

A Study of *Protesilaus microdamas* (Burmeister) and the Little-known *P. dospassosi* (Rütimeyer) and *P. huanucana* (Varea de Luque) (Papilionidae)

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Abstract. Certain wing and genitalic characters of *P. microdamas* are distinctive from other *Protesilaus sens. lat.*. Based on these genitalic distinctions, *P. dospassosi* is associated with *Protesilaus*, and *P. microdamas* in particular, for the first time. *P. huanucana* is accorded species status based on wing and genitalic examination of all *Protesilaus* taxa. Specimens with wings similar to *P. huanucana*, but sharing the distinctive genitalic traits of *P. microdamas* and *P. dospassosi*, are discussed relative to their possibly representing a further terminal taxon of the genus. All of the above taxa have received little or no previous taxonomic examination.

Introduction

Recently, we published taxonomic studies of several groups of Papilionidae (Johnson, Rozycki and Matusik, 1985, 1986a, 1986b; Johnson and Rozycki, 1986). These studies resulted because we were able to assemble samples of several papilionids previously known from only their types or which were apparently undescribed. This research led to cooperation with Dr. Keith S. Brown (Universidade Estadual de Campinas, São Paulo, Brazil) who is preparing a synonymic list of Neotropical Papilionidae, since there was mutual interest in the examination of types and the location of specimens of certain little-known taxa. The present paper summarizes taxonomic results concerning taxa of the genus *Protesilaus* (*sensu* Hancock, 1983). Some results of this study

were published in our paper concerning *P. illuminatus* Niepelt (Johnson, Rozycki and Matusik, 1986b), a taxon previously known from one extant syntype male and accompanying female but of which we were able to assemble recently collected specimens. The results of the present paper concern a cluster of *Protesilaus* taxa which have hitherto been either little-known or of uncertain status.

Study of male genitalia of *Protesilaus* indicated *P. microdamas* (Burmeister) differed from all other *Protesilaus* taxa in lacking the ventral process of the valval harpe. This process is prominent in other taxa of the group. Examination of the unique type of *Papilio dospassosi* Rüttimeyer (a taxon inadvertently misplaced in *Heraclides* by Hancock, 1983, who had not examined the type) indicated that *P. dospassosi* belongs in *Protesilaus* and that its holotype also lacks a ventral valval process. Further study resulted in location of another assemblage of specimens in *Protesilaus* lacking this process. We suspected these represented an undescribed taxon. Since these specimens and *P. dospassosi* were characterized by extreme reduction of red on the hindwing upper surface, and since these and *P. microdamas* lacked the ventral valval process, a previously unrecognized species group within *Protesilaus* was suggested.

Subsequently, Keith Brown discovered that little-known *Papilio huanucana* Varea de Luque (1975) matched the salient appearance of specimens located by us which lacked the ventral valval process. Oddly, however, dissection of representatives of the types series of *P. huanucana* disclosed a much larger valval process than in other *Protesilaus*. Hence, the present study inadvertently discovered several taxonomic characters suggesting species status for *P. huanucana*, but it is doubtful that this species is closely related to *P. microdamas*. The purpose of the following presentation, therefore, will be to review the taxonomic characters of *P. microdamas* and enumerate the several new statuses and synonymies which result from our study of it, *P. dospassosi* and *P. huanucana*. Also, we will discuss the specimens resembling *P. huanucana* which lack the ventral valval process in hope that this review will promote eventual discovery of whether authentic natural populations exist which exhibit the wing markings characterizing *P. huanucana* but lack the ventral valval process characteristic of *P. microdamas* and the holotype of *P. dospassosi*.

Eventual resolution of the precise cladistic relationships in *Protesilaus* will require a full consideration of character polarity in its own and outgroup taxa. Such study cannot be accomplished, however, without definition of the relevant terminal taxa. To this end, the following treatment is provided.

Taxonomic Analysis

Both Munroe (1960) and Hancock (1983) recognized apparent

monophyly in a "*lysithous*-related group" within the genus *Eurytides*. Hancock (1983) accorded this group generic status as *Protesilaus*. According to these authors the group includes the following taxa, which as noted below are tailed or untaild and mimic various other neotropical butterfly taxa: *Short-tailed* or *Untailed* – *pausanis* (Hewitson) [heliconine mimic]; *protodamas* (Godart) [banded, or heliconine mimic depending on form]; *microdamas* (Burmeister); *phaon* (Boisduval) [banded]; *chibcha* (Fassl); *euryleon* (Hewitson); *hipparchus* (Staudinger); *harmodius* (Doubleday); *trapeza* (Rothschild and Jordan); *xynias* (Hewitson); *ariarathes* (Esper); *ilus* (Fabricius); *branchus* (Doubleday); *belesis* (Bates) [troidine papilionid mimics]. *Long-Tailed* – *thymbraeus* (Boisduval), *lysithous* (Hübner), *kumbachi* (Vogeler), *asius* (Fabricius).

Morphological Structures: *Protesilaus*, *lysithous* group, taxa exhibit a single-layered valval harpe (dark, keel-like structure centrad in Figs. 2–6) with a laterally extending spike associated just ventrad and a variously rhomboid structure cephalo-ventrad exhibiting a ventrally extending process. Contrastingly, the sister "*marcellus* group" taxa (*sensu* Munroe, 1961) display a harpe of two parallel layers (as with a keel beneath a keel) without an emphatic associated spike and without a ventrally extending process. The keel-like structure in Figs. 2–6 consists ventrad of two closely paralleled high ridges (drawn in thick solid black) separated by a deep fissure (shown in white or very light gray). The ventrad ridge is variously dentate. The keel can terminate caudad with a variously expressed "head", characteristically single-edged and serrate, double-edged and serrate, or non-serrate in particular species clusters. The laterally pointing spike can be characteristically pointed, furcate, or conical, the ventral process of the rhomboid structure variously emphatic. Characters of the keel of the valval harpe are most useful with those of the laterally pointing spike being less reliable though sometimes distinctive in some taxa.

