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A NEW HAIRSTREAK BUTTERFLY (LYCAENIDAE) FROM MONA ISLAND, PUERTO RICO

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INTRODUCTION

Mona (Amoná) Island lies in the southern reaches of the Mona Passage linking the Atlantic Ocean with the Caribbean Sea, at 18° 3-8'N and 67° 51-57'W, almost midway between Puerto Rico to the east and Hispaniola to the west. It is a small island, about 23 square miles (62 km²) in area, without continuous human habitation since the mid-16th century and thereby, for this populous part of the world, uniquely undegraded. At the time of publication of the most recent account of the butterflies of Mona (Smith, Ramos, McKenzie, Munroe & Miller, 1988), 46 species had been recorded from the island; subsequent field work has raised the total to 50 and an account of our current view of the fauna will be presented elsewhere (Smith, McKenzie, & Ramos, in preparation).

The richness of Mona's butterfly populations is all the more remarkable since much of the surface of the island is a cliff-bound karst limestone plateau (Aaron, 1973), ranging from 90 m to 30 m above sea level covered with dense xeric forest or lower dry scrub, over much of which butterflies are generally sparsely distributed. A restricted low coastal plain is present in the southwest, including littoral scrub, disturbed land around the few buildings on the island, and cleared areas that may at one time have been cultivated, together with a narrow strip of hammock forest, continuing up the cliff behind the plain onto which it extends in a narrow fringe. Calvesbert (1973) estimated the island to be

'Semi arid' on the Thornthwaite system. The mean annual rainfall for the period 1936-1970 is given as about 32 inches with no strongly marked or predictable wet and dry seasons other than the increased probability of occasional days of high rainfall associated with the tropical storms affecting the area generally, though not invariably, between September and November.

In December 1986, on the second of a recent series of six visits to Mona Island, two of the present authors (DSS and FM) collected a hairstreak, newly recorded from the island that was at the time identified as *Strymon toussainti* (Comstock & Huntington, 1943). This determination was based on the conspicuous blue-scaled patch between the 'Thecla spot' and tornal lobe on the hindwing beneath and particularly from the disjointed sequence of postdiscal spots on the under surface of the forewing (Smith *et al.*, 1988, fig. 15). Subsequently, one of the present authors (KJ), who knew *S. toussainti* in the field in the Dominican Republic, examined some of the Mona butterflies and assessed them as unusual. The belief that the specimens were quite distinct from *S. toussainti* were strengthened further by Albert Schwartz (pers. comm). In particular, Johnson noted (i) the pale grey underside ground color, whitish in the recently described *S. andrewi* (Johnson & Matusik, 1988) and beige to tawny in *S. toussainti* and *S. columella* (Fabricius, 1793), (ii) the conspicuous black hindwing spots beneath, quite red in fresh specimens of *S. andrewi* and brownish-black in the two other *Strymon* mentioned, and (iii) the boldness of the medial row of these spots and the presence of a prominent anal spot in both sexes, tending to obsolescence, or entirely absent in *S. toussainti*. These observations prompted a closer examination of the insects, which led to the realisation that Mona possesses an endemic *Strymon*, similar to *toussainti* (and indeed to the recently described Hispaniolan endemic *S. andrewi*), but distinct from both in wing facies and genitalic details, as described below. Photographs of paratypes of *S. toussainti* are illustrated in Figures 3 and 4, and Johnson & Matusik (1988) provide comparative figures of this species in addition to *S. andrewi* and *S. columella*.

***Strymon amonensis* (new species)**

Figures 1 (♂), 2 (♀), 6 (♂ genitalia), 7 (♀ genitalia)

MALE: Forewing length mean 10.8 mm (range 8.7-12.2 mm, S.D.=0.70, n = 44). *Upper surface forewing* dark brown, with blackish ovoid androconial patch at distal end of cell and scattering of light blue scales basally, especially along basal half of tornal margin. *Hindwing* ground color as forewing with large black marginal spots between veins 2A, Cu₂, and Cu₁, more obscure spots in spaces M₃-Cu₁, M₂-M₃. Tornal lobe well developed, including a black marginal crescent capped inwardly with rust red and an adjacent minute patch of blue scales; elsewhere, blue scales lightly and variably present along veins 2A and 1A, with a minute patch at base of tail. *Under surface* ground color pale grey (less brown than in *S. toussainti*); *forewing* with row of six postmedial black spots, the third and fourth displaced basad (as in *S. toussainti* and *S. andrewi*), dark grey bar at end of discal cell and white chevrons in margin and submargin. *Hindwing* with three prominent white-ringed postbasal spots, black with variable red scaling, near costa, in discal cell and beneath vein 2A near anal margin; medial band of six spots, paralleling basal series, a seventh sometimes present in cell below large spot at mid-costa. Grey bar at distal end of discal cell. Marginal grey spots flanked externally by black line then white, narrowly capped basad by white; irregular row of white chevrons in postmarginal area. 'Thecla spot' black superimposed on grey, with orange cap of similar width; prominent white-ringed blue scaled patch below 'Thecla spot' anterior to black tornal lobe.

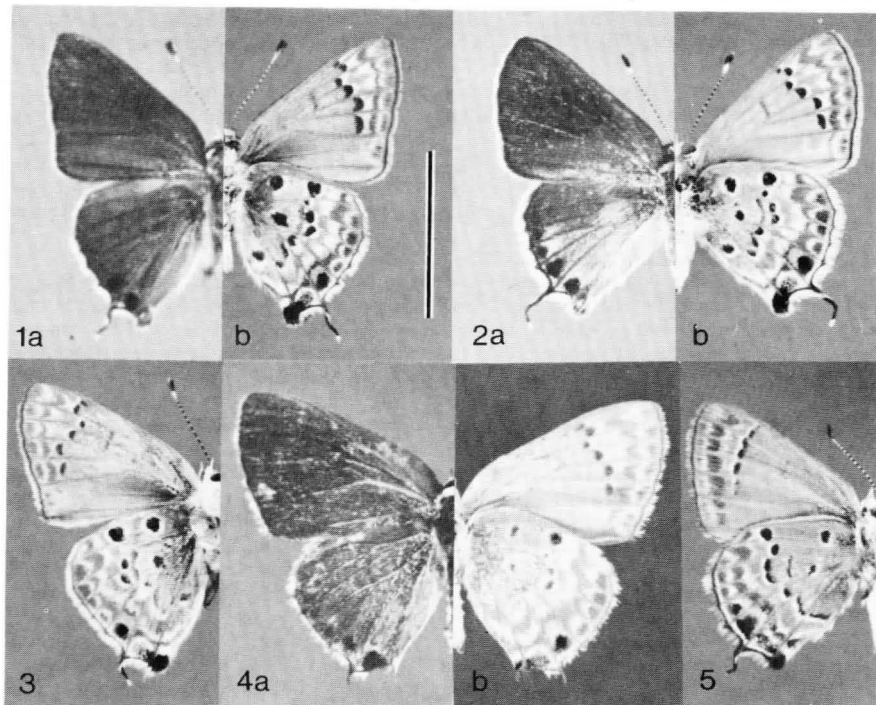
FEMALE: Forewing length mean 10 mm (range 8.7-11.4 mm, S.D.=0.6, n = 70). *Upper surface forewing* grey-black, lacking androconial patch but with diffuse area of black scaling distal to cell end from R₄ to Cu₁. Blue scaling more extensive than in male, in postero-basal area and further along tornal margin. *Hindwing* ground color as forewing; marginal black spots as in male but more clearly defined by adjacent blue scaling; elsewhere, blue scaling more extensive than in male in posterior half of wing and across

cell. Ternal lobe and markings as in male. *Under surface* similar to male, though hindwing maculation slightly bolder (see below).

Fringes grey on forewing, becoming white towards ternal margin, especially in females; white on hindwing in both sexes, with grey-black scaling at vein ends, resulting in faintly scalloped contour of wing margin.

Individual variation: On the under surface hindwing a small supplementary medial white-ringed black spot between those near costa and in discal cell is present in about 25% of males and females. In all females, a similar small spot is present immediately below the uppermost spot in the postdiscal series, above the bar at distal end of discal cell; in about 30% of males, this spot is absent or represented by a minute white patch lacking a black center. Maculation in the posterior half of the hindwing is somewhat variable; spots beneath the cell-end bar tend to be reduced though rarely obsolete in males although the basal spot near the anal margin is invariably present in all individuals. Scale loss during life reduces the contrast between the maculation pattern and the pale ground but the full complement of black spots is retained in worn specimens

Genitalia: As noted by Johnson, Eisele, and MacPherson (1990), genitalia of *Strymon* species show a rather simple ground plan characterized by an elongate, caudally spiralled ductus bursae in females and, in males, by a robust vinculum, symmetric or asymmetric



Figures 1-5. Figure 1, *Strymon amonensis*, male (Holotype) 1a upper surface; 1b under surface. Figure 2, *Strymon amonensis*, female (Allotype) 2a upper surface; 2b under surface. Figure 3, *Strymon toussainti* male (Paratype) Fond Parisien, Haiti, February 1922 (American Museum of Natural History), under surface. Figure 4, *Strymon toussainti*, female (Paratype) Port-au-Prince, Haiti, June 1922 (American Museum of Natural History) 4a upper surface; 4b under surface. Figure 5, *Strymon columella*, female, Uvero, Mona Island, December 1990; under surface. (Scale bar = 10 mm)

(pointed or parabolic) saccus, caudally tapered valvae and terminally undulate aedeagus. Consequently, diagnostic interspecific differences are often extralimital, involving specializations of the cervix bursae (corpus bursae) and the adjoining ductal spiral in females, and of the saccus and/or valvae in the males.

Male genitalia: In *S. andrewi* (Johnson & Matusik 1988, fig. 5C), the valvae are tapered gradually but are uniformly stouter than in *S. amonensis* (Fig. 6), while in *S. toussainti* (Johnson & Matusik 1988, fig. 5E), the valvae narrow sharply from the middle and are then very slender and only slightly tapering posteriorly. The incurved inner margin of the valvae in *S. amonensis* is a uniform feature in all specimens examined (12) and is much more pronounced than in *S. toussainti* or *S. andrewi*. