NEW DISTRIBUTIONAL RECORDS OF NYMPHALID SPECIES (LEPIDOPTERA: NYMPHALIDAE) FOR THE CHOCÓ REGION AND WESTERN ECUADOR

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Abstract- Butterflies were collected using traps baited with fermented shrimp at the Río Canandé Reserve in Esmeraldas, northwestern Ecuador, one of the last remnants of tropical wet forests in the Chocó biogeographic region of Ecuador. We recorded one species not previously reported from Ecuador, *Opsiphanes zelotes zelotes*, and two species not previously reported from the Chocó region, *Adelpha naxia naxia* and *Eunica orphise*. In addition, we provide new distributional data for several species that are known from very few localities in western Ecuador, including: *Memphis artacaena*, *M. anna elina*, *Prepona gnorima jordani*, *Adelpha hesterbergi*, *A. heraclea heraclea*, A. *basiloides* and *A. barnesia leucas*.

Key words: Chocó Region, new records, northwestern Ecuador, Nymphalidae.

INTRODUCTION

Western Ecuador contains two biogeographic regions of especially high endemism: the Chocó Region, with evergreen or wet forest in the north, and the Tumbes Region, with deciduous or dry forest in the south. The Chocó Region extends from eastern Panama through the Pacific lowlands of Colombia into northern Ecuador, and it receives more than 7000 mm of rain per year, which makes this region one of the wettest worldwide (Faber-Langendoen and Gentry 1991 and citations therein). The Chocó biogeographic region is also one of the few global "hotspots" of diversity and endemism (Chocó-Darien Western Ecuador hotspot), areas characterized by exceptional concentrations of endemic species and undergoing tremendous rates of habitat loss (Myers *et al.* 2000). In the last few decades a number of new species have been discovered in this area, including vertebrates (McCarthy *et al.* 2000, Anderson & Jarrin 2002, Davalos 2004, Guayasamin 2004, Guayasamin & Bonacorrorso 2004, Guayasamin & Trueb 2007,) and plants (Gentry 1992, Delprete 1998, Dodson 1998, Taylor *et al.* 1999). In addition, in a recent analysis of palm distributions in Ecuador, the highest rate of palm endemism was predicted to occur in the northwest (Leimbeck 2004). In the case of butterflies, western Ecuador to western Colombia is also an area of high endemism, (Willmott & Hall 2004), and several new butterfly species have been discovered recently in this area (Willmott & Lamas 2004 and citations therein, Hall 2005, Hall & Willmott 2005, Pyrcz *et al.* 2006).

Unfortunately, northwestern Ecuador faces severe pressure from deforestation due to logging and cultivation of oil palm plantations; conservative estimates suggest that less than 25% of native forest remains (Checa 2008). In addition, "Chocó-Darien Western Ecuador" headed the list of hotspots facing elevated risks of degradation due to its high rate of population growth (around 3.2 % yr^{-1}), followed by the Tropical Andes (also including Ecuadorian territory) and Madagascar (Cincotta *et al.* 2000). In fact, according to the report by FAO (2007), Ecuador (along with El Salvador and Honduras) led Latin American countries in its rate of deforestation, losing over 1.5 % of its forests per year from 2000-2005. These facts emphasize the importance of biological surveys and conservation efforts in remaining forest habitats throughout Ecuador.

We conducted ecological studies (to be published elsewhere) on the butterfly fauna in one of the few remnants of primary forest in northwestern Ecuador, the Río Canandé Reserve. During the course of our investigations we encountered a number of taxa that represent important phenological and distributional records, including range extensions and new records for Ecuador and the Chocó Region, which we report here.

STUDY AREA

The Río Canandé Reserve (RCR: 00°28'60''N; 79°12'04''W) is located in the southwest corner of Esmeraldas Province, northwestern Ecuador. The vegetation of the study area is the evergreen lowland forest of the Ecuadorian coast (Sierra 1999), and according to ecological maps based on the Holdridge system, the RCR corresponds to tropical wet forest (Cañadas & Estrada 1978). The Reserve is located in a small range of hills with an elevation not higher than 500 m, surrounded by flat terrain converted to monocultures of oil palm. The mountains capture the humidity coming from the Pacific Ocean and for this reason the higher elevations are usually cloudy, resulting in high precipitation rates across the entire reserve. Although the southern half of western Ecuador receives less than 1,000 mm of annual rainfall (a rainless period of eight months occurs from May to early January), the region becomes increasingly humid northward, reaching a level of around 7,000 mm per year, in the northernmost part (Dodson & Gentry 1991).

The RCR is a private reserve of about 200 ha managed by the Fundación Jocotoco, an Ecuadorian organization created to purchase and preserve fragments of primary forest throughout Ecuador. At the moment, this foundation possesses eight reserves, protecting about 13,000 ha of native forests (Fundación Jocotoco 2008).

The RCR supports an exceptionally diverse and endemic flora and fauna due to its location in the Chocó Region. Around

Fig. 1: Notable butterfly species recorded at Río Canandé Reserve, northwestern Ecuador. Dorsal (left) and ventral surfaces (right) of wings are presented, and butterflies are shown at lifesize. New record for Ecuador: 1. *Opsiphanes zelotes zelotes*; New records for the Chocó Region: 2. *Eunica orphise*; 3. *Adelpha naxia naxia*; Rare or poorly known species: 4. *Memphis anna elina*, 5. *M. artacaena*, 6. *Prepona gnorima jordani*, 7. *Adelpha barnesia leucas,* 8. *A. heraclea heraclea,* 9. A. *basiloides* and 10. *A. hesterbergi*.

20% of the plant species present here are endemic to western Ecuador (Dodson & Gentry 1991) and several threatened species of mammals shelter in the northwestern area, specifically in the RCR, including howler monkey *Alouata palliata* (Gray 1849), the critically endangered Baird's Tapir *Tapirus bairdii* (Gill, 1865) and brown-headed spider monkey *Ateles fusciceps* Gray 1866 (see Tirira 2001). The Reserve also hosts dozens of Chocó's endemic and endangered birds, including long-wattled umbrellabird *Cephalopterus penduliger* P. L. Sclater, 1859. Most other animal groups remain poorly studied in the region.

CENSUS TECHNIQUES

Butterflies were sampled using Van Someren-Rydon traps (Rydon 1964) baited with shrimp that had been fermenting 10-18 days. Three sampling sites were established within eleven 1ha plots: seven 1ha plots were within primary forest and four 1ha plots within 5-year successional forest. At each sampling site, two baited traps were set up in two different strata, understorey (1.5 m) and canopy (20-27 m). Traps were checked daily during the last 8 days of each month from May 2006 to April 2007, at which time all trapped butterflies were collected and baits were renewed. All specimens are deposited at the Museo de Zoología QCAZ from the Pontificia Universidad Católica del Ecuador in Quito. Classification and nomenclature used in this paper follows Lamas (1994), except for *Prepona gnorima jordani.*

RESULTS AND DISCUSSION

We collected 5572 individuals of 150 species. The sample included one new record for Ecuador, *Opsiphanes zelotes zelotes*, and two new records for the Chocó Biogeographic Region: *Adelpha naxia naxia* and *Eunica orphise*. Seven other species are known from few specimens and/or localities, and were often known only from sites further north, including: *Memphis artacaena*, *M. anna elina*, *Prepona gnorima jordani*, *Adelpha hesterbergi*, *A. heraclea heraclea*, A. *basiloides* and *A. barnesia leucas*. Details of each of these species are provided below.

NEW RECORDS FOR ECUADOR

Morphinae, Brassolini:

***Opsiphanes zelotes zelotes* Hewitson, 1873**

Three male specimens of *Opsiphanes zelotes zelotes* were trapped in the forest understorey, two of them in August in primary forest and the third one in December in successional forest. In the last revision of the genus, the distribution of *O. zelotes zelotes* was reported as Panama and western Colombia (Bristow 1991); thus, our specimens represent a new record for Ecuador. The wing patterns of the specimens collected in the RCR and the holotype of *O. zelotes* (as figured by Bristow 1991) are very similar, the former differs from the holotype by having the distal part of the forewing band disjointed, the marking in space Cu_2-Cu_1 being isolated. Information on the natural history of *O. zelotes* (subspecies not specified) is available from Costa Rica, with hostplants records in the Arecaceae (see Janzen & Hallwachs 2009).

NEW RECORDS FOR THE CHOCÓ BIOGEOGRAPHIC REGION

Limenitidinae, Limenitidini:

***Adelpha naxia naxia* (C. & R. Felder, 1867)**

Nineteen individuals of *Adelpha naxia naxia* were collected, mostly in the canopy and in successional forest. Butterflies were collected mainly in May (14 individuals), with two individuals in June and August, and one individual in February. According to Willmott (2003), this taxon ranges from Mexico to northern Colombia, and east of the Andes from Venezuela to Bolivia, the Brazilian Amazon and the Guianas. Willmott (2003) predicted the occurrence of this species in western Ecuador, formally reported for the first time here. The species has also recently been recorded in western Ecuador from one other site, in Manabí (Padrón pers. comm.). Populations of co-mimic species of *A. naxia* occurring in the east and west slopes of the Andes (e.g. *A. iphiclus* (Linnaeus, 1758)) often correspond to different subspecies, so it is possible that the individuals of *A. naxia naxia* collected in RCR might also represent a new subspecies different from the Amazonian nominate subspecies (Willmott pers. comm.). These specimens differ from individuals from the Ecuadorian Amazonia in two aspects: first, the postdical spot on the dorsal surface of the forewing in cell M3-M2 is at least twice the size as that in cell M2-M1. Second, the ventral surface has a brownish ground color rather than reddish.

In Central America, *A. naxia naxia* tends to be common; however, in South America it is rather rare (Willmott 2003). Immature stages are unknown (Willmott 2003), although hosplants for some subspecies have been reported (Beccaloni *et al*. 2008).

Biblidinae, Biblidini:

***Eunica orphise* (Cramer, 1776)**

Eunica orphise was represented in our samples by only one male specimen, which was collected in November in the canopy of primary forest. *Eunica orphise* was formerly reported from Colombia and Guyana south to Bolivia and throughout most of the Amazon Basin (Jenkins 1990), but not from the Chocó Region. There is no information available about the immature stages of this species. The specimen shows some differences in comparison with Amazonian specimens, and the possibility that it represents a distinct subspecies is under investigation (Checa in prep.).

ADDITIONAL SPECIES (NEW DISTRIBUTION DATA)

Charaxinae, Anaeini:

***Memphis artacaena* (Hewitson, 1869)**

One female specimen of *Memphis artacaena* was collected in the canopy of successional forest in May. According to DeVries (1987), this species occurs from Mexico to Colombia, though it has recently been recorded at isolated localities in western Ecuador in Loja, Manabí and Guayas (Willmott pers. comm.). Other known west Ecuadorian sites are all in dry forests habitats, and the discovery of *M. artacaena* in the RCR, in tropical wet forests, significantly expands our knowledge of the habitats where this species occurs. Information on the natural history of

this species is known (see DeVries 1987, Janzen & Hallwachs 2009).

***Memphis anna elina* (Staudinger, 1897)**
Seven specimens of *M. anna elina* were collected, most of them in the canopy of primary and successional forest, all trapped between June to August 2006. Comstock (1961) reported specimens of this taxon collected in the Chocó and other localities in Colombia, and there are records from Carchi and northern Esmeraldas in Ecuador (Willmott, pers. comm.). The Canandé specimens thus represent the southernmost locality for this taxon.

Charaxinae, Preponini:
***Prepona gnorima jordani* Fruhstorfer, 1905**
Only one male specimen of this taxon was collected, in June in the understorey of primary forest. The range of the nominate subspecies is from Honduras to Colombia, and it is "very rare" throughout its entire range (DeVries 1987). In western Ecuador, the taxon was known previously only from northern Esmeraldas (Willmott pers. comm.); therefore, our record represents a southern extension of its known range. Hostplants for *P. gnorima* and information on the early stages are unknown (DeVries 1987, Neild 1996).

Limenitidinae, Limenitidini:
***Adelpha hesterbergi* Willmott & J. Hall, 1999**
Two specimens of this species were collected in the canopy of primary forest in June and July. This species has been recorded elsewhere only from one locality in Carchi, Ecuador, and one locality in Cartago, Costa Rica, and is one of the rarest species in the genus (Willmott 2003). Most significantly, the Canandé record represents a extension in the known elevational range of the species, which was formerly known only from 1050-1200m (Willmott 2003). The immature stages and hostplants are unknown.

***Adelpha heraclea heraclea* (C. Felder & R. Felder, 1867)**
This species was represented by 22 specimens, most of them collected in the canopy of primary and successional forest. Most butterflies were trapped in May (n=12), with others collected in June (n=5), July (n=3) and one in March and September. This species is distributed from Guatemala to western Ecuador, throughout Colombia, to southeastern Peru and Brazil. Only one sight record has been reported for northwestern Ecuador at El Durango, Esmeraldas (north of the RCR); thus, these are the first specimens collected of *A. heraclea heraclea* in western Ecuador and represent the southernmost locality for the species west of the Andes. Information on the natural history of this taxon is available (Willmott 2003).

***Adelpha basiloides* (H. W. Bates, 1865)**
One specimen of this species was collected in the understorey of primary forest in May. *Adelpha basiloides* occurs from extreme southwestern USA (Texas) throughout Central America to northern Venezuela and western Ecuador, with its abundance declining towards the south, so that in Ecuador the species is rare (Willmott 2003). This species has only been recorded from two localities in Ecuador (9 individuals collected) in Esmeraldas province, north of the RCR (see Willmott 2003); thus, the Canandé specimens represent a southern extension of its known range. Information on immature stages and hostplant records are available (see Willmott 2003, Beccaloni *et al.* 2008, Janzen & Hallwachs 2009).

***Adelpha barnesia leucas* Fruhstorfer, 1915**
Thirty-five specimens of *A. barnesia leucas* were trapped, mainly in the canopy of primary forest. The majority of butterflies were collected from May to July (n=30), but some were also collected in January (n=4) and March (n=1). The distribution of this taxon includes both Pacific and Atlantic slopes of Mexico to northwestern Venezuela and northwestern Ecuador; it is not uncommon in Central America but it is rare in Venezuela and Ecuador (Willmott 2003). Indeed, this taxon has only been reported from 2 Ecuadorian localities north of the RCR (7 individuals collected) (see Willmott 2003); therefore, the Canandé specimens represent a southern extension of its known range. Information on its natural history, including hostplants and immature stages, is available (see Willmott 2003, Janzen & Hallwachs 2009).

It is important to point out most species reported here were recorded only, or at least more abundant, during the months May, June and July, and this corresponds with overall patterns of butterfly abundance which are likely linked to temperature and rainfall (Checa in prep.). Thus, the fact that we recorded some species like *A. heraclea* and *A. naxia* as abundant, when they have very few former records, supports the idea that they are highly seasonal.

To help prioritize conservation efforts in western Ecuador it would be worthwhile to assess the IUCN conservation status of the species reported in this study which have restricted geographic ranges, especially *Opsiphanes zelotes zelotes*, *Memphis anna elina* and *Adelpha hesterbergi*. Further studies on abundance patterns and ecology of these species are urgently required to accomplish this goal. Unfortunately, the rapid rate of habitat degradation in northwestern Ecuador limits these prospects.

This study only included nymphalid butterfly species attracted to baits, and more than three-quarters of the species that probably occur in the RCR remain to be studied, including the least known and most speciose families: Hesperiidae, Lycaenidae and Riodinidae. Without doubt, several butterfly species undescribed or not reported from Ecuador may be present in this area. Finally, our results demonstrate the tremendous significance of the remaining patches of primary forest persisting in northwestern Ecuador and emphasize the importance of preserving these last remmants of tropical wet forests in the Chocó Region.

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