

Fruit-feeding butterflies guide of subtropical Atlantic Forest and Araucaria Moist Forest in State of Rio Grande do Sul, Brazil

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Abstract: This study presents a compilation of fruit-feeding butterflies species for Rio Grande do Sul Atlantic Forest aiming to be a tool for identification of these lepidopterans from two phytophysiognomies of this biome. Samples were carried out for more than four years with entomological nets and bait traps techniques in areas of Subtropical Atlantic Forest (SAF) and Araucaria Moist Forest (AMF). Seventy-six butterfly species were recorded in this region of Atlantic Forest, 60 species for SAF and 53 for AMF. Fruit-feeding butterflies represent about 50% of the total species richness of the Nymphalidae recorded for the region, a value of the same order of those found for similar studies in tropical forests regions. *Dasyophthalma rusina* is a new record for Rio Grande do Sul. **Keywords:** Atlantic Forest, inventory, field guide, nymphalidae, species richness.

SANTOS, J.P., ISERHARD, C.A., TEIXEIRA, M.O. & ROMANOWSKI, H.P. **Guia de borboletas frugívoras das Florestas Ombrófilas Densa e Mista do Rio Grande do Sul, Brasil.** *Biota Neotrop.* 11(3): <http://www.biotaneotropica.org.br/v11n2/pt/abstract?article+bn01311032011>

Resumo: Este estudo é uma compilação de dados sobre a fauna de borboletas frugívoras na Mata Atlântica no Rio Grande do Sul, e tem como objetivo possibilitar a identificação das espécies ocorrentes em duas formações vegetais deste bioma. Foram realizadas amostragens com as técnicas de rede entomológica e armadilhas de iscas atrativas em áreas de Floresta Ombrófila Densa (FOD) e Floresta Ombrófila Mista (FOM), ao longo de mais de quatro anos. Foram registradas 76 espécies para a Mata Atlântica, sendo 60 espécies para a FOD e 53 para a FOM. As borboletas frugívoras representaram cerca de 50% da riqueza total de espécies da família Nymphalidae já registradas para a mesma área, valor semelhante foi encontrado para outras regiões de florestas tropicais. *Dasyophthalma rusina* constitui-se em um novo registro para o Rio Grande do Sul. **Palavras-chave:** mata atlântica, inventário, guia de campo, nymphalidae, riqueza de espécies.

Introduction

Nymphalidae is divided into two guilds according to adult feeding habits: nectarivorous species, which use flower nectar as a resource, and fruit-feeding species, which feed on decomposing fruits, plant exudates, and mammal excrement (DeVries 1987). Usually, fruit-feeding butterflies comprise between 40 and 55% of the total diversity of Nymphalidae in a rainforest site (Pinheiro & Ortiz 1992, Daily & Ehrlich 1995, DeVries et al. 1999, DeVries & Walla 2001). Because the guild can be easily sampled with well established protocols using bait traps, it is regarded as a useful tool for monitoring and studies on community structure (Freitas et al. 2003).

Given their charming appeal and importance for the development of conservation and ecological theory, researchers and admirers alike are interested in ways to recognize butterfly species. In fact, butterflies may be used as flagship species in conservation planning and to raise the awareness and attract the public to activities related to the maintenance and preservation of native environments. Field guides provide an invaluable service for these issues, allowing the identification of species and helping to solve doubts with regards to natural history information. In the case of butterflies, use of field guides may lessen the need for unnecessary collections, ensuring the survival of individuals and the performance of faster inventories. This can be of great use for the planning and management of natural reserves, as well as for ecological and taxonomic studies (Brown 1992).

Field guides to insects of tropical regions are scarce and Brazil is no exception. A few pioneer works comprise a guide of the fruit-feeding butterflies of the Reserva Estadual do Morro Grande and Caucaia do Alto (Uehara-Prado et al. 2004) and a guide to the butterflies of Serra do Japi (Brown 1992), both in the state of São Paulo. For southern Brazil, our region of interest, butterfly identification guides are available for provinces in Argentina, such as Misiones and Buenos Aires (Canals 2000, 2003, Klimaitis 2000, Varga 2000, Fernández Díaz 2007, Nuñez-Bustos 2010). Although these guides are useful for the identification of some species, their coverage is far from complete for southern Brazil, especially for the Atlantic Forest.

The Atlantic Forest is classified as a set of forest physiognomies and formations that consists of coastal areas, lowland forests, and high-altitude forest and grasslands. The major forest types in this are Atlantic Forest stricto sensu, Araucaria Moist Forest, Semi-deciduous and Deciduous Seasonal Forests; the associated ecosystems are mangroves, salt marshes, inland swamps, high-altitude grasslands, and coastal and oceanic islands (SOS Mata Atlântica 2010). According to Brown (1996), about two-thirds of the butterfly species in Brazil occur in the Atlantic Forest biome.

The Laboratório de Ecologia de Insetos (Insect Ecology Lab) of the Universidade Federal do Rio Grande do Sul, through the program “Borboletas do Rio Grande do Sul” (Rio Grande do Sul Butterflies) have been studying butterfly fauna in various habitats of the state. The main objective of the program is to contribute to the knowledge on butterfly diversity and to stimulate the conservation of the species and their environments. Consequently, various projects have been developed in Atlantic forest sites, primarily in the Subtropical Atlantic Forest (Iserhard & Romanowski 2004) and Araucaria Moist Forest (Bond-Buckup 2008, Romanowski et al. 2009, Iserhard et al. 2010, Pedrotti et al. 2011). This work presents a compilation of the data on fruit-feeding butterflies inventoried in these studies and aims to: (i) contribute to the knowledge of the species richness of this group of butterflies in the Atlantic Forest; and (ii) provide an identification guide for the butterflies of this guild in this region.

Material and Methods

1. Study areas

Maquiné municipality (29° 35' S and 50° 16' W) is located in the northeast region of Rio Grande do Sul, on the slopes of Serra Geral, between the coastal plain and the basaltic plateau, at altitudes varying from 100 to 950 m a.s.l.. The climate is humid subtropical with an

average annual temperature higher than 18 °C (Cfa) (Maluf 2000). The vegetation is predominantly secondary subtropical Atlantic Forest (from now on referred to as SAF), at various degrees of development interspersed with pastures and various crops (for more details see Iserhard & Romanowski 2004).

The “Floresta Nacional de São Francisco de Paula (FLONA)” (29° 24' S and 50° 22' W), in the municipality of São Francisco de Paula, is also at the northeastern Rio Grande do Sul, but lays in the basaltic plateau, by the region of “Campos de Cima da Serra” (high altitude grasslands). FLONA has an area of 1606.60 ha at 900 m a.s.l. The climate is temperate (Cfb) and the average annual temperature is 14.5 °C (Fernandes & Backes 1998). The vegetation comprises native Araucaria Moist Forest (from now on referred to as AMF) amidst patches of *Araucaria angustifolia* (Bertol) Kuntze, *Eucalyptus* sp., and *Pinus* sp. plots and areas of grasslands within their boundaries.

2. Sampling

Data on the fruit-feeding butterflies were obtained with two techniques: (i) transects with entomological nets; and (ii) bait traps. The first methodology was used to study butterflies belonging to Papilionoidea and Hesperioidea superfamilies in the subtropical Atlantic Forest between 2001 and 2002 (Iserhard & Romanowski 2004), between 2006 and 2008 (Iserhard 2009) and in the Araucaria Moist Forest between 2006 and 2009 (Iserhard et al. 2010). Sampling was carried out for two hours in each transect, always between 10:00 AM and 4:30 PM, and the sampling effort was measured in net/hour. All butterflies seen were registered and, if necessary for identification, collected with entomological nets. More details on the sampling protocol are provided by Iserhard & Romanowski (2004) and Paz et al. (2008).

Traps for sampling fruit-feeding butterflies were cylinder-shaped, 110 cm high and 35 cm in diameter with voile cloth. Each trap has an internal funnel 22 cm in diameter to prevent the possible escape of the captured insects (adapted from Uehara-Prado et al. 2005). The traps were attached to a rope at approximately 1.5 m above ground. The bait was a mixture of sugarcane juice and mashed banana fermented for at least 48 hours and placed on a plate on a metal screen (50 × 45 cm) base hanging from a nylon thread ca.5 cm below the cylinder. The traps were arranged along the transects in sampling units (SU), each consisting of a group of five traps distant approximately 20 m from each other; the distance between successive SUs along the transect was 100 m. Captured specimens were identified, marked with an overhead projector marker in the wings, and released. Individuals which were difficult to identify were collected for subsequent mounting and identification.

In the SAF region, monthly field surveys expeditions lasted up to six days and were carried out from December 2006 to April 2007. Traps were reviewed once every 24 hours, four times at each sampling occasion. For the AMF region, samplings were performed twice per season from January 2008 to December 2009. At each expedition, the traps were set in the morning of the first day and then checked 3 times at intervals of 24 hours.

Vouchers were deposited at “Coleção de Lepidoptera” of “Departamento de Zoologia” of UFRGS. The nomenclature follows Lamas (2004) and the classification of the subfamilies and tribes follows Wahlberg et al. (2009).

3. Components of the guide

A list of fruit-feeding butterfly species of the Atlantic Forest is presented in Table 1. The guide contains color plates with digital images of the species recorded in the study areas. Butterflies are shown in dorsal (D) and ventral view (V), as well as males (♂) and females (♀) when there is evident sexual dimorphism. Species are represented at 90% (mentioned as 0:9:1 on Figures) of their natural size, except for those larger species shown on Figures 5,8,9,10 and 11, which appear at only 70% (mentioned as 0:7:1 on Figures) of their natural size.

Fruit-feeding butterflies guide of Atlantic Forest

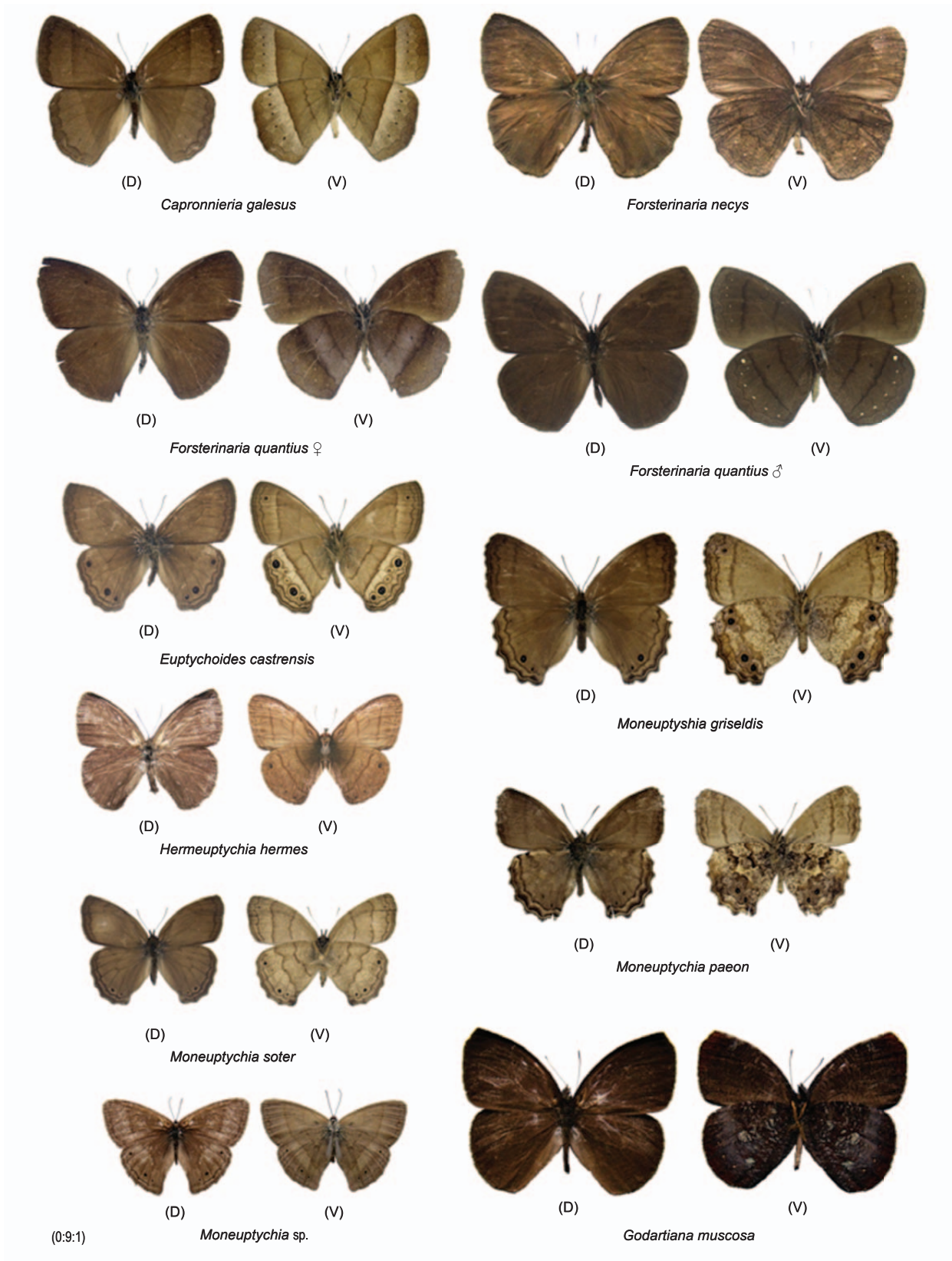


Figure 1. Satyrinae (Satyrini) of the Subtropical Atlantic Forest and Araucaria Moist Forest regions of Rio Grande do Sul.

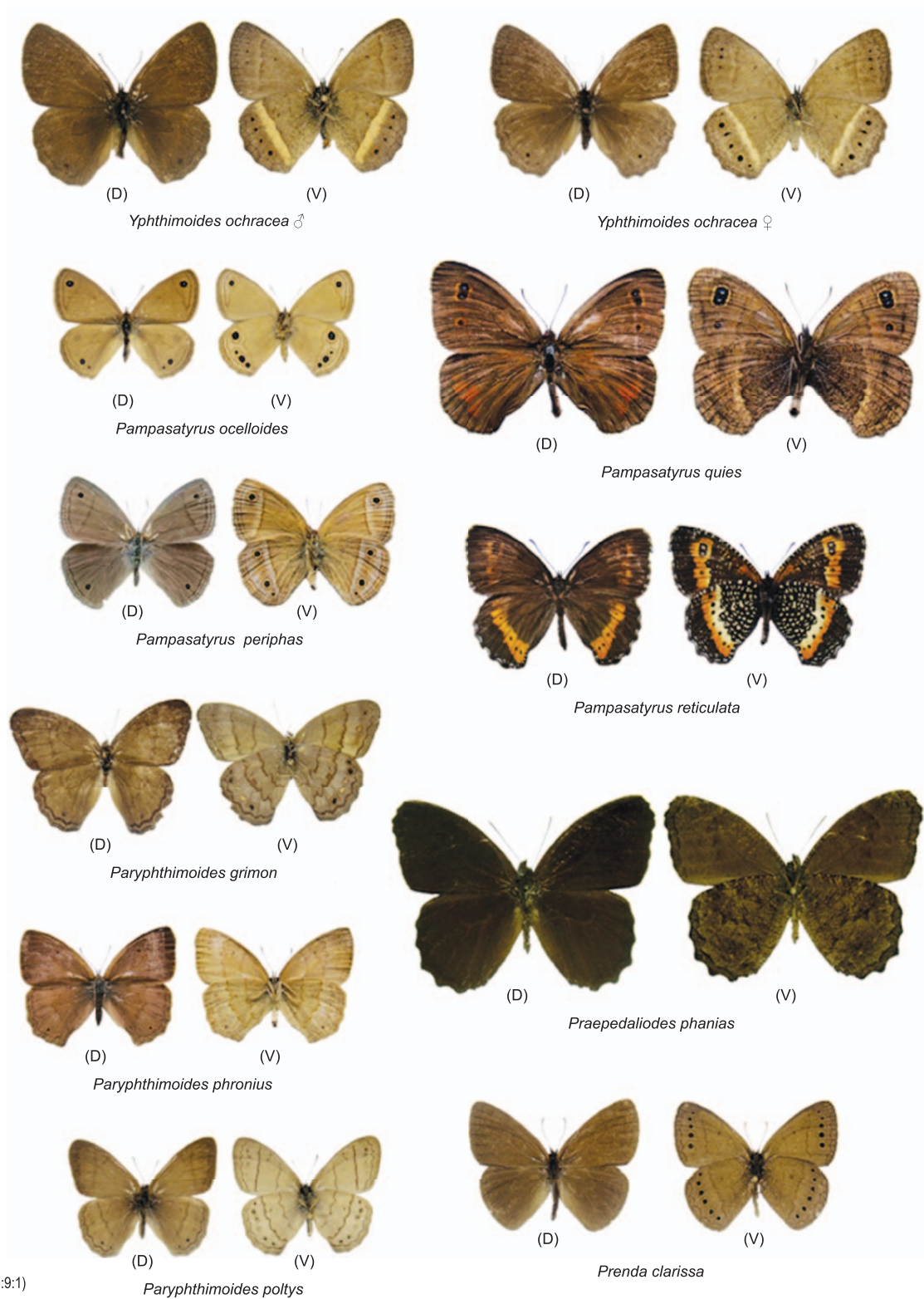


Figure 2. Satyrinae (Satyrini) of the Subtropical Atlantic Forest and Araucaria Moist Forest regions of Rio Grande do Sul.

Fruit-feeding butterflies guide of Atlantic Forest

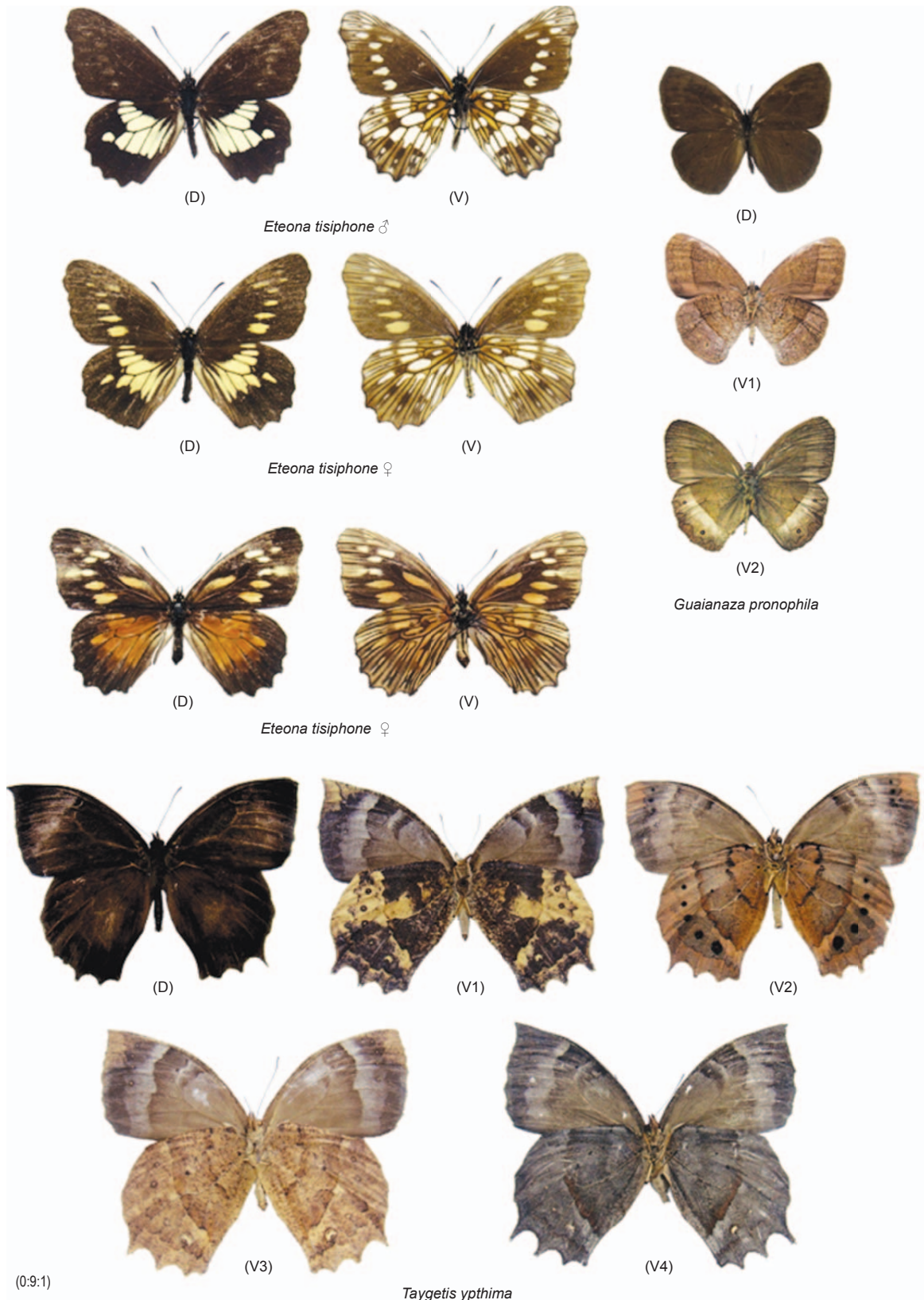


Figure 3. Satyrinae (Satyrini) of the Subtropical Atlantic Forest and Araucaria Moist Forest regions of Rio Grande do Sul.



Figure 4. Satyrinae (Morphini) of the Subtropical Atlantic Forest and Araucaria Moist Forest regions of Rio Grande do Sul.

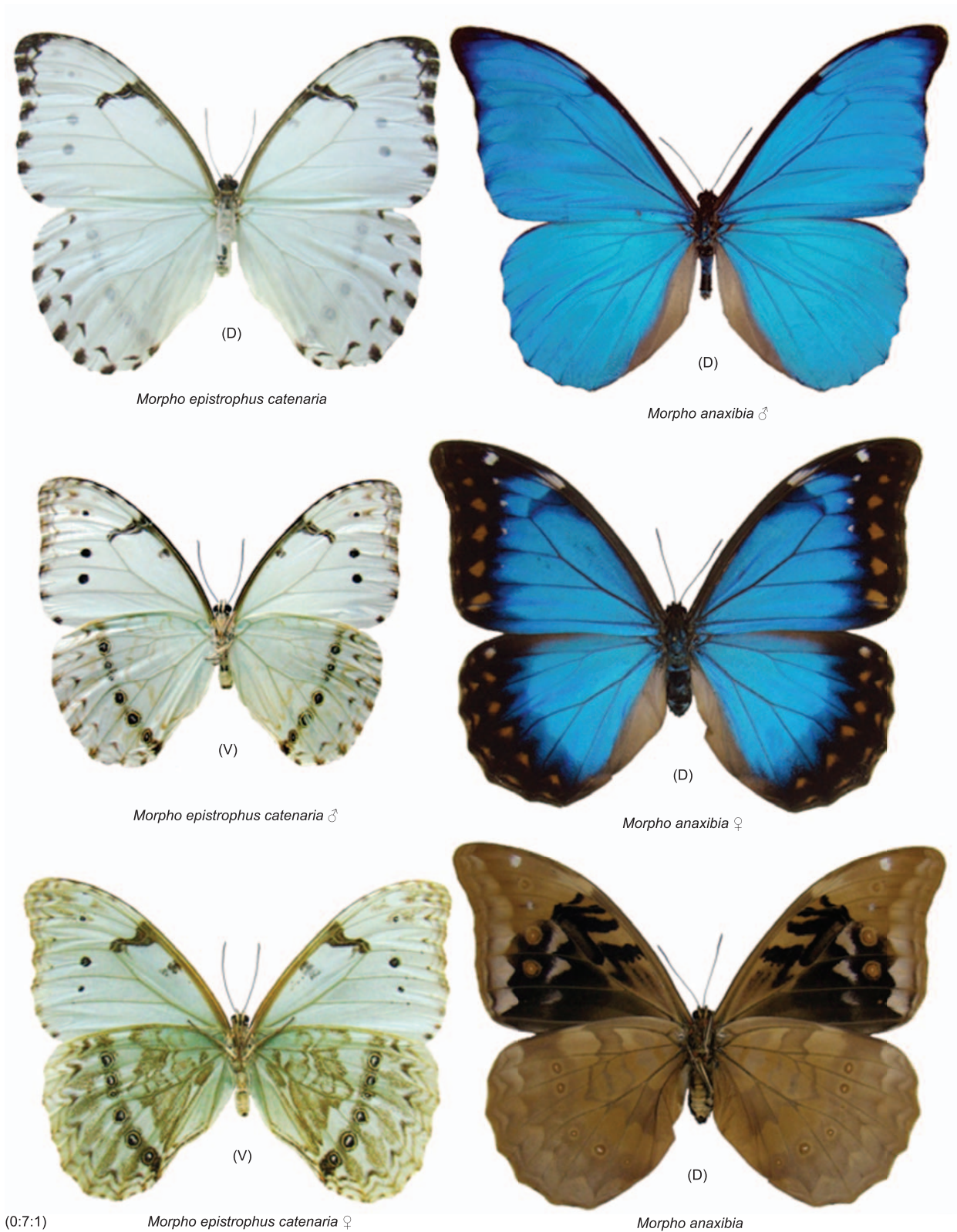
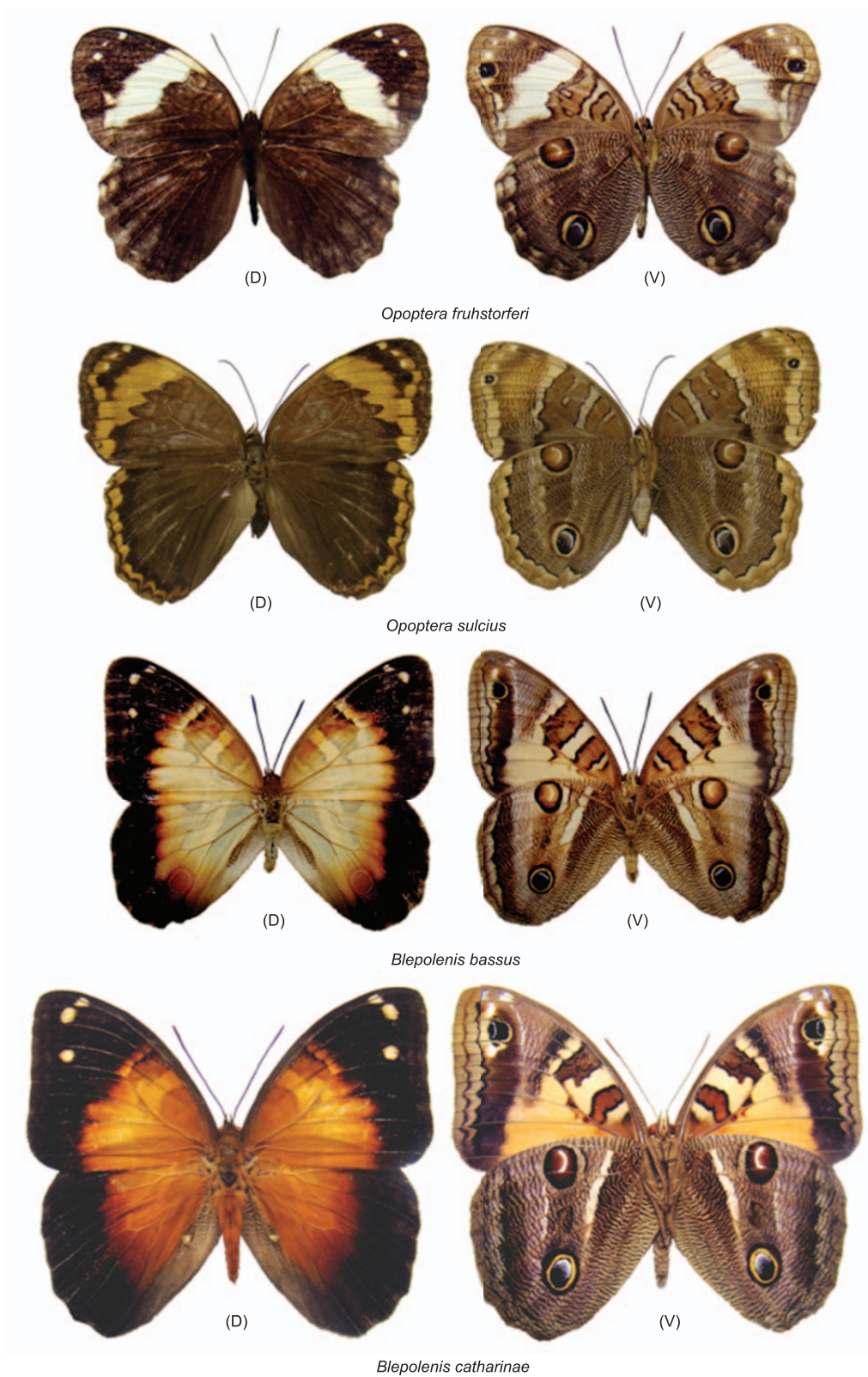


Figure 5. Satyrinae (Morphini) of the Subtropical Atlantic Forest and Araucaria Moist Forest regions of Rio Grande do Sul.

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(0:9:1)

Figure 6. Satyrinae (Brassolini) of the Subtropical Atlantic Forest and Araucaria Moist Forest regions of Rio Grande do Sul.

