinae	551
Danainae	506
lthomiinae	386
Observed	**375**

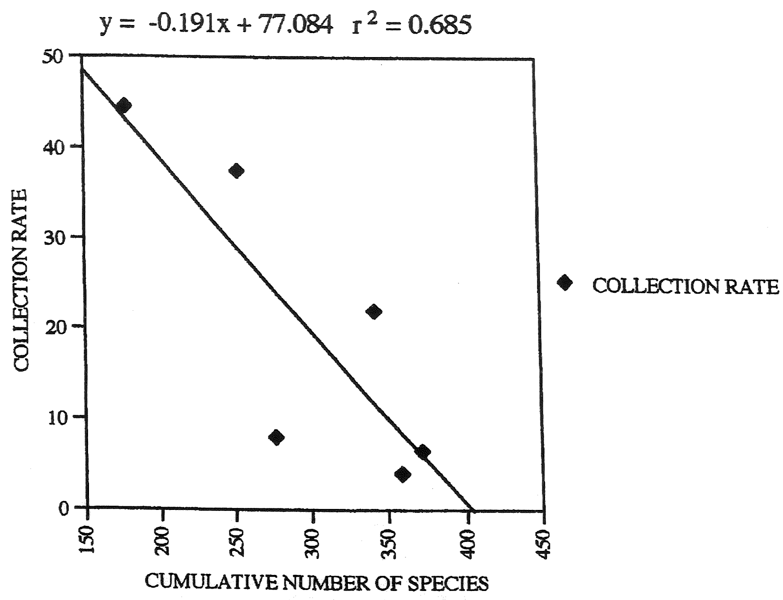

Table 2a. Cumulative number of species collected at Upper Garrapatas valley vs. subsequent rate of collection.

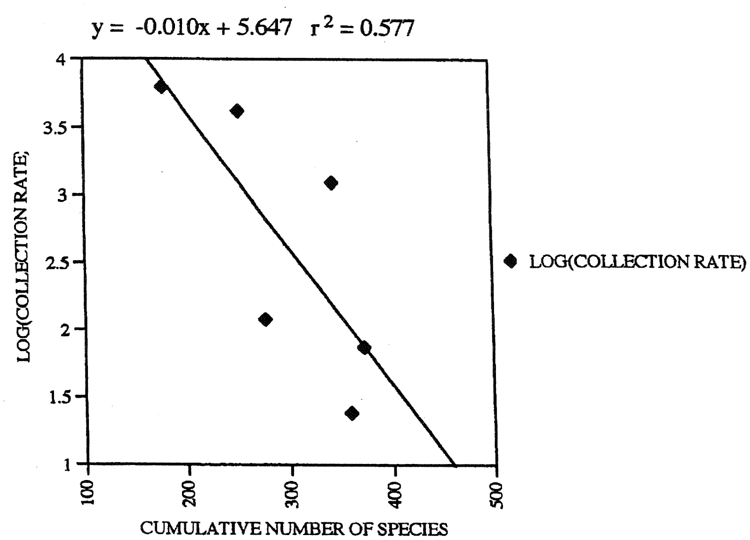

Table 2b. Cumulative number of species collected at Upper Garrapatas valley vs. log (subsequent rate of collection).

Table 3. Total butterfly species richness of Garrapatas valley and other Neotropical areas, and the proportions of species families and subfamilies of butterflies recorded from each.

	Total butterfly	% of total													
	species	Hesp.	Papil.	Pier.	Lycae.	Riodi.	Libyt.	Nymph.	Satyr.	Brass.	Morph.	Helic.	Acre.	Danai.	Ithom.
Garrapatas	372	16.4	4.8	4.3	9.1	14.8	0.3	17	6.5	3	2.2	5.4	1.1	0.8	4.8
Planalto[a]	185	11.4	4.3	8.1	16.8	9.2	0.0	24	14	2.7	0.0	4.9	1.6	1.1	2.7
Alto Jurua[b]	1319	26.7	2.9	2.7	13.7	20.5	0.1	14	7.7	2	0.9	2.1	0.2	0.4	6.1
Caucalandia[c]	1575	37.4	1.7	2.0	16.0	16.6	0.1	12	6.5	1.2	0.7	1.7	0.1	0.4	4.1
Jaru, Rondonia[d]	956	29.2	2.4	2.7	6.5	20.5	0.1	14	9.6	2.4	1.2	2.5	0.1	0.2	6
Brasilia[e]	757	37.0	1.6	3.6	17.7	17.2	0.1	13	5.9	1.7	0.5	1.7	0.8	0.4	3.2
Linhares, Espirito[f]	819	30.5	2.0	2.9	9.9	12.6	0.1	13	5.1	1.6	0.5	2.0	0.5	0.5	3.9
Pocos de Caldas[g]	572	39.0	61.0	6.1	15.2	8.2	0.2	13	5.9	1.2	0.9	1.6	1.2	0.7	5.1
Serra Japi[h]	660	37.4	2.9	5.5	16.8	7.9	0.2	14	4.1	2	0.9	2.0	1.8	0.6	4.2
Itatiaia, Río Janeiro[i]	931	40.2	2.3	4.3	16.5	12.8	0.0	9.8	5	1.4	0.6	1.4	1.3	0.4	3
Campinas[j]	537	42.5	3.0	5.0	7.3	5.0	0.2	17	4.1	1.9	0.9	2.2	2.0	0.7	3.9
Río de Janeiro[k]	658	38.0	3.0	5.5	15.7	12.2	0.2	11	3	0.9	0.9	2.4	0.9	0.5	4.4
Loreto[l]	673	24.5	3.9	3.4	10.1	22.7	0.0	13	7.7	1	1.2	2.4	0.1	0.1	7.7
Sira[m]	293	11.3	3.8	7.8	1.0	8.9	0.0	26	11	3.8	2.7	6.5	0.3	0.3	8.5
Laguna Encantada[n]	182	19.8	5.0	8.8	11.0	9.3	0.0	27	5.5	0.5	1.1	5.0	0.6	1.7	5
Boca del Chorradero[o]	544	27.2	4.8	5.7	11.8	14.0	0.0	21	4.8	2.4	0.6	3.3	0.2	0.7	3.7
El Chorradero[p]	177	20.3	6.2	14.1	7.4	7.9	0.6	29	2.8	0.6	0.6	2.8	0.6	2.3	4.5
Chamela[q]	150	30.0	9.3	14.7	5.3	6.7	0.7	27	1.3	0	0.7	2.0	0.0	2.7	0
Pakitzar[r]	1307	23.5	1.3	2.9	17.7	21.9	0.0	11	9.4	1.5	0.7	2.4	0.2	0.2	7.1
Tambopata[s]	1249	31.8	2.2	2.2	12.7	18.7	0.1	15	8.7	1.9	1.0	2.1	0.1	0.3	3.6
Manaus[t]	365	14.3	1.9	1.9	14.0	30.4	0.0	13	11	1.9	1.9	4.9	0.0	0.6	4.9
Santa Teresa[u]	513	29.2	2.5	6.8	6.4	13.7	0.2	18	7.8	3.9	1.6	3.3	1.4	0.6	5.1
Sumare[v]	658	38.0	3.0	5.5	15.7	12.2	0.2	11	3.2	2	0.8	2.4	0.9	0.5	4.4
Campinas[w]	537	31.3	3.2	5.4	10.1	11.2	0.2	21	5.2	2.6	0.9	2.4	1.3	0.8	4.1
Buriti[x]	533	31.9	4.1	3.8	9.8	15.0	0.2	16	8.4	1.7	0.4	2.6	0.6	0.8	4.7
Average		29.0	5.3	5.1	11.9	14.9	0.1	16	6.5	1.8	0.9	2.7	0.7	0.7	

[a] Taken from Lopez-Vaamonde et al. (in press)

[b, c, d, e, f, g, h, i, j, k] Taken from Brown (1997) and Brown (com, pers.)

[l] Taken from Lamas et al. (1996)

[m] taken from Lamas & Grados (1996)

[n, o, p, q, r, s, t, u, v, w, x] Taken from beccaloni & Gaston (1995), [r, s] updated using Robbins et al. (1996) and Lamas (1997)

Table 4. Number of butterily species shared between Upper Garrapatas valley (GARR) and San Jose del Palmar (SJP); Upper Garrapatas valley and Santa Cecilia (SC) and among the three localities.

	GARR/ISJP	GARR/SC	GARR/SJP/SC
Heliconiinae	14	15	9
Danainae	1	3	1
lthomiinae	4	18	4
Morphinae	6	7	6
Brassolinae	5	8	4
Libytheinae	0	1	0
Acraeinae	2	4	2
Charaxinae	11	15	10
Nymphalinae	30	56	28
Melitaeinae	8	9	8
Apaturinae	4	5	4
Satyrinae	20	23	19
Riodinidae	17	48	17
Lycaenidae	8	20	8
Pieridae	8	16	8
Papilionidae	5	15	5
Pyrrhopyginae	1	2	1
Pyrginae	3	13	3
Hesperiinae	2	18	3

Table 5. Number of butterfly species recorded in each of the six principal habitats in the upper Garrapatas valley (H = hilltop, F = primary upland forest, E = edge habitats, D fallow fields and second growth forest, R= ravine, riverine forest, 1 Inga and Lantana area).

	H	F	E	0	R	1
Heliconiinae	2	7	10	6	2	-
Danainae	-	-	1	2	-	1
lthoniinae	1	12	7	1	-	3
Morphinae	3	2	-	1	-	3
Brassolinae	1	7	1	2	-	-
Libytheinae	-	-	-	1	-	-
Acraeinae	-		2	3	-	-
Charaxinae	15	-	16	3	-	-
Nymphalinae	17	8	19	33	4	-
Melitaeinae	-	-	-	9	2	-
Apaturinae	1	-	2	4	-	-
Satyrinae	1	17	12	3	-	-
Riodinidae	25	15	11	11	2	-
Lycaenidae	8	5	13	11	-	-
Pieridae	-	3	3	10	-	2
Papilionidae	4	-	-	6	2	12
Hesperiidae	6	17	8	34	-	5
TOTAL	84	93	105	140	12	26

Appendix 1. List of the butterfly species recorded in the Upper Garrapatas Valley Compiled by J.A. Salazar & C.L Vaamonde with new records of J.I.Vargas Ch.**

*No butterflies are listed under subfamily level.

RHOPALOCERA

HELICONIIDAE*

Genus Philaethria Bill., 1 820

1. P dido chocoensis Const., 1999

Genus Dryadula Mich., 1 942

2. D. phaetusa I.,1758

Genus Dione Hbn.,1819

3. D. juno C r., 1 779

Genus Agraulis Bsd,& Lec.,l 833

4. A. vanillae L., 1 758

Genus Dryas Hbn.,1807

5. D. iulia F., 1 775

Genus Eueides Hbn., 1816

6. E. lybia olympia F., 1783
7. E. isabella arquata Stich., 1 903
8. E. vibilia vialis Stich., 1903
9. E. aliphera Gdt., 1 81 9

Genus Laparus Bill., 1 820

10. L. doris obscurus Weym., 1890

Genus Heliconius Kluk, 1802

11. H. ismenius occidentalis Neust., 1928
12. H. hecale melicerta Bates, 1866
13. H. cydno zelinde Btlr., 1869
14. H. hecalesia longarena Hew.,
15. H. melpomene vulcanus Btlr., 1865
16. H. erato venus Stgr., 1882
17. H. erato chestertoni Hew., 1872
18. H. charitonia L., 1767
19. H. sara F., 1793
20. H. eleuchia Hew., 1853
21. H. eleuchia eleusinus Stgr., 1885

DANAIDAE*

Genus Ituna Dbl., 1847

22. I. ilione albescens Dist., 1876

Genus Lycorea Dbl., 1 847

23. L. cleobaea atergatis Dbl., 1847

Genus Danaus Kluk,1802

24. D. plexippus megalippe Hbn.

ITHOMIIDAE*

Genus Olyras Dbl., 1847

25. O. insignis praestans G. & S., 1897

Genus Melinaea Hbn.,1816

26. M. lilis messatis Hew., 1855

Genus Thyridia Hbn., 1816

27. Th. psidii aedesía Dbl., 1847

Genus Athesis Dbl., 1847

28. A. clearista colombiensis Kaye, 1918

Genus Mechanitis F.,1807

29. M. polymnia isthmia Bates, 1863

Genus Callithomia Bates,1862

30. C. hezia tridactyla Kaye, 1918

Genus Napeogenes Bates,1862

31. Napeogenes sp.

Genus Ithomia Hbn.,1816

32. I. hyala Hew.,1856
33. I. diasia spp.
34. I. diasia galata Hew., 1855

Genus Hyposcada G.&S., 1879

35. H. virginiana colombiana Hering & Hopp, 1925
36. H. illinissa abida Hew., 1871

Genus Episcada G. &. S., 1879

37. E. polita Weym., 1 899

Genus Pteronymia Btlr.& Dce.,1872

38. Pteronymía sp.

Genus Aeria Hbn., 1816

39. A. eurimedia latistriga Hering.& Hopp, 1925

Genus Godyris Bsd.,1870

40. G. zavaleta gonusssa Hew., 1856
41. G. kedema albinotata Btlr., 1873

Genus Hypothyris Hbn.,1821

42. H .euclea spp.
43. H. lycaste limosa Fox, 1971
44. H. Iycaste spp.

MORPHIDAE*

Genus Morpho F.,1807

45. M. theseus Deyr., 1860
46. M. niepelti staudingeri Niep., 1927
47. M. cypris Ww., 1847
48. M. amathonte Deyr.,1860
49. M. achilles microphtalmus Frust.
50. M. granadensis Fidr.,1865

Genus Anthirraea Hbn.,1822

51. A. miltiades F., 1872

Genus Caerois Hbn., 181 9

52. C. gerdrudtus F., 1792

BRASSOLIDAE*

Genus Brassolis F., 1807

53. B. isthmia Bates, 1864

Genus Catoblepia Stich., 1902

54. C. xanthicles occidentalis Bstw.

Genus Eryphanis Bsd., 1870

55. E. automedon lycomedon Fldr.

Genus Opsiphanes Dbl., 1849

56. 0. tamarindi Fldr.,l 861
57. 0. quiteria badius Stich., 1902
58. 0. invirae Hbn.,1808

Genus Caligo Hbn.,1816

59. C. oedippus fruhstorferí Stich., 1903
60. C. illioneus oberon Btlr.
61. C. bellerophon Stich.,l 903
62. C. zeuxippus Dce., 1902

LIBYTHEIDAE*

Genus Libytheana

63. L. carinenta mexicana Mich., 1943

ACRAEIDAE*

Genus Actinote Hbn., 1819

64. A. neleus Latr., 1811
65. A. ozomene Gdt., 1824
66. A. equatoria Bates, 1864
67. A. guatemalena Bates, 1864

NYMPHALIDAE*

Genus Mestra Hbn.,1825

68. M. cana Erichs., 1848

Genus Marpesia Hbn., 1818

69. M. zerynthia Hbn.
70. M. chiron F., 1775
71. M. merops Bsd., 1836
72. M. berania Hew., 1852
73. M. marcella Fidr.,1861
74. M. iole Dry., 1770
75. M. petreus Cr., 1776

Genus Historis Hbn.,1819

76.H. odius dious Lam.,1995

Genus Smyrna Hbn.,1823

78. S. blomfildia F., 17 81

Genus Colobura Bill., 1820

79. C. dirce L., 1758

Genus Baeotus Hemm., 1939

80. B. baeotus Dbl., 1849

Genus Pyrrhogyra Hbn.,1819

81. P. nasica Stg r., 1886

Genus Panacea G.&.S., 1883

82. P. prola Dbl., 1848
83. P. procilla Hew., 1853

Genus Ectima Dbl., 1848

84. E. thecla astricta F., 1796

Genus Hamadryas Hbn., 1806

85. H. februa Hbn., 1 823
86. H. feronia L., 1758
87. H. fornax fornacalia Fruhst., 1907
88. H. amphinome L., 1767
89. H. laodamia saurites Fruhst., 1916

Genus Biblis F., 1807

90. B. aganissa Bsd., 1836

Genus Nessaea Hbn.,1819

91. N. aglaura Dbl., 1848

Genus Catonephele Hbn.,1819

92. C. nyctimus Ww., 1850
93. C. numilia esite Fldr., 1869
94. C. orites Stich.,1899

Genus Eunica Hbn., l819

95. E. norica Hew.,1864
96. E. alcmena Dbl.& Hew., 1864
97. E. carias Hew., 1 857
98. E. araucana Fldr., 1862
99. E mygdonia Gdt., 1824

Genus Nica Hbn.,1826

100. N. flavilla canthara Dbl., 1848

Genus Temenis Hbn., 1819

101. T. laothoe Cr., 1777

Genus Haematera Dbl., 1849

102. H. pyrame Hbn., 181 9

Genus Mesotaenia Röb

103. M. vaninka Hew., 1852

Genus Diaethria Bill., 1820

104. D. marchalli Guer., 1844
105. D. euclides Latr.,1809
106. D. astala Guer.,1844

Genus Callicore Hbn., 181 9

107. C. manova spp.
108. C. chimana daguana Barg.,
109. C. aegina bella Röb.

Genus Dynamine Hbn.,1819

110. D. paulina thalassina Bsd. 1865
111. D. postverta Cr., 1779

Genus Adelpha Hbn., 1819

112. A. melanthe melanippe G. &S.
113. A. zalmona eponina Stgr.
114. A. zina Hew., 1870
115. A. cocala Cr., 1779
116. A. erotia Hew., 1847
117. A. cytherea L., 1758
118. A. ixia Fldr., 1867
119. A. iphicleola Bat.
120. A. leuceria Dce., 1872
121. A. melona Hew., 1847

Genus Siproeta Hbn., 1823

122. S. epaphus Latr.,1819

Genus Junonia Hbn., 1819

123. J. evarette Cr., 1775

Genus Hypanartia Hbn.,1821

124. H. dione Latr., 1819
125. H. godmani Bat., 1864

Genus Anartia Hbn., 1816

126. A. amathea L., 1758
127. A. jatrophae L., 1763

Genus Euptoieta Dbl.,1848

128. E. hegesia Cr., 1780

Genus Chlosyne Btlr., 1870
129. C. lacinia Geyer, 1837
Genus Tegosa Hgg., 1981
130. T. anieta Hew.,1864
Genus Eresia Bsd., 1836
131. E. mimas Stgr., 1885
132. E. clara Bates, 1864
133. E. eunice Hbn., 1807
Genus Janatella Hgg.,1981
134. J. leucodesma Fidr.,1861
Genus Castilia Hgg., 1981
135. C. eranites Hew., 1 857
136. C. ofella Hew.,1864
Genus Anthanassa Scudd., 1875
137. A. drusilla Fldr.,1861
Genus Doxocopa Hbn.,1819
138. D. cyane Latr., 1813
139. D. cherubina Fldr., 1867
140. D. felderi G. & S., 1884
141. D. clothilda Fldr., 1860
142. D. pavon Latr., 1 809

CHARAXIDAE*
Genus Agrias Dbl., 1845
143. A. amydon amaryllis Mich., 1930
Genus Archaeoprepona Fruhst.,1915
144. A. demophon muson Fruhst., 1905
145. A. demophoon gulina Fruhst., 1904
146. A. camilla G.& S., 1884
147. A. meander Cr., 1775
148. A. amphimachus F., 1775
Genus Prepona Bsd., 1 836
149. P. pylene jordani Fruhst., 1 904
150. P. omphale subdives LM., 932
151. P. werneri Hering& Hopp., 1925
Genus Siderone Hbn.,1823
152. S. galanthis thebais Fldr., 1862
153. S. syntyche vulcanus Fldr., 1862
Genus Zaretis Hbn., 1 823
154. Z itys Cr., 1 777
155. Z ellops Men., 1855
156. Z. violacea (Hall & Will., 2000.)
Genus Hypna Hbn.,1819
157. H. clytemnestra Cr., 1777
Genus Consul Hbn., 1 807
158. C. fabius cecrops Dbi. & Hew., 1849
Genus Fountainea Rydon, 1971
159. F. ryphea Cr., 1775
Genus Memphis Hbn.,1819
160. M. laura caucana J.& T., 1922
161. M. lyceus Dce., 1 877
162. M. oenomaís Bsd., 1 870
163. M. mora Dce., 1 874
164. M. cleomestra Hew., 1 869
165. M. chaeronea indigotica Salvin, 1869
Genus Cymatogramma Dbl.,1849
166. C. pithyusa Fldr. 1869
167. C. felderi Röb.,1916
Genus Annagrapha Salz.& Const.,2001
168. A. elina Stg r., 1897
169. A. dia G. & S., 1884
170. A. aureola Bates, 1866**

SATYRIDAE*
Genus Dulcedo D'alm.,1951
171. D. polita Hew., 1869
Genus Cithaerias Hbn.,1819
172. C. pireta Cr., 1780
Genus Pierella Ww., 1851
173. P.elvina ocreata S.& G.
174. P. luna lesbia Stgr., 1887
Genus Taygetis Hbn.,l 818
175. T. virgilia C r., 1779
176. T. celia Cr., 1779

177. T. andromeda Cr.,1779
178. T. sylvia Bates, 1 866
Genus Pareuptychia Forst., 1964
179. P. metaleuca Bsd., 1870
Genus Chloreuptychia Forst.1964
180. Ch. arnaca F., 1 777
Genus Magneuptychia Forst.,1964
181. M. mycalensis Röb., 1927
Genus Megeuptychia Forst.,64
182. M. antonoe Cr., 1779
Genus Euptychia Hbn.,1816
183. E. molina Hbn., 1818
184. E westwoodi Btlr., 1866
185. E. hilara Fldr.,1867
186. E. tiessa Hew., 1869
187. E renata Cr., 1782
188. E. hermes F., 1775
189. E. polyphemus Btlr.,1867
190. E. ocnus Btlr., 1867
191. E. gulnare Btlr.,1870
Genus Cissia Dbl., 1848
192. C. terrestris Btlr., 1866
Genus Oxeoschistus Btlr. 1867
193. 0. submaculatus pervius Th
Genus Pedaliodes Btlr.,1867
194. Pedaliodes sp.

RIODINIDAE*
Genus Euselasia Hbn.,1819
195. E. tarinta Schaus, 1902
196. E. eucrates leucorrhoa G
197. E midas ater Seitz, 1924
198. E. athena Hew., 1869
199. E. amphidecta G. &S. 1 878
200. E. rhodogyne G od., 1 903
201. Euselasia sp.
Gen. Perophthalma Ww. 1851
202. P. tullius F.,1787
GenusLeucochimona Stich Og
203. L. lagora H-Schff., 1859
204. L. leucolaga G & S.
Genus Mesosemia Hbn.,1819
205. M. telegone Bsd., 1 836
206. M. zonalis G.&.S., 1 885
207. M. mevania pacifica Stich.
Genus Eurybia Ill., 1807
208. E. juturna Fldr., 1865
209. E. nicaeus F., 1775
Genus Napaea Hbn.,1819
210. N. nepos theages G. &S., 1 878
Genus Lyropteryx Ww., 1 857
211. L. lyra Sndrs., 1 858
Genus Ancyluris Hbn., 1 81 9
212. A. huascar Sndrs.,1859
Genus Metacharis Btir.,1867
213. M. lucius F., 1 793
Genus Monethe Ww.,1857
214. M. albettus Fidr., 1862
Genus Lepricornis Fidr.,1865
215. L. incerta Stg r., 1 888
Genus Charis Hbn., 1819
216. Ch. gynaea zama Bates, 1868
Genus Caria Hbn., 1 823
217. C. lampeto G.&S., 1 886
Genus Lasaia bates, 1868
218. L. meris Stoll, 1781
Genus Setabis Ww., 1 857
219. S.. lagus jánsoni Bti r., 1 870
Genus Theope Dbl., 1847
220 Th. eurygonína Bates, 1868
221.Th. serícea Bates, 1868
222.Th. phaeo Pritwz., 1 865
Genus Juditha Hemm., 1964
223. J. molpe Hbn.,1808
Genus Nymphidium F.,1807
224. N. cachrus ascolides Bsd.

Genus Mesenopsis G.&S.,1816
225. M. bryaxis Hew., 1870
Genus Calospila Geyer, 1832
226. C. andraemon Stich., 1910
Genus Symmachia Hbn.,1819
227. S. rubina Bates, 1866
228.S. jugurtha Stgr., 1887
229.S. accusatrixWw.,1851
230.S. probetor belti G. &S.
231. S. rubrica Stích., 1929
232.S. tricolor H ew., 1867
233.S. threissa Hew., 1870
234.S. leena harmodíus G.&S.
Genus Stichelia Zikan, 1 949
235. S. tyriotes G.&S., 1 878
Genus Sarota Ww.,1851
236. S. chrysus Cr.,1782
237. S. gyas Cr.,1775
238. S. acanthoides myrtea G.& S.,1886
Genus Argyrogrammana Strand., 1932
239. A. sulphurea macularia Bsd.
240. A. stilbe holosticta G.& S.,1878
241. A. venilia Bates, 1868
242. A. crocea G. & S.1878
Genus Anteros Hbn., 1819
243. A. renaldus indigator Stich.
244. A. acheus Stoll, 1781
Genus Emesis F., 1 807
245. E. lacrines Hew., 1870
246. E. lucinda Cr., 1778
247. E. mandana cr., 1780
248. E. tenedia Fldr., 1861
Genus Pixus Call., 1983
249. P. corculum Stich., 1929
Genus Uraneis Bates,1868
250. U. zamuro Th., 1907
Genus Thisbe Hbn.,1819
251. Th. germanus G.&S.
Genus Melanis Hbn.,1819
252. M. hodia Btir., 1870

LYCAENIDAE

Genus Arcas Swns., 1832
253. A. imperialis Cr., 1775
254. A. katia John& Salz
Genus Angulopis John, 1992
255. A. hesperitis Dce., 1872
Genus Evenus Hbn.,1819
256. E .regalis Cr., 1775
Genus Pseudolycaena Wall.
257. P. marsyas damo Dce
Genus Cryptaenota John.
258. C. mavors Hbn.,1818
Genus Denivia John., 1992
259. D. hemon Cr., 1775
Genus Cycnus Hbn.,1819
260. C. bathildis Fidr., 1865
Genus Gibbossa Sal.& Lóp.
261 G.giberossa Hew., 1867
Genus Thecla F., 1 807
262. T. doryassa Hew.,1874
263. T. corolena Hew.,1874
264. T. pharus Dce., 1907
265. Thecla sp. 1
266. Thecia sp.2
267. Thecla sp.3
Genus Arawacus Kye, 1904
268. A. togarna Hew.,1869
Genus Chalybs Hbn.,1819
269. Ch. janias Cr., 1779
Gen. Janthecla Rob& Ven.
270. J. leea Rob & Ven, 1991
Genus Ocaria Ciench, 1970
271. O. thales F., 1793
272. Ocaria sp.

273. O (circa) peruviana

Genus Panthiades Hbn.,1819

274. P. bitias Cr.,1777

Genus Calycopis Scudd.1819

275. C.beon Cr.,1780

Genus Argentostriatus John.

276. A. calus Gdt.,1824

Genus Serracenota John.

277. Serracenota sp.

Genus Calystryma Field,1967

278. C. trebula Hew., 1868

Genus Ministrymon Clench, 1 961

279. M. azia Hew., 1873

Genus Strymon Hbn., 1818

280. S. yojoa Reak., 1866

281. S. mulucha Hew.,1867

282. S. basilides Gy.,1837

283. Strymon sp.

Genus Rekoa Kaye,1904

284. R. meton Cr., 1779

Genus Leptotes Scudd., 1876

285. L. cassius Cr., 1 777

Genus Zizula Chap., 1910

286. Z. tulliola G. &S., 1887

Genus Mercedes John.,1991

287. M. demonassa Hew.,1868

Genus Strephonota John. et al., 1997

288. St. ericeta Hew., 1 887**

Genus Ostrinotes John.et al.,1997

289. Ostrinotes sp.

PIERIDAE / DISMORPHINAE

Genus Dismorphia Hbn.,1818

290. D. arcadia ssp.

291. D. theucarilla xanthone Röb.

292. D. amphione arsinoe Fldr.

Genus Enantia Hbn.,1819

293. E. licinia ssp.

Genus Patia Klots, 1933

294. P. orise sororna Btlr., 1872

PIERIDAE*

Genus Phoebis Hbn.,1819

295. P. sennae L.

296. P. philea Johan.,1784

Genus Aphrissa Btlr.,1873

297. A. statira Cr., 1777

Genus Eurema Hbn.,1819

298. E. albula Cr., 1775

299. E. proterpia F.,1775

300. E. gratiosa Dbl., 1847

Genus Ascia Scop., 1777

301. A., monuste L.,1764

Genus ltaballia Kaye, 1904

302. l. pandosia sabeta Fruhst.

Genus Periballia VJots,1933

303. P .mandela locusta Fldr.

Genus Perrhybris Hbn.,1819

304. P.pyrrha bogotana Btlr.

305. P. lypera Koll., 1850

PAPILIONIDAE

Genus Battus Scop.,1777

306. B. polydamas L.,1758

307. B.chalceus ingenuus Dyar

Genus Parides Hbn.,1819

308. P. eurimedes emilius Const.,1999

309. P. sesostris torquinius Bsd.

310. P. erithalion ssp. n.

311. P. (circa) polyzelus

Gen. Protographium Mun.