Phenetic resemblance in the genitalia of short-tailed or non-tailed members of the *lysithous* group of *Protesilaus* generally support the clustering by D'Abrera (1981) based on characters of the wing. Four general groups, disparate from the long-tailed members of the group, are suggested, as shown in the accompanying figures listed below, named in accordance with cluster names proposed by Keith Brown (pers. comm.) and cited with the appropriate D'Abrera (1981) page numbers: the "*phaon* cluster" (pp. 62–63) [Fig. 2], the "*harmodius* cluster" (pp. 64–65) [Fig. 3], the "*ariarathes* cluster" (pp. 66–67) [top] [Fig. 4], and the "*belesis* cluster": (p. 67 [bottom]) [Fig. 5]. We (Johnson, Rozycki and Matusik, 1986b) have reviewed the major genitalic characters generally defining these clusters.

Major exception to the general morphological similarity in the groups listed above occurs in specimens having no ventral process on the valval harpe. Such include all specimens examined by us or Brown of *P.*

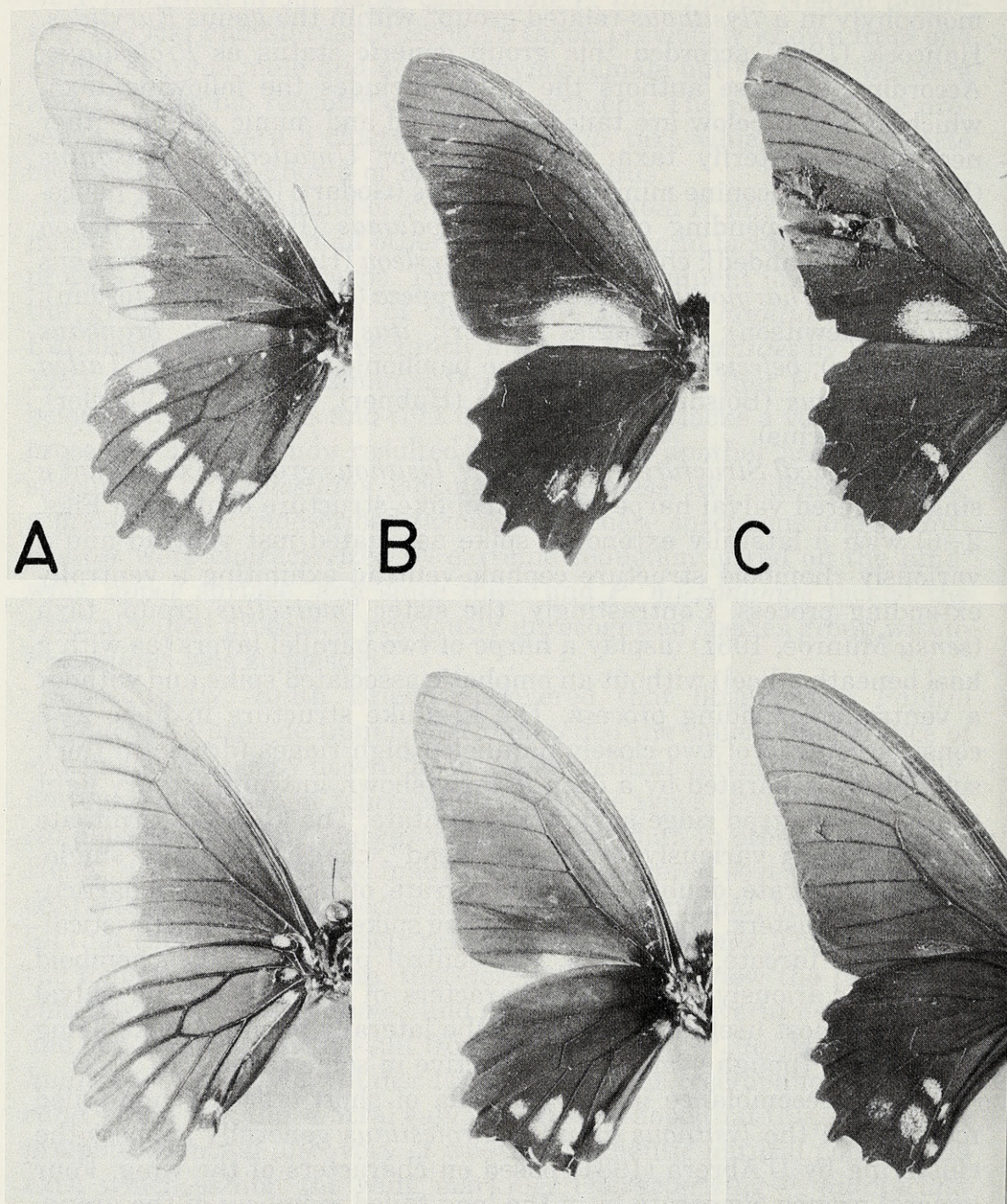


Fig. 1. Upper surfaces (above) and under surfaces (below) of A. *P. microdamas*, male (Sapucay, Paraguay, AMNH); B. *P. huanucana*, male (Tingo Maria, Peru, BMNH); C. *P. dospassosi*, holotype male, (Rio Putumayo, Colombia, AMNH).

microdamas (figured alone by D'Abrera, 1981, p. 63), the *dospassosi* type, and some specimens otherwise like *P. huanucana* [Fig. 6–7]. We thus propose the following species cluster as defined by the following key:

GENITALIC KEY TO MICRODAMAS SPECIES CLUSTER

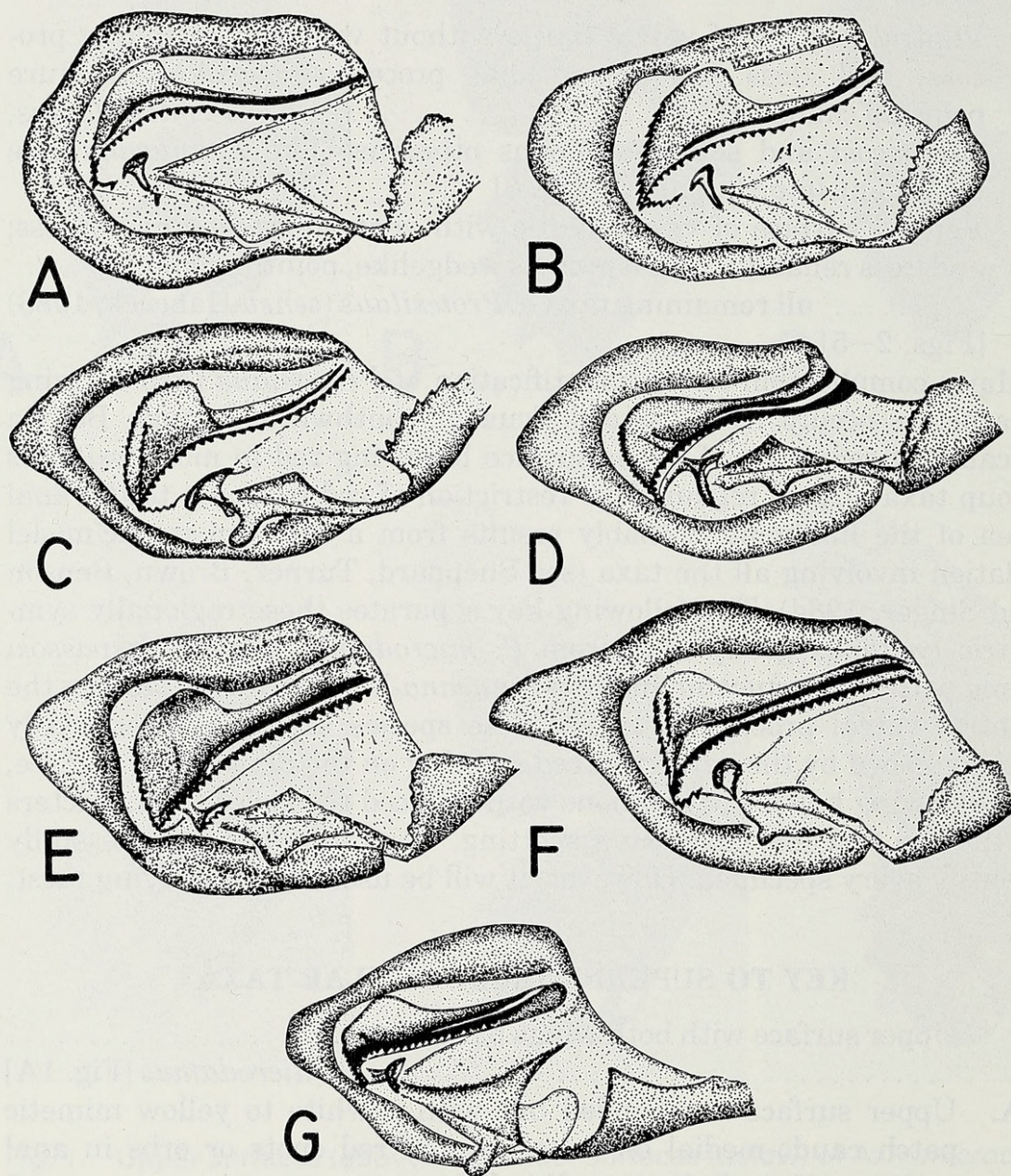
- 1. Ventral surface of valval harpe without ventrad-protruding process; and (less reliably) medial process fingerlike structure pointing caudad *P. microdamas*, *dospassosi* and some specimens otherwise like *huanucana* (see treatment later in paper) [Fig. 6]
- 2. Ventral surface of valval harpe with ventrad-protruding process; and (less reliably) medial process wedgelike, pointing laterally all remaining taxa of *Protesilaus* (*sensu* Hancock, 1983) [Figs. 2–5]

Major complication to the identification of *Protesilaus* taxa by wing characters occurs from eastern Ecuador southward through Bolivia because of reduction of upper surface hindwing red in most *lysithous* group taxa of that region. This restriction of red basically to the anal area of the hindwing probably results from a common mimic/model relation involving all the taxa (see Sheppard, Turner, Brown, Benson and Singer, 1984). The following key separates these regionally sympatric *lysithous* group taxa from *P. microdamas* and *P. dospassosi* along with *P. huanucana* and *P. huanucana*-like specimens lacking the ventral valval process. Because these species are usually primarily distinguished by the pattern of red spotting on the upper wing surface, the following key for populations with reduced red relies on characters of the tail and marginal wing spotting. Thus, it will not successfully identify every specimen. However, it will be useful in identifying most.

KEY TO SUPERFICIALLY SIMILAR TAXA

- 1. Upper surface with both wings banded. *P. microdamas* [Fig. 1A]
- 1A. Upper surface not banded but with a white to yellow mimetic patch caudo-medial on forewing and red spots or orbs in anal and/or anal-medial areas of hindwing 2
- 2. Upper surface margin of hindwing with yellow dots or slashes in cells, usually from anal margin to cell M_2 and/or M_3 3
- 2A. Upper surface margin of hindwing without yellow dots or slashes in cells 4
- 3. Yellow marginal markings are slashes extending costad to cell M_2 and with tail at terminus of cell Cu_1 thinly pointed *P. xynias* [Fig. 7A]
- 3A. Yellow marginal markings are small dots extending costad only

- to cell M_3 and with tail at terminus of cell Cu_1 short and stubby *P. trapeza* [Fig. 7B]
4. Margin of hindwing with either short stubby tail or thinly pointed tail at terminus of vein Cu_1 5
- 4A. Margin of hindwing without noticeable tail and with vein termini all about equally crennated 6



phaon CLUSTER

Fig. 2. Genitalia of the "phaon cluster" (number of dissections, parentheses) A. *pausanias*, Jepelacio, Peru (3); B. *protodamas*, Gavea, Brazil (3); C. *phaon*, Colombia (3); D. *euryleon euryleon*, Costa Rica (3); E. *euryleon haenshi* (Rothschild and Jordan), Balzabamba, Ecuador (3); F. *euryleon pithonius* (Rothschild and Jordan), Cauca Valley, Colombia (3); G. *illuminatus*, Rio Putumayo Valley, Colombia (2).

ariarathes CLUSTER

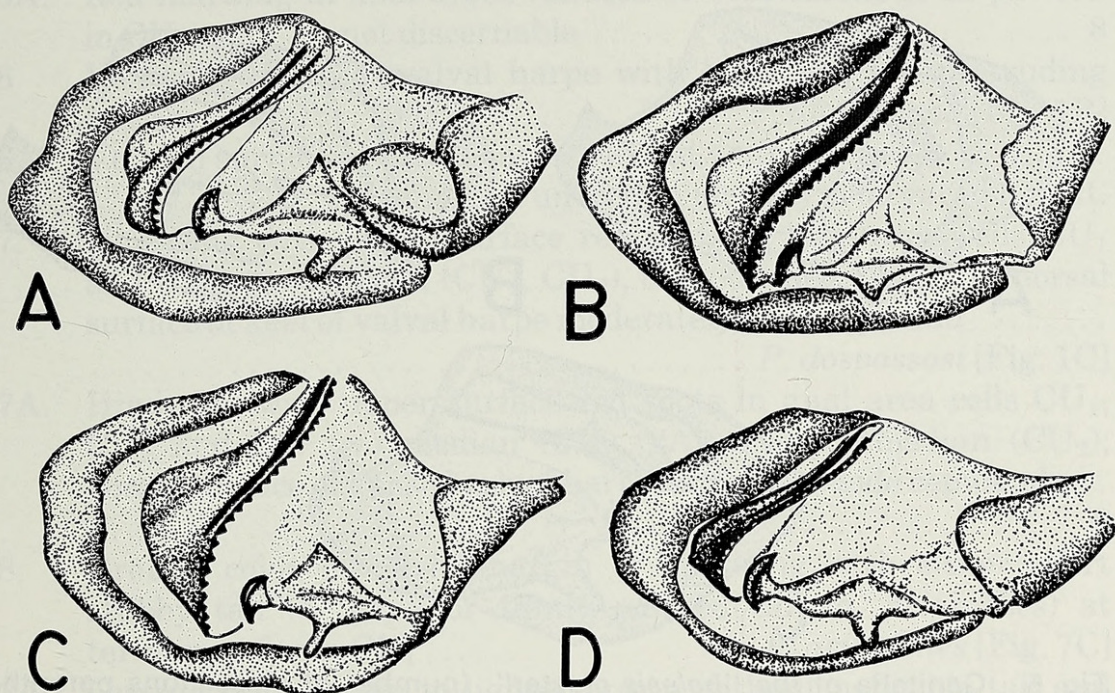


Fig. 3. Genitalia of the "ariarathes cluster" (number of dissections, parentheses, other localities, brackets). A. *ariarathes ariarathes*, French Guiana (3); B. *ariarathes gayi* f. *cyamon* (Grey), Middle Rio Ucayali, Peru (3), Alto Jurua, Brazil (1) [additional studied: *gayi gayi*, Janjui, Peru (1), Buena Vista, Bolivia (1); *gayi metagenes* (Rothschild and Jordan), Mt. Duida, Venezuela (1)]; C. *ariarathes menes* (Rothschild and Jordan), Tukeit, Guyana (3). D. *ariarathes*, Janjui, Peru.

harmodius CLUSTER

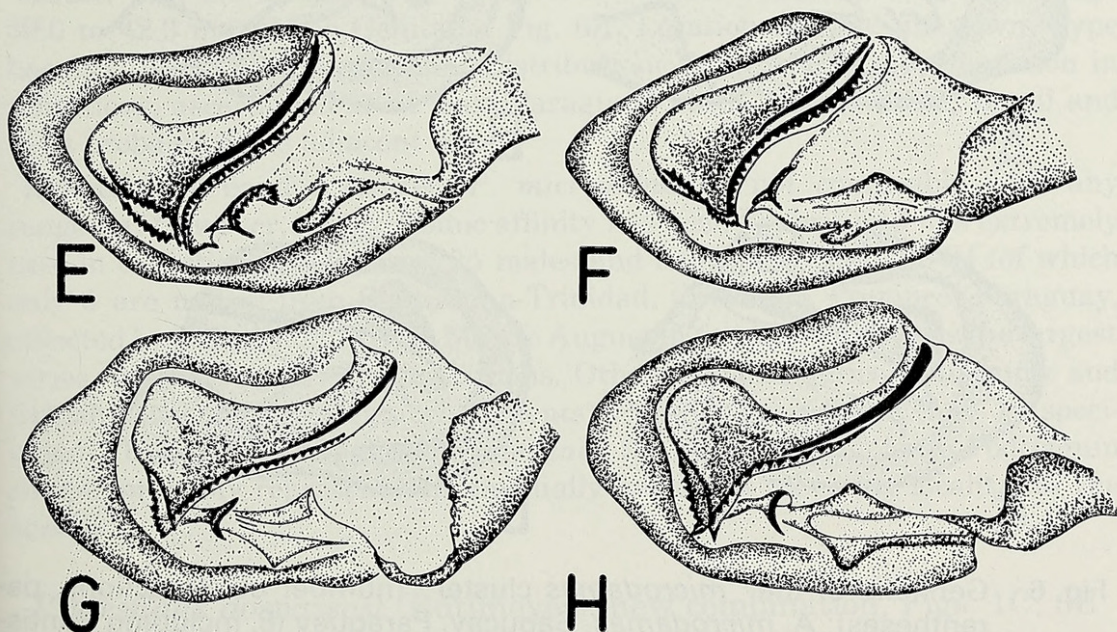


Fig. 4. Genitalia of the "harmodius cluster" (number of dissections, parentheses): E. *harmodius harmodius*, Bolivia (3); F. *harmodius xenaides* (Hewitson), Rio Pastaza, Ecuador (3); G. *trapeza*, Rio Napo, Ecuador (3); H. *xynias*, Rio Santiago, Peru (3).

belesis CLUSTER

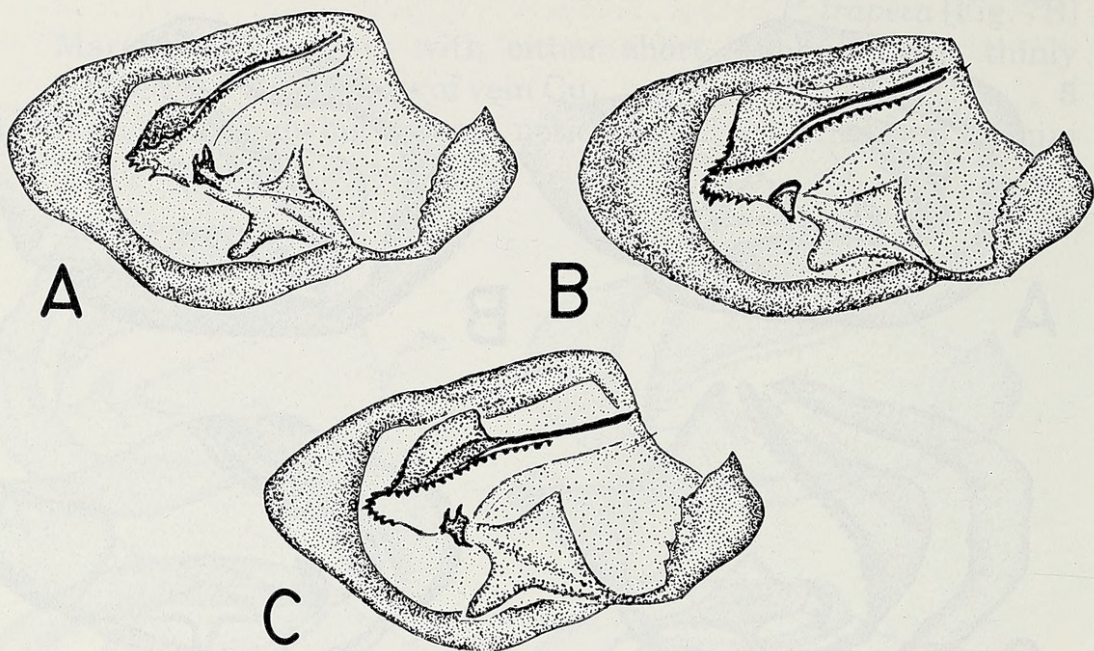


Fig. 5. Genitalia of the "belesis cluster": (number of dissections parentheses): A. *belesis*, Soyolapan, Mexico (3); B. *branchus*, San Jeronimo (Chiapas), Mexico (3); C. *illus*, Sosumuco, Colombia (3).

microdamas CLUSTER

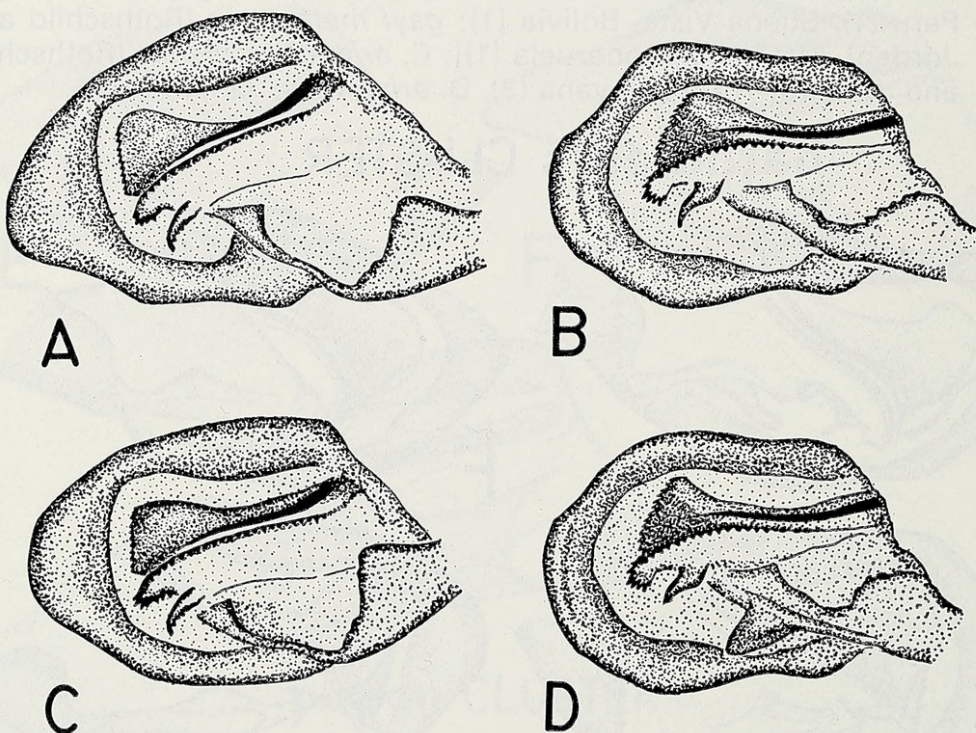


Fig. 6. Genitalia of the "microdamas cluster" (number of dissections, parentheses): A. *microdamas*, Sapucay, Paraguay (5, including Santissima Trinidad, Paraguay); B. holotype, *dospassosi*; C. specimen of uncertain status, wings markings like *huanucana* but lacking ventral valval process like taxa of *microdamas* cluster, Rio Santiago, Peru (4) including specimens listed in Fig. 7; D. *P. huanucana*, from Ehrmann series (CMNH), Sarajacu, Ecuador.

5. Red markings in anal areas of cells CU_1 and CU_2 7
- 5A. Red marking in anal areas reduced or obsolescent so as pattern in CU_1 and CU_2 not discernable 8
6. Ventral surface of valval harpe with large ventrad protruding process *P. huanucana* [Fig. 1B]
- 6A. Ventral surface of valval harpe without ventral process specimens of uncertain identity referenced in text.
7. Hindwing with upper surface red spots in anal area cells CU_1 and CU_2 : two median (CU_1 , CU_2), one postmedian (CU_1); dorsal surface of keel of valval harpe moderately wide cephalad *P. dospassosi* [Fig. 1C]
- 7A. Hindwing with upper surface red spots in anal area cells CU_1 , CU_2 and 2A: two median (CU_2 , 2A), one postmedian (CU_2); dorsal surface of keel of valval harpe extremely wide cephalad ... 8
8. Ground color blackish, margin of hindwing with either short stubby tail (*a. gayi*) or thinly pointed tail (*a. ariarathes*) at terminus of vein CU_1 *P. ariarathes* [Fig. 7C]
- 8A. Ground color brown to lighter brown without noticable tail and with vein termini of hindwing all about equally crenated 6

Annotated Taxonomic List (Including New Synonymies and Statuses)

P. microdamas species cluster:

Protesilaus microdamas (Burmeister), Figs. 1A, 6A

Papilio microdamas Burmeister 1878. Description Physique de la Republique Argentine. Lepidopteres 5: 63.

Adult. Fig. 1A. Length of forewing: \bar{X} of 5 males (AMNH), 40.2 mm., range 39.0 to 42.0 mm. Male Genitalia: Fig. 6A. Location of type: unknown. Type Locality: Corrientes, Argentina. Distribution: From sparse representation in collections, ascertained as at least Paraguay, Matto Grosso State, Brazil and most probably some adjacent areas.

Remarks. A banded species, *P. microdamas* is not confusable with any congener. However, its taxonomic affinity has been unclear and it is extremely rare in collections. A series of 25 males and females at the AMNH (of which only 5 are males) from Santissima-Trinidad, Cordillera Province, Paraguay, collected by B. Podtiaguin from May to August in an unnoted year, is the largest series in North American institutions. Other North American museums and British Museum (see Acknowledgments) together have fewer than 15 specimens. The rarity of females of *Protesilaus* taxa suggests the large Podtiaguin sample probably represents an unusually fortuitous collecting locality for the species.

Protesilaus dospassosi (Rütimeyer), new combination, Figs. 1C, 6B
Papilio dospassosi Rütimeyer 1969. J. Lepid. Soc. 23: 255–257.

Adult. Fig. 1C. Length of forewing: holotype, male, 37.5 mm. Male Genitalia: Fig. 6B. Location of type: AMNH. Type locality: Rio Putumayo, Colombia. Distribution: Known only from type locality.

Remarks. As noted previously, Hancock (1983) inadvertently misplaced this taxon in the genus *Heracles* (tribe Papilionini) since he had not examined the type. Keith Brown (pers. comm.) suggested the need to differentiate *P. dospassosi* from *P. morrиси* Ehrmann (Ehrmann, 1921; Holland, 1927) a taxon somewhat similar in original description. We have examined the type of *P. morrиси* at the CMNH, a male from "Loja, SE Ecuador, 30 November 1914, Rev. Hyde Collection". The type and a group of associated specimens identified by Ehrmann all have postmedian red spots costad to cells 2A and CU₂, and by genitalic dissection are clearly allied to *P. harmonius*, of which *morrиси* should probably be considered a subspecies. Keith Brown informs us that he has seen a possible specimen of *P. dospassosi* in the collection of the Los Angeles County Museum.

The apparent species status and insular distribution of *P. dospassosi* should be considered in light of its local sympatry with several other extremely insular butterfly taxa equally rare in collections surveyed by us. These include: *P. illuminatus* (Niepelt) (Johnson, Rozycki and Matusik, 1986b), known from only nine specimens; the nymphalid butterfly *Anaeomorpha splendida* Rothschild (only four specimens located by Johnson and H. Descimon [Universit  de Provence, Marseilles, France] at AMNH, BMNH or Mus um National d'Histoire Naturelle (Paris) and of which species a subspecies *columbiana* Niepelt (1928) was named, and is known only from, two specimens taken near the type locality of *P. dospassosi*; and an apparently undescribed subspecies of *Prepona werneri* Hering and Hopp known from a single specimen obtained by Johnson and Matusik from the same collectors capturing *P. illuminatus* in 1981. According to a museum survey by Johnson and Descimon, *P. werneri* is itself known from fewer than 10 specimens, though the exact number is uncertain since most are owned by private collectors.

It remains to be clarified whether further specimens of *P. dospassosi* will corroborate or falsify the notion that lack of the ventral valval process, as in the holotype, indicates sister species relationship with *P. microdamas*.

Other Taxa:

Protesilaus huanucana (Varea de Luque), new combination, revised status Figs. 1B, 6D

Graphium trapeza huanucana Varea de Luque, 1975. Shilap. Rvta. Lep. 3(9): 28–32.

Adult. Fig. 1B. Length of Forewing: \bar{X} of 5 specimens in Ehrmann series (CMNH), 39.8 mm., range 38.0 – 42.0 mm. Male Genitalia: Fig. 6D. Location of type: British Museum (Natural History). Type Locality: Tingo Maria, Peru. Distribution: noted from dissected specimens by Keith Brown (pers. comm.) as including southwest Colombia, eastern Peru, Acre, Rondonia and Amazonas states, Brazil and northern Bolivia.

Remarks. Hitherto, Varea de Luque's publication of the name *huanucana* has received no further report in the literature. The taxon is distinctive, a fact which formerly led us and Brown (at AMNH, 1972) to note it as undescribed or not identifiable. Also, Varea de Luque suggested that *huanucana* might be "quiza bona species." It is distinguishable from congeners by the extreme reduction of red spotting on the upper surface of the hindwing (limited to anal

area only) and by its cream-yellow mimetic patch on the forewing upper surface. Amongst other taxa with regionally reduced upper surface red, it is distinguishable by other characters (see Key). These characters, along with those of the genitalia have led us and Brown to consider it as a valid species pending biological studies. The existence of this taxon was also recognized by Ehrmann who designated a type (CMNH) for a manuscript name which was never validly published (Holland, 1927). Ehrmann's study series was from "Sarayoi'u, E. Ecuador" or "Sarajacu, Oriente, Ecuador" undated and from E. T. Owen in the Buckley Collection. Our dissection of these specimens shows that all examined have a ventral valval process and are thus *P. huanucana*.

Process-less Specimens Otherwise like *P. huanucana*:

Adult. Fig. 7D. Length of Forewing: \bar{X} of 3 males, AMNH, 41.8 mm., range 41.0 to 42.5 mm. Male Genitalia: Fig. 6C. Distribution: from dissections by the authors: AMNH – Rio Santiago, Peru; Rio Purus, Brazil; Costa Rica, Bolivia; David Matusik Collection – Costa Rica, Bolivia.

Remarks. Among specimens generally resembling *P. huanucana* a number of specimens have been found which lack the ventral valval process and are thus like *P. microdamas* and *P. dospassosi* (Fig. 6). A high frequency of these was found when we first began sorting from collections *P. huanucana*-like specimens which we suspected represented an undescribed entity. When Brown discovered the apparent external similarity between our series and the *P. huanucana* types he further discovered these latter had a large ventral valval process. Subsequently, by looking at a larger range of specimens, we also found such examples. A number of lepidopterists have been consulted concerning this and there is consensus that the smoothly edged cephalo-ventral surface of the valval harpe on which a ventrad pointing process has not developed must be considered as a possibly strong character within *Protesilaus*. Also, we and John Rawlins (CMNH) agree there are some differences in the wing markings of the specimens without the ventral valval process which suggest they are often separable from *P. huanucana*. The former appear more brown (as opposed to black or blackish) than *P. huanucana* and evidence a more evenly crennated hindwing margin and a more yellow to ochre forewing mimetic patch.

It is important to ascertain whether specimens lacking the ventral valval process represent simple and insignificant variation aside from the consistency of the valval process character in *P. microdamas*, are individuals representing reversion to a primitive process-less configuration characteristic of plesiomorphy in *Protesilaus*, or whether authentic natural populations occur with the *P. microdamas*-like valval harpe being taxonomically significant. If the latter is true, such populations would constitute another important terminal taxon in the cladistic structure of the genus.

Summary and Conclusions

Study of wing and male genital characters in the genus *Protesilaus* indicates *P. microdamas* differs significantly from congeners and that at least one other taxon, *P. dospassosi* (hitherto not placed in *Protesilaus*), shares with *P. microdamas* a valval harpe with a smoothly edged ventral surface. Other *Protesilaus* specimens have been found with a

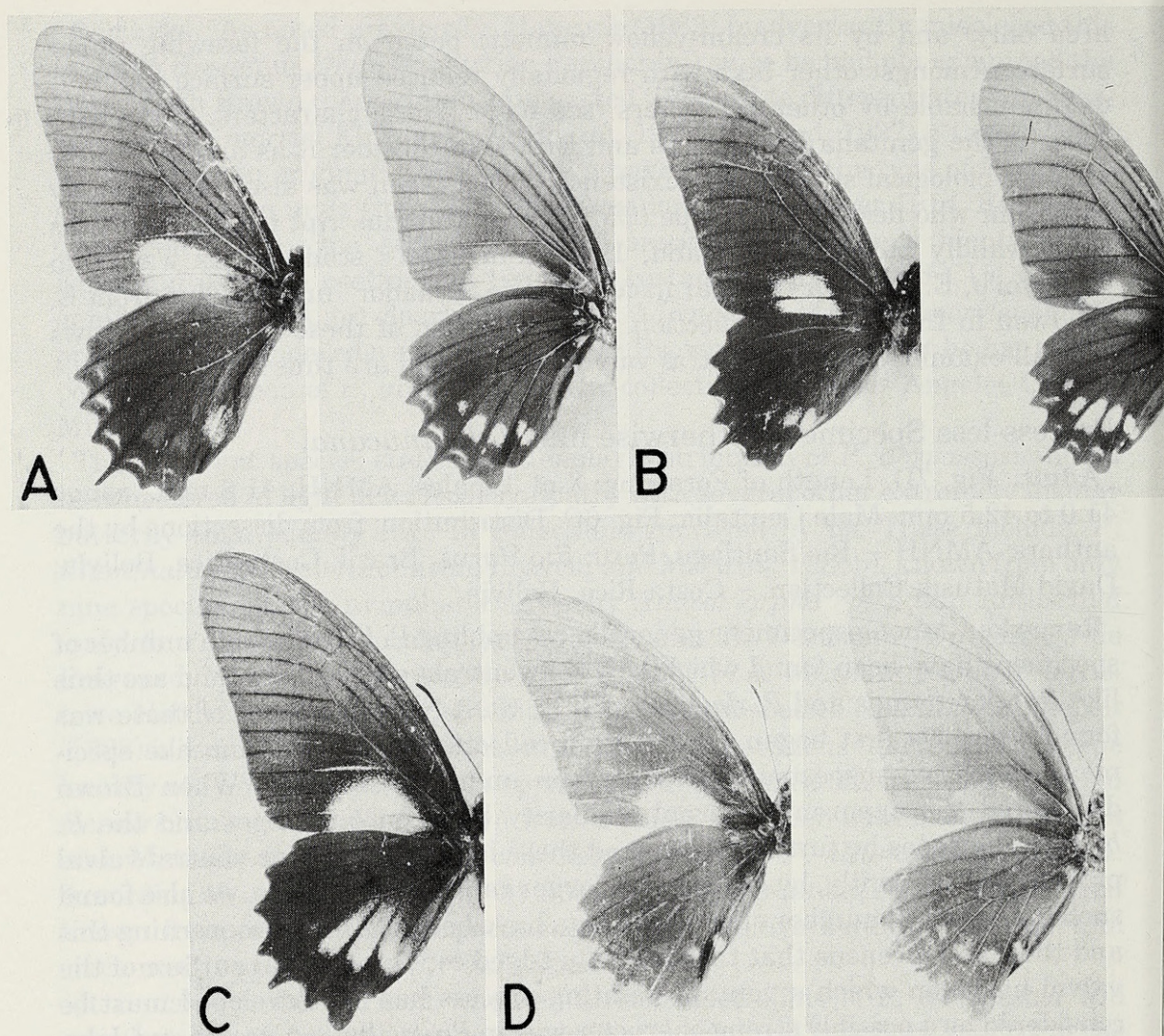


Fig. 7. Examples of wing patterns from "Key to Superficially Similar Taxa" and specimens resembling *P. huanucana* but lacking ventral process on valval harpe. A. *P. xynias*, male (left, upper surface; right, under surface) Rio Santiago, Peru, AMNH; B. *P. trapeza*, male (left, upper surface; right, under surface) Rio Napo, Ecuador, AMNH; C. *P. ariarathes*, male (upper surface; extent of under surface marking similar) Janjui, Peru, AMNH; D. example of specimens somewhat resembling *P. huanucana* but lacking ventral process on valval harpe. These may represent an undescribed taxon, male (left, upper surface; right, under surface) Costa Rica, Bolivia, AMNH.

similar, processless, ventral harpe surface. Still others, similar in wing facies to these latter have a large ventral process and comprise the taxon *P. huanucana*. This taxon, distinctive in a number of characters from other *Protesilaus*, is suggested as a species level taxon whose biology should be studied in detail. The status of specimens like *P. huanucana* lacking the ventral valval process is unresolved. If authentic natural populations are found which evidence this latter character, such populations must be suspected as representing a further terminal taxon for the genus.

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Literature Cited

- D'ABRERA, B. 1981. Butterflies of the Neotropical Region. Part 1. Papilionidae and Pieridae. Landsdowne Editions. East Melbourne, 172 pp.
- EHRMANN, G. A. 1921. Some new *Papilios* and Ornithoptera. *Lepidoptera* 5: 17-19.
- HANCOCK, D. 1983. Classification of the Papilionidae (Lepidoptera): a phylogenetic approach. *Smithersia* 2: 1-48.
- HOLLAND, W. J. 1927. The Lepidoptera named by George A. Ehrmann. *Ann. Carn. Mus.* 17: 299-364.
- JOHNSON, K. & R. ROZYCKI. 1986. A new species of the *anchisiades* Group of *Heraclides* from Venezuela (Lepidoptera: Papilionidae). *J. New York Ent. Soc.* 94(3): 383-393.
- JOHNSON, K., R. ROZYKI, & D. MATUSIK. 1985. Species status and the hitherto unrecognized male of *Papilio diaphora* Staudinger (1891), (Lepidoptera: Papilionidae). *J. New York Ent. Soc.* 93: 99-109.
- JOHNSON, K., R. ROZYCKI & D. MATUSIK. 1986a. The female of *Papilio xanthopleura* Godman & Salvin (Papilionidae). *J. Lepid. Soc.* 40: 65-66.
- JOHNSON, K., R. ROZYCKI & D. MATUSIK. 1986b. Rediscovery and species status of the Neotropical swallowtail butterfly *Papilio illuminatus* Niepelt (Lepidoptera: Papilionidae). *J. New York Ent. Soc.* 94: 516-525.
- MUNROE, E. 1961. The classification of the Papilionidae (Lepidoptera). *Can. Ent. Suppl.* 17, 51 pp.
- NIEPELT, W. 1928. Neue Tagfalter aus Columbien. *Int. Entom. zeitschr.* 21: 390.
- SHEPPARD, P. M., J. R. G. TURNER, K. S. BROWN, W. W. BENSON & M. C. SINGER. 1985. Genetics and the evolution of Muellierian mimicry in *Heliconius* butterflies. *Phil. Trans. R. Lond., B* 308: 433-610.



Johnson, Kurt, Matusik, David, and Rozycki, Rick. 1989. "A Study of *Protesilaus microdamas* Burmeister and the Little-known *P. dospassosi* Rüttimeyer and *P. huanucana* Varea de Luque (Papilionidae)." *The Journal of Research on the Lepidoptera* 27(2), 83–95. <https://doi.org/10.5962/p.332212>.

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