Fruit-feeding butterflies guide of Atlantic Forest

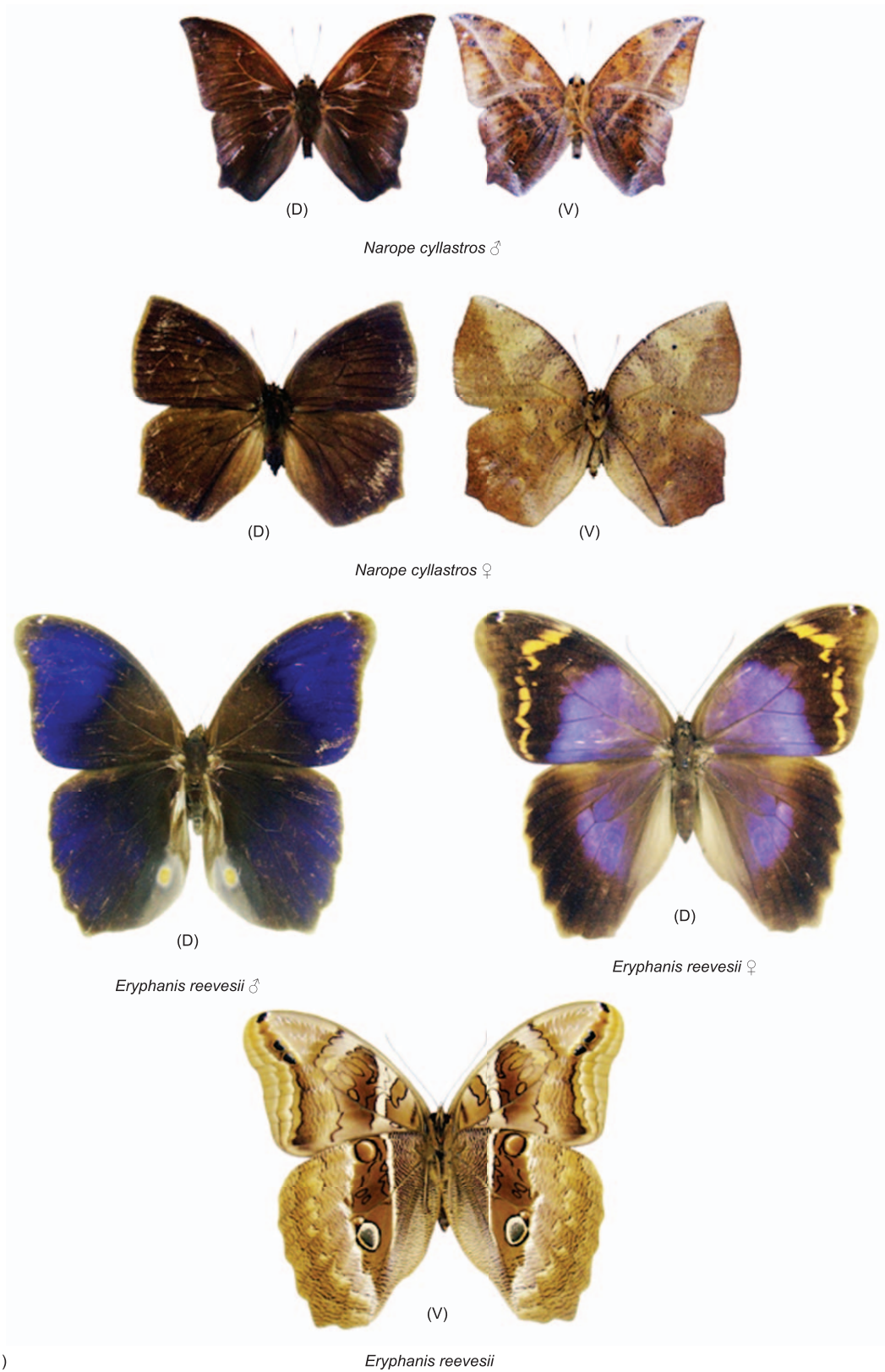


Figure 7. Satyrinae (Brassolini) of the Subtropical Atlantic Forest and Araucaria Moist Forest regions of Rio Grande do Sul.

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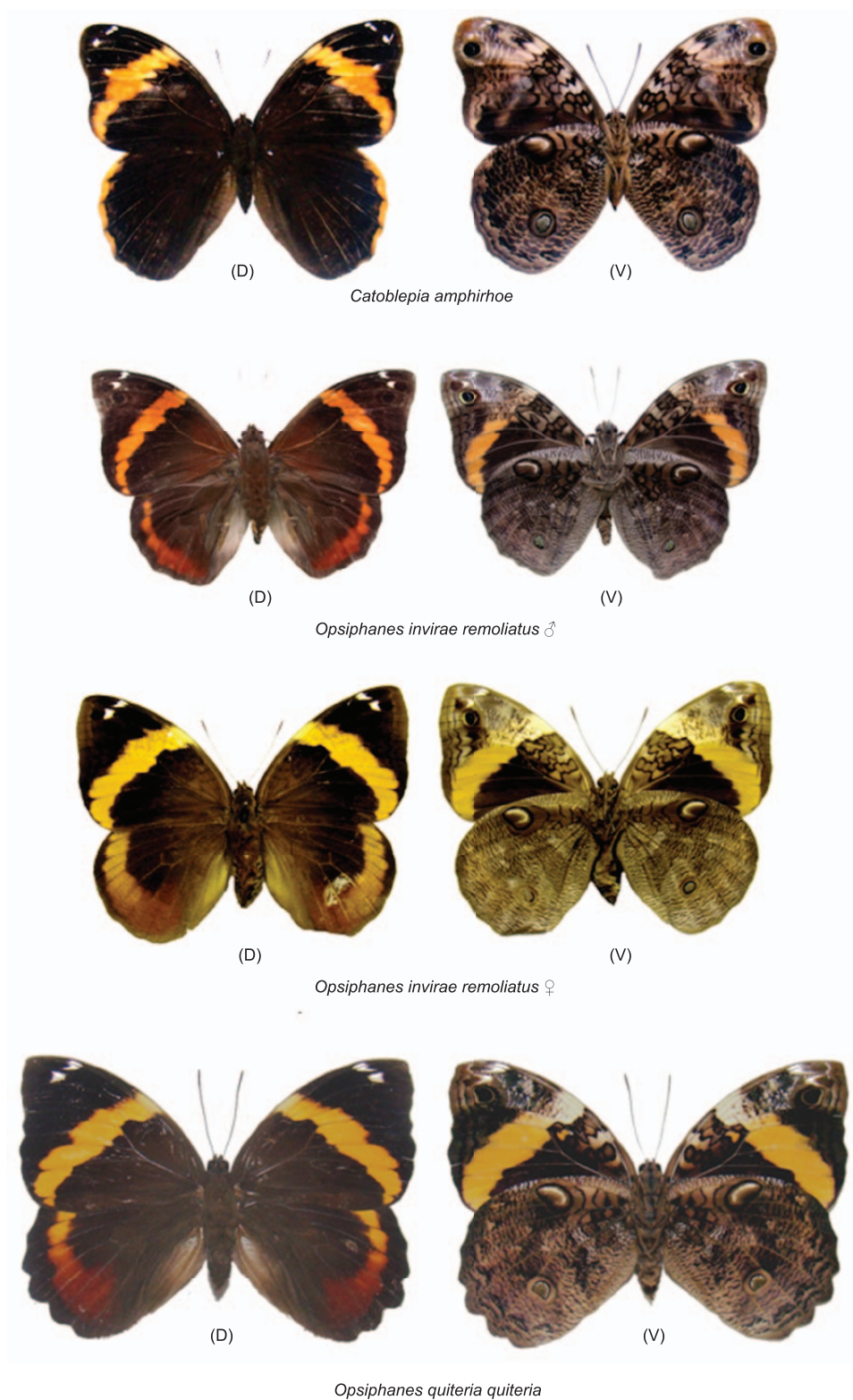


Figure 8. Satyrinae (Brassolini) of the Subtropical Atlantic Forest and Araucaria Moist Forest regions of Rio Grande do Sul.

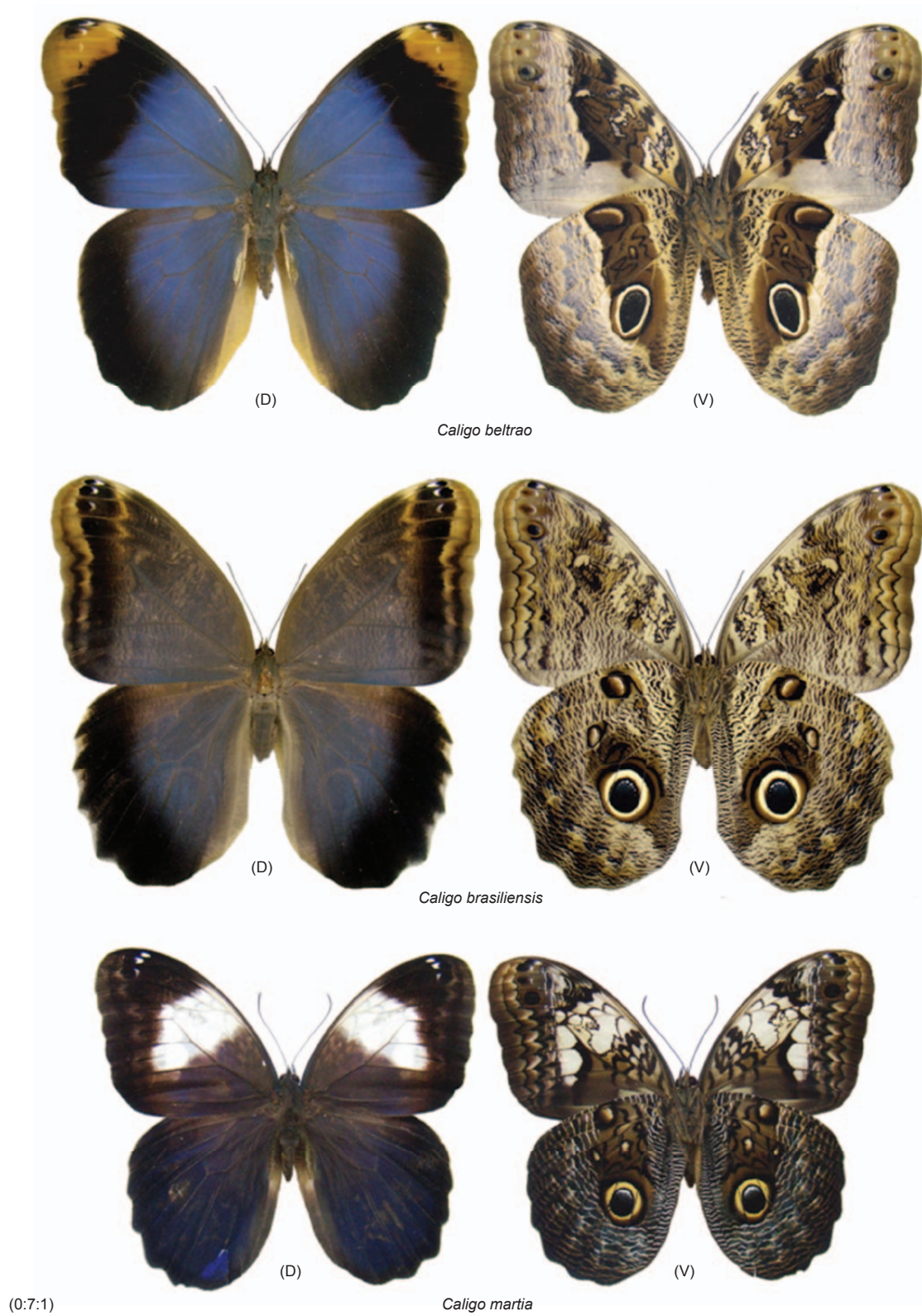


Figure 9. Satyrinae (Brassolini) of the Subtropical Atlantic Forest and Araucaria Moist Forest regions of Rio Grande do Sul.