312 P.th. panamensis Ob.**

Gen. Eurytides Hbn., 1 821

313. E. o. isocharis R.&J.

314. E. s. columbus Koll.
Gen Mimoides Brown, 1991
315. M. e .pithonius R&J.
316. M. ph .therodamas Fldr
Genus Heraclides Hbn., 1819
317. H..idaeus F.,1793
318. H .jeani Br.& Lam.
319. H. pacificus R.&J.
320. H. .epidaurus G & S.
321. H. th.nealces R & J.
322. H. p. thrasson Fldr.
Genus Pterourus Btlr. 1872
323. P. z. daguanus R.&J.
324. P. birchalli Hew., 1863

HESPERIIDAE*
Gen. Jemadia Wat., 1853
325. J. hospita Btlr., 1877
Genus Mimoniades Hbn.
326. M. nurscia Swn..,1821
Gen. Pyrrhopyge Hbn.1866
327. P. spatiosa Hew. 1 870
328. Pyrrhopyge sp.
Gen. Phocides Hb.,1819
329. P. polybius F.
330. Phocides sp.
Gen. Phanus Hbn.,1819
331. Ph. vitreus Stoll, 1781
Genus Entheus Hb.1819
332. E.m.latifascius H.&.H.
Genus Cogias Btlr.,1870
333. Cogias sp.
Genus Staphylus G,&S.
334. Staphylus sp.
Gen. Antigonus Hbn.,1878
335. Antigonus sp.
Gen. Achlyodes Hbn., 1819
336. A. busirus Cr.,1780
337. A. thrasso Hbn.,1807
338. Achlyodes sp.
Genus Epargyreus Hbn.
339. E. exadeus Cr.1780
Genus Pyrgus Hb.,1819
340. Pyrgus sp.
Genus Calliades Mab.&Boull., 1912
341. C. phrynicus Hew., 1867
Genus Cecropterus Mab.
342. C. aunus F.
Genus Gorgopas G.&S., 1894
343. G. ch. viridiceps Btlr.&Dce. 1872
Genus Xenophanes G.&S.,1895
344 Xenophanes trhyxus-
Genus Anastrus Hbn., 1824
345. A. obscurus Hbn., 1824
Genus Quadrus Lind.,1925
346. Q. cerealis Stoll, 1 782
Genus Cycloglypha Mab.,1903
347. C. thrasibulus F.,1793
Genus Noctuana Bell, 1937
348. Noctuana sp.
Genus Phareas Ww., 1852
349. Ph. coeleste Ww., 1852
Genus Heliopetes Bill.,1820
350. H. arsalte L.,1758
351. H. laviana Hew.,1868
Genus Vettius Godt.,1901
352. V. phyllus Cr., 1777
353. V. lafresnayi Latr., 1824
354. V. artona Hew.,1866
Genus Phanes Godt.,1901
355. Ph. aleletes-
Genus Synaptes Mab.,1904
356. S. malitiosa puma-
Genus Carrhenes
357. Carrhenes sp.

Genus Metron Godt.,1900

358. Metron sp.

Genus Argon Ev.,1955

359. Argon sp.

Genus Celaenorrhinus

360. C. eligius Stoll, 1781

361. Celaenorrhinus sp.

Genus Perichares Scud., 1822

362. P. philetes Gml., 1790

363. P. agrippa G.&S., 1901

Genus Saliana Ev., 1955

364. S. triangularis Kaye, 1 904'

365. S. salius Cr., 1 775

Genus Tirynthia

366. Th. conflua H-Schff., 1869

Genus Moeris Godt., 1900

367. Moeris sp.**

Genus Burca

368. B. braco H-Schff., 1865

Genus Eutychide Godt., 1900

369. E. olympia Plotz, 1882

Genus Mellana Hayw.,1948

370. M. villa Ev., 1 955

Genus Nyctelius

371. N. nyctelius-

Genus Thespieus Godt.

372. Th.dalman Latr.

Gen. Oxynthes Gdt. 1900

373. O. corusca H-Schff.

Gen.Thracídes Hbn.

374. Thracides sp.

Gen. Apaustus Hbn.

375. A. gracilis Fldr.

376. A. juventus Scudd.

Gen.Gorgythion G&S.

377. Gorgythion sp.

Genus Lento Ev.,1955

378. Lento sp.

Genus Aethilla

379. A. echina Hew., 1870

Genus Panoquina Hem.

380. P. evadnes Stoll.

Genus Astraptes Hbn., 1819

381. A. fulgerator Walch.

382. A. pheres Mb. 1903

383 A. anaphus Cr., 1777

384. A. aulestes Cr. 1777

Genus Phanes Gd.1901

385. Ph. almoda Hew.

Genus Papias G.&S.

386. P. microsema Godm.

Genus Prenes Scudd.

387. P. sylvicola H-S Gen.

Genus Pellicia H-Schff.

388. P. vecina Schaus.