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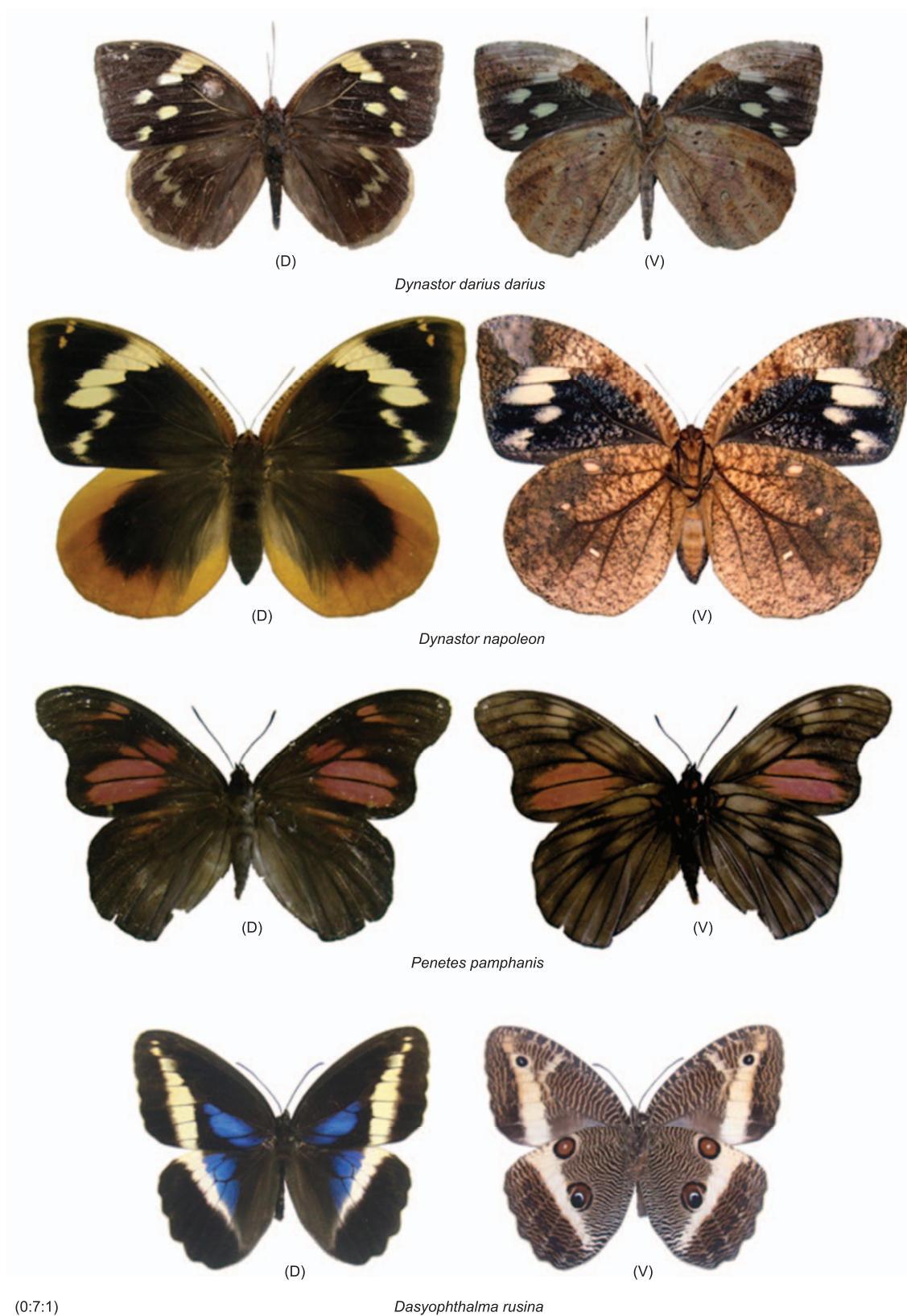


Figure 10. Satyrinae (Brassolini) of the Subtropical Atlantic Forest and Araucaria Moist Forest regions of Rio Grande do Sul.

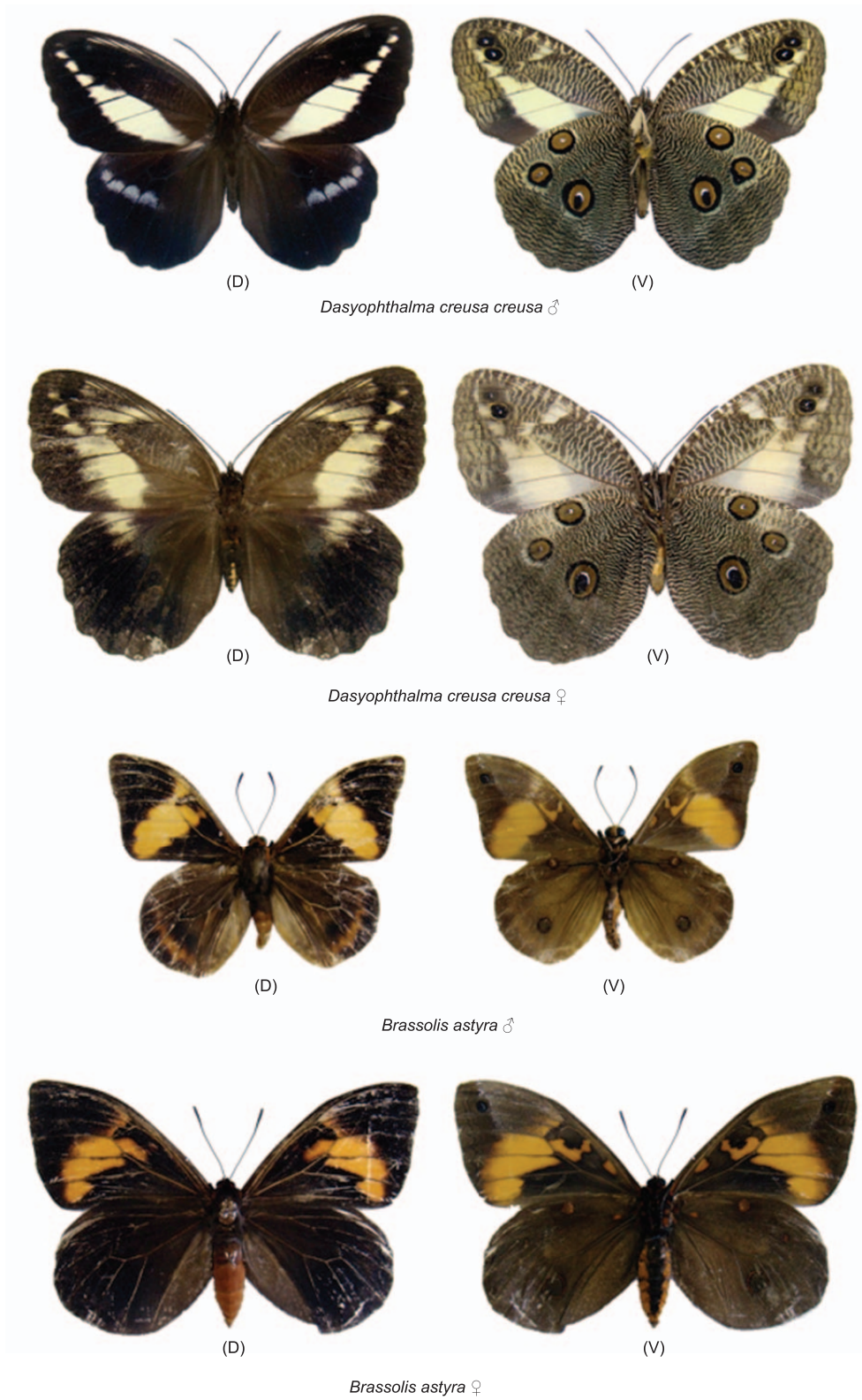


Figure 11. Satyrinae (Brassolini) of the Subtropical Atlantic Forest and Araucaria Moist Forest regions of Rio Grande do Sul.

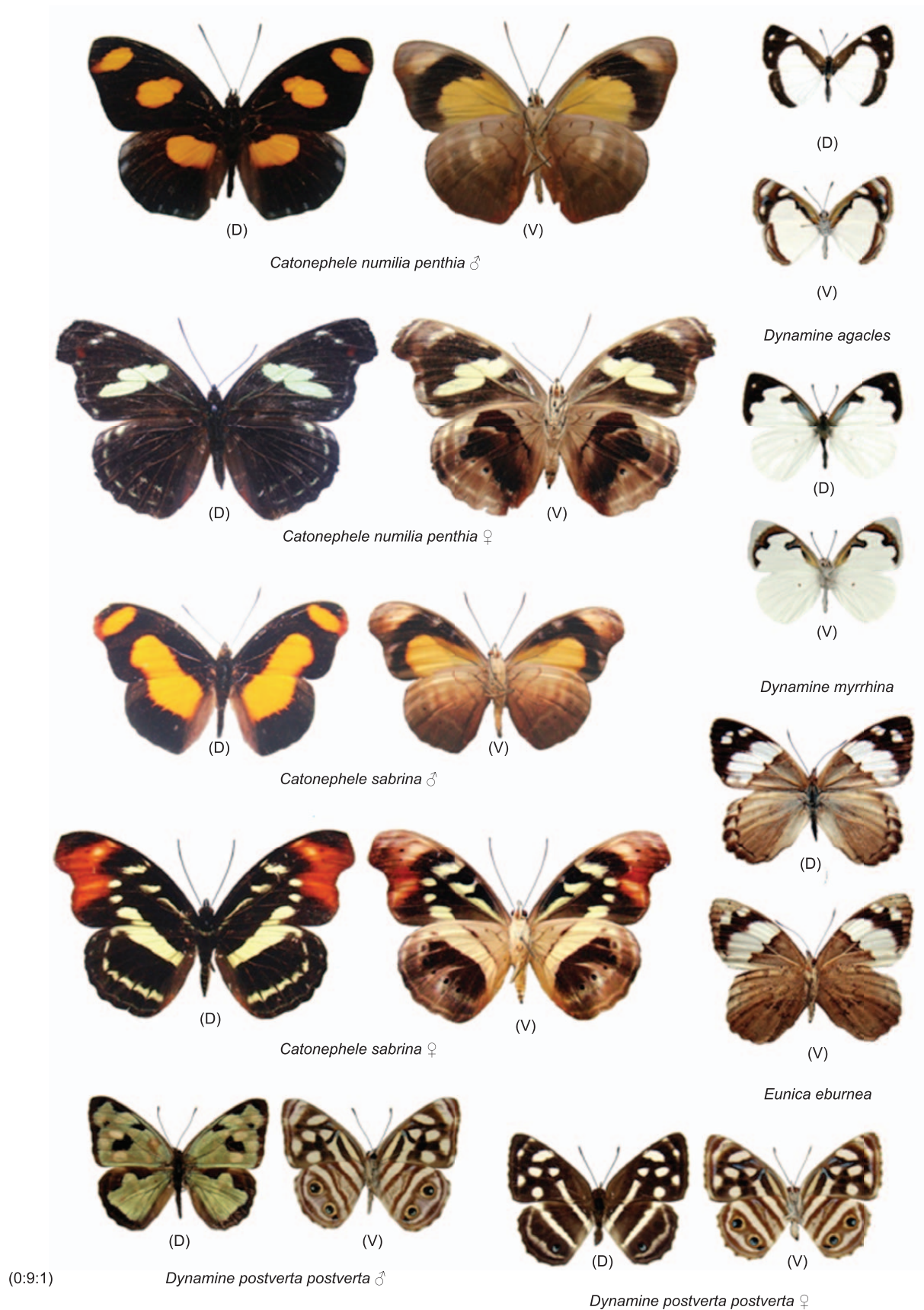
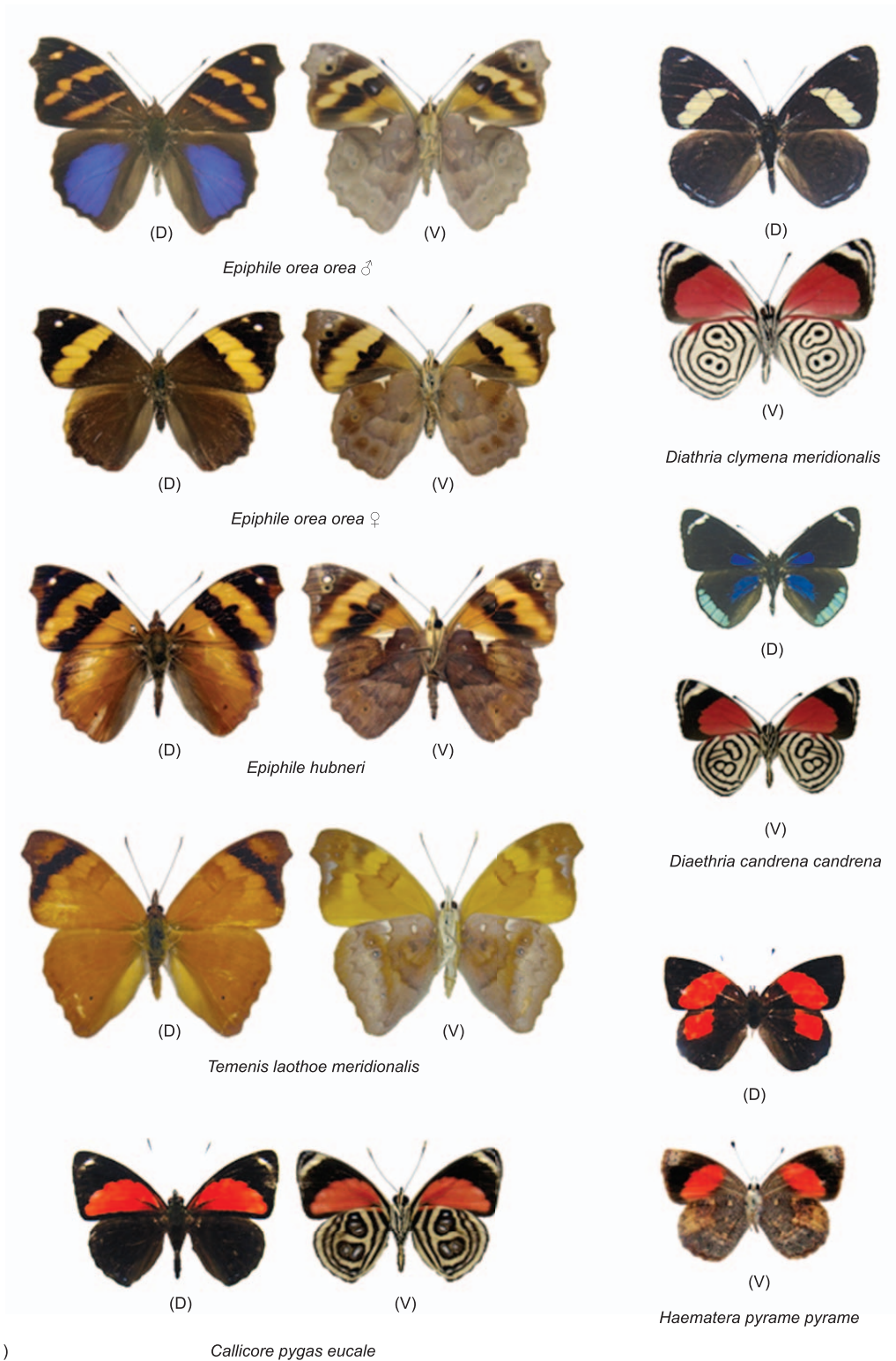


Figure 12. Biblidinae (Catonephelini, Eubagini) of the Subtropical Atlantic Forest and Araucaria Moist Forest regions of Rio Grande do Sul.



(0:9:1)

Figure 13. Biblidinae (Epiphilini, Catagrammini) of the Subtropical Atlantic Forest and Araucaria Moist Forest regions of Rio Grande do Sul.

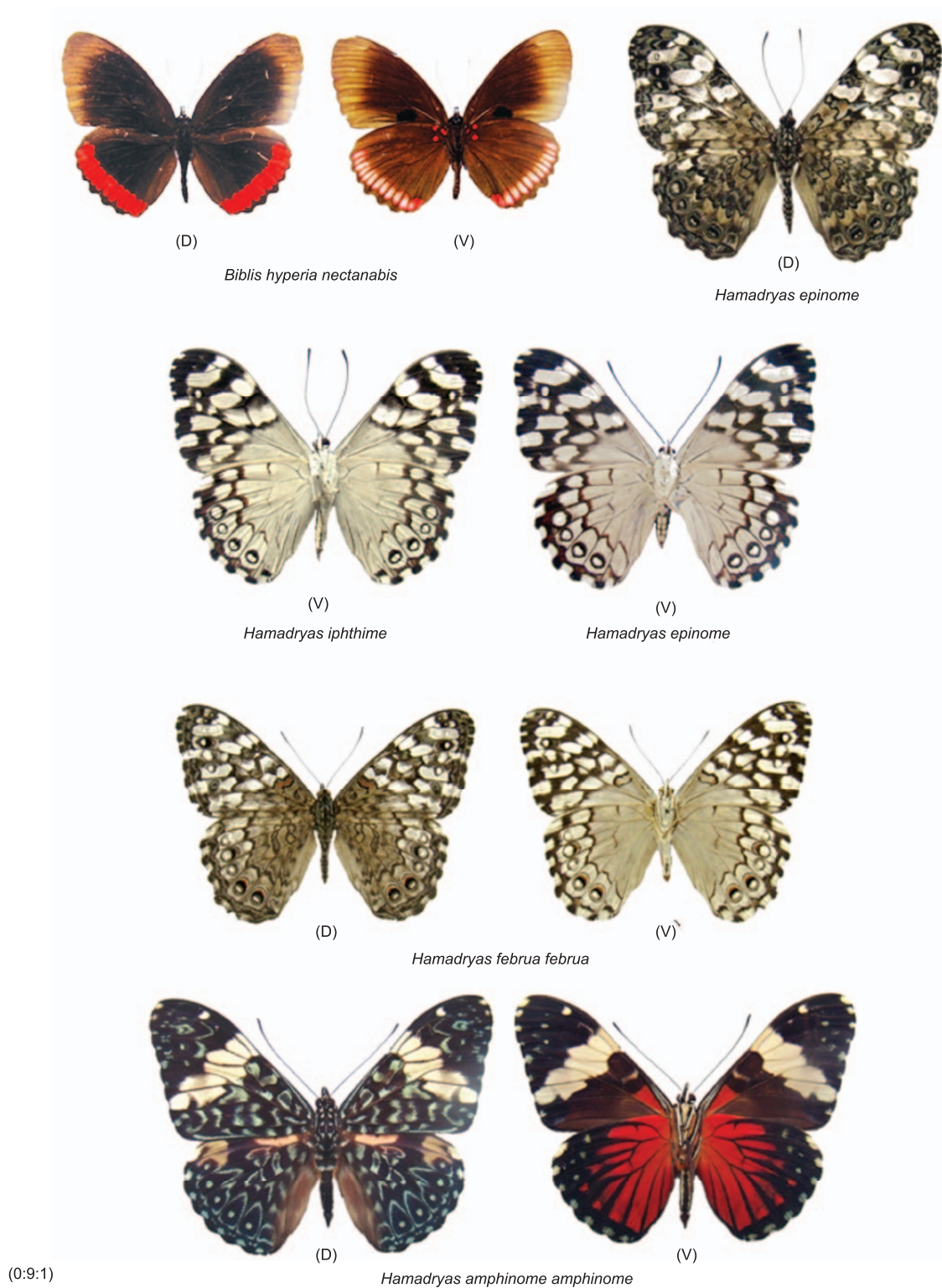


Figure 14. Biblidinae (Ageroniini, Biblidini) of the Subtropical Atlantic Forest and Araucaria Moist Forest regions of Rio Grande do Sul.

Fruit-feeding butterflies guide of Atlantic Forest

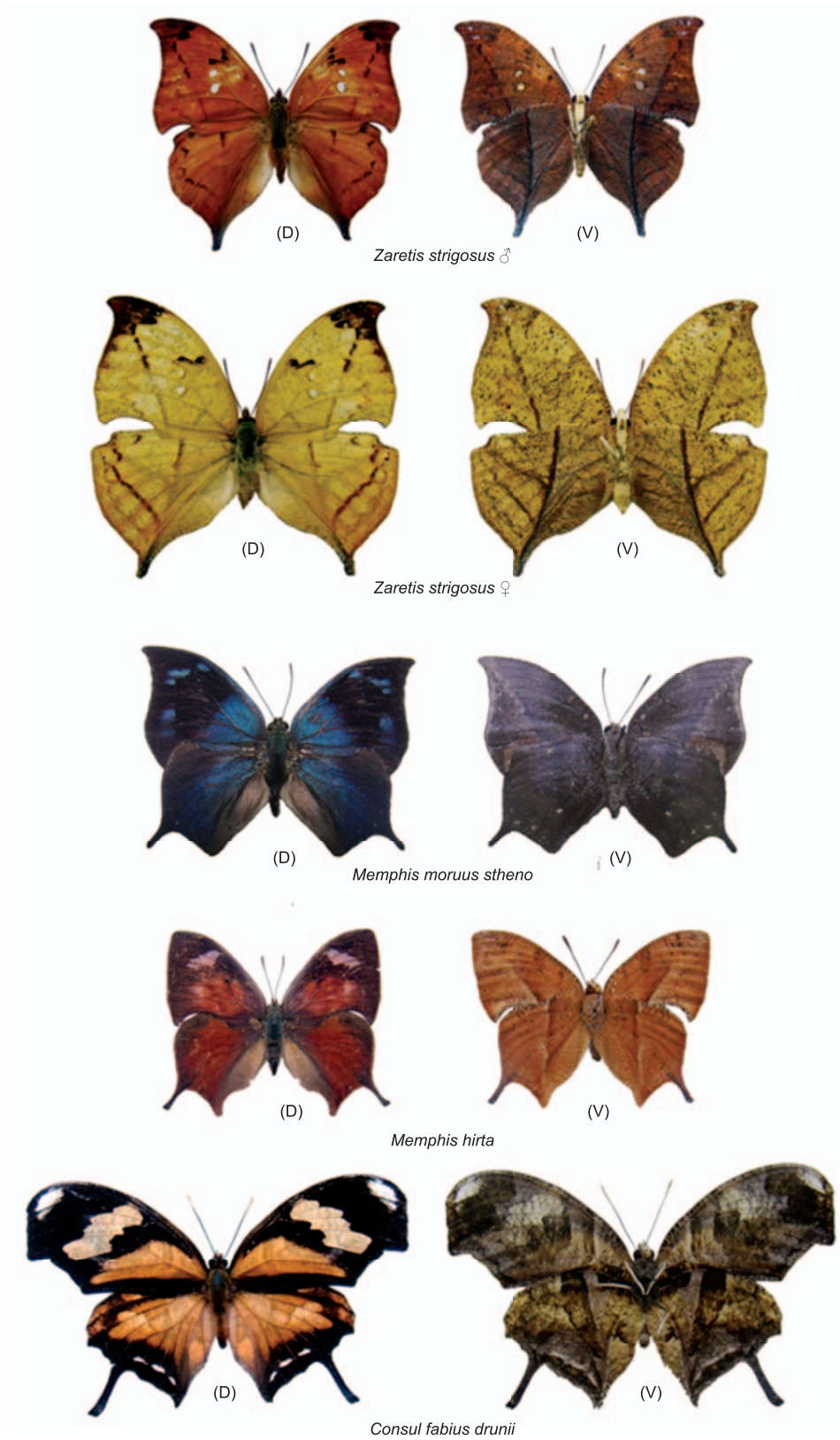


Figure 15. Charaxinae (Anaeni) of the Subtropical Atlantic Forest and Araucaria Moist Forest regions of Rio Grande do Sul.

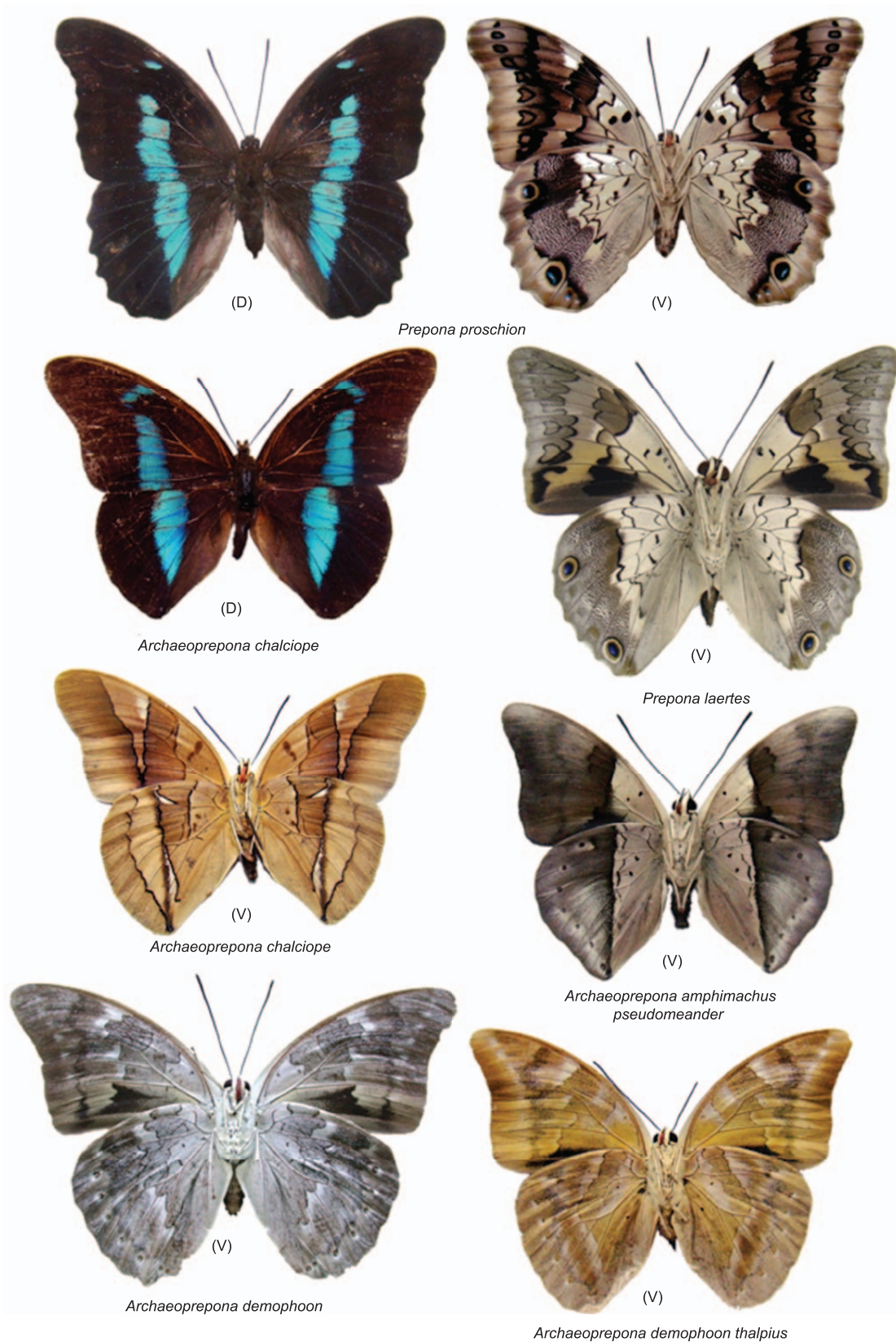


Figure 16. Charaxinae (Preponini) of the Subtropical Atlantic Forest and Araucaria Moist Forest regions of Rio Grande do Sul.

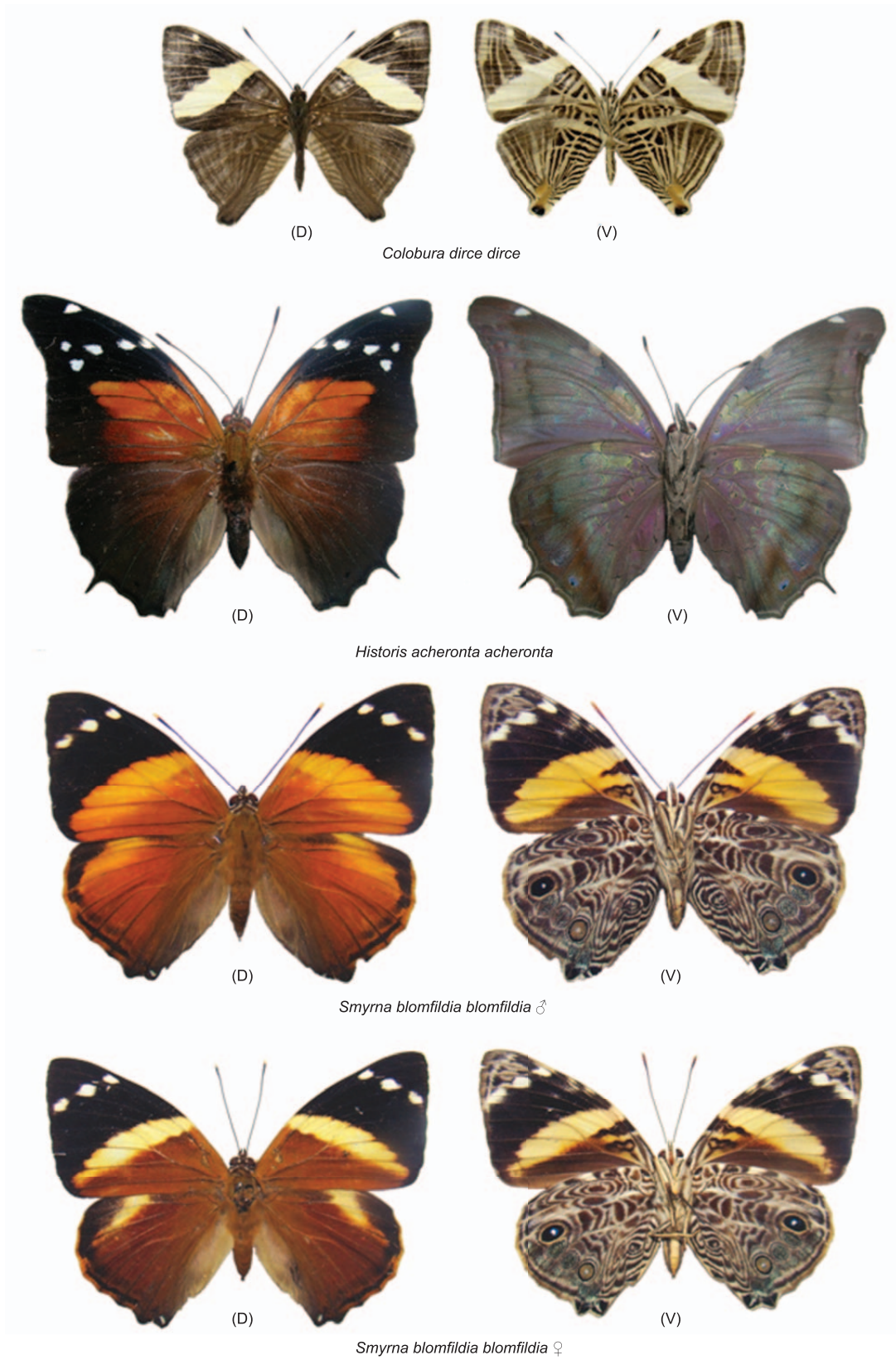


Figure 17. Nymphalinae (Coeini) of the Subtropical Atlantic Forest and Araucaria Moist Forest regions of Rio Grande do Sul.

Table 1. Species list of fruit-feeding butterflies recorded at the formations of the Atlantic Forest of Rio Grande do Sul. SAF = Subtropical Atlantic Forest; AMF = Araucaria Moist Forest; S = Species richness.

Family/subfamilies/tribes/species	Environments		Family/subfamilies/tribes/species	Environments	
	SAF	AMF		SAF	AMF
Nymphalidae (S=76)			<i>Ypthimoides ochracea</i> (Butler, 1867)	x	x
Satyrinae (S=45)			Total S	34	33
Brassolini			Charaxinae (S=10)		
<i>Blepolenis bassus</i> (C. Felder & R. Felder, 1867)	-	x	Anaeni		
<i>Blepolenis catharinae</i> (Stichel, 1902)	x	x	<i>Consul fabius drurii</i> (Butler, 1874)	x	-
<i>Brassolis astyra</i> (Godart, [1824])	x	-	<i>Memphis hirta</i> (Weymer, 1907)	-	x
<i>Caligo beltrao</i> (Illiger, 1801)	x	-	<i>Memphis moruus stheno</i> (Prittwitz, 1865)	x	x
<i>Caligo brasiliensis</i> (C. Felders, 1862)	x	-	<i>Zaretis strigosus</i> (Gmelin 1790)	x	x
<i>Caligo martia</i> (Godart, [1824])	x	x	Preponini		
<i>Catoblepia amphirhoe</i> (Hübner, [1825])	x	x	<i>Archaeoprepona amphimachus pseudomeander</i> (Fruhstorfer, 1906)	-	x
<i>Dasyophthalma creusa creusa</i> (Hübner, 1821)	x	-	<i>Archaeoprepona chalciope</i> (Hübner, [1823])	x	x
<i>Dasyophthalma rusina</i> (Godart, [1824])	x	-	<i>Archaeoprepona demophon thalpius</i> (Hübner, 1814)	x	x
<i>Dynastor darius darius</i> (Fabricius, 1775)	x	-	<i>Archaeoprepona demophoon</i> (Hübner, [1814])	x	-
<i>Dynastor napoleon</i> Doubleday, [1849]	-	x	<i>Prepona laertes laertes</i> (Hübner, [1811])	x	-
<i>Eryphanis reevesii</i> (Doubleday, [1849])	x	x	<i>Prepona proschion</i> Fruhstorfer 1904	-	x
<i>Narope cyllastros</i> Doubleday, [1849]	x	x	Total S	7	7
<i>Opoptera fruhstorferi</i> (Röber, 1896)	x	x	Biblidinae (S=18)		
<i>Opoptera sulcius</i> (Staudinger, 1887)	x	-	Ageroniini		
<i>Opsiphanes quiteria quiteria</i> Staudinger, 1887	-	x	<i>Hamadryas amphinome amphinome</i> (Linnaeus, 1767)	x	x
<i>Opsiphanes invirae remoliatu</i> Fruhstorfer, 1907	x	-	<i>Hamadryas epinome</i> (C. Felder & R. Felder, 1867)	x	x
<i>Penetes pamphanis</i> Doubleday, [1849]	x	-	<i>Hamadryas februa februa</i> (Hübner, [1823])	x	x
Morphini			<i>Hamadryas iphthime</i> (Battes, 1864)	-	x
<i>Morpho aega</i> (Hübner, 1822)	x	x	Biblidini		
<i>Morpho anaxibia</i> (Esper, [1801])	x	-	<i>Biblis hyperia nectanabis</i> (Fruhstorfer, 1909)	x	x
<i>Morpho epistrophus catenaria</i> (Perry, 1811)	x	x	Catagrammini		
<i>Morpho portis thamyris</i> (Felder & Felder, 1867)	x	x	<i>Callicore pygas eucale</i> (Fruhstorfer, 1916)	x	-
Satyrini			<i>Diaethria candrena candrena</i> (Godart, [1824])	x	-
<i>Capronniera galesus</i> (Godart, [1824])	x	x	<i>Diaethria clymena meridionalis</i> (H.W.Bates, 1864)	x	x
<i>Eteona tisiphone</i> (Boisduval, 1836)	x	x	<i>Haematera pyrame pyrame</i> Hübner, [1819]	x	x
<i>Euptychoides castrensis</i> (Schaus, 1902)	-	x	Catonephelini		
<i>Forsterinaria necys</i> (Godart, [1824])	x	x	<i>Catonephele numilia penthia</i> (Hewitson, 1852)	x	-
<i>Forsterinaria quantius</i> (Godart, [1824])	x	x	<i>Catonephele sabrina</i> (Hewitson, 1852)	x	x
<i>Godartiana muscosa</i> (Butler, 1870)	x	x	<i>Eunica eburnea</i> Fruhstorfer, 1907	x	x
<i>Guaianaza pronophila</i> (Butler, 1867)	x	x	Epiphilini		
<i>Hermeuptychia hermes</i> (Fabricius, 1775)	x	x	<i>Epiphile hubneri</i> Hewitson, 1861		x
<i>Moneuptychia griseldis</i> (Weymer, 1911)	-	x	<i>Epiphile orea orea</i> (Hübner, 1823)	x	x
<i>Moneuptychia paeon</i> (Godart, [1824])	x	x	<i>Temenis laothoe meridionalis</i> Ebert, 1961	x	-
<i>Moneuptychia soter</i> (Butler, 1877)	x	x	Eubagini		
<i>Moneuptychia</i> sp.	-	x	<i>Dynamine agacles</i> (Dalman, 1823)	x	-
<i>Pampasatyrus ocelloides</i> (Schaus, 1902)	x	x	<i>Dynamine myrrhina</i> (Doubleday, 1849)	x	x
<i>Pampasatyrus periphias</i> (Godart, [1824])	-	x	<i>Dynamine postverta postverta</i> (Cramer, 1779)	x	-
<i>Pampasatyrus quies</i> (Berg, 1877)	-	x	Total S	16	12
<i>Pampasatyrus reticulata</i> (Weymer, 1907)	-	x	Nymphalinae (S=3)		
<i>Paryphthimoides grimon</i> (Godart, [1824])	x	-	Coeini		
<i>Paryphthimoides phronius</i> (Godart, [1824])	x	x	<i>Colobura dirce dirce</i> (Linnaeus, 1758)	x	-
<i>Paryphthimoides poltys</i> (Prittwitz, 1865)	x	-	<i>Historis acheronta acheronta</i> (Fabricius, 1775)	x	-
<i>Praepedaliodes phanias</i> (Hewitson, 1862)	x	x	<i>Smyrna blomfieldia blomfieldia</i> (Fabricius, 1781)	x	x
<i>Prenda clarissa</i> (Freitas & Mielke, 2011)	-	x	Total S	3	1
<i>Taygetis ypthima</i> Hübner, [1821]	x	x			

Results and Discussion

Overall, 8,850 fruit-feeding butterfly individuals, in 76 species belonging to 4 subfamilies of Nymphalidae were recorded in the SAF and AMF (Table 1). In the AMF region of FLONA, between the years of 2006 and 2009, 5,603 individuals in 53 species were recorded. For the SAF in Maquiné, from 2001 to 2002 and from 2006 to 2008, 3,247 butterflies were recorded in 60 species. Thirty-eight species were common to the two sites (Table 1).

Fruit-feeding butterflies represented 49% of the total richness of Nymphalidae in these areas. This result is similar to the range of 40 to 55% for fruit-feeding species of this family reported by other studies of tropical forests (Pinheiro & Ortiz 1992, Daily & Ehrlich 1995, DeVries et al. 1999, DeVries & Walla 2001). Satyrinae was the subfamily with the highest species richness with 59.5% of the representativeness, followed by Biblidinae (23%), Charaxinae (13.5%), and Nymphalinae (4%). When analyzing the data of SAF and AMF separately, this pattern of representativeness is maintained. Similar patterns of representativeness per subfamily were registered by Uehara-Prado et al. (2004) in the Atlantic Forest of São Paulo State.

During the two-year sampling period that exclusively used bait traps at FLONA, 39 species were recorded. In April 2010, after this sampling period was completed, two new records were obtained. *Hamadryas februa* (Hübner, 1823) was seen around a trap attracted to the bait, and *Dynastor napoleon* (Doubleday, 1849), a dead individual was found along a trail of Araucaria reforestation. This species is characteristic of high-altitude forest environments (Brown & Freitas 2000) and has been recorded in Minas Gerais, Rio de Janeiro (Otero et al. 2000), Paraná (Mielke, pers. comm.) and Rio Grande do Sul (Teston & Corseuil 2002). The last record of *D. napoleon* for this region was also in FLONA and dates back to 1959 (which was then called “Estação Florestal de Morrinhos”, of the Instituto Nacional do Pinho) (Romanowski et al. 2009). This specimen is deposited at the “Coleção de Lepidoptera” of “Departamento de Zoologia of the Universidade Federal do Rio Grande do Sul”. *Dynastor napoleon* has crepuscular habits. Otero et al. (2000) includes this species in the red list of threatened fauna in Rio de Janeiro State.

Brassolis astyra (Godart, 1824), *Dasyophthalma rusina* (Godart, 1824) and *Morpho anaxibia* (Esper, 1801) were only found in the SAF. The species of the *Brassolis* have a reduced proboscis and was not attracted to the bait. *Dasyophthalma rusina* is a new record for Rio Grande do Sul; formerly, it was known to be distributed from Bahia and only as far south as Santa Catarina.

Euptychoides castrensis (Schaus, 1902) and the species of *Pampasatyris* have been observed exclusively in the AMF (Teston & Corseuil 2002, Romanowski et al. 2009, Iserhard et al. 2010). *Pampasatyris ocelloides* (Schaus, 1902) and *P. periphias* (Godart, 1824) have been recorded in other regions of the grasslands of Rio Grande do Sul (Marchiori & Romanowski 2006, Morais et al. 2007, Paz et al. 2008), while *P. quies* (Berg, 1877) and *P. reticulata* (Weymer, 1907) are closely associated with the Campos de Cima da Serra, the adjacent grassland formation that is mingled with the Araucaria Forest of Rio Grande do Sul.

Prenda clarissa Freitas & Mielke, 2011 was recently described as a new genus and species of Satyrinae. Its distribution includes the Southern states of Rio Grande do Sul, Santa Catarina and Paraná. *P. clarissa* appears to be linked to highland native grasslands in south Brazil (*Campos de Cima da Serra* region) (Freitas et al. 2011). Therefore, *P. clarissa* can be treated as potential threatened species due to fragmentation and conversion of its native habitats and should be included in future conservation plans for this biome (Freitas et al. 2011).

This study contains previously unknown information about the fruit-feeding butterflies of the Atlantic Forest of Rio Grande do Sul. It is hoped that these results together with the identification guide, will help the observation and study of fruit-feeding butterflies by amateurs and scientists alike and thus contribute the development of a sense of love for these organisms and their habitats and for their conservation. It also serves as a starting point for future monitoring efforts intended to track future changes in the fruit-feeding butterfly community of this region.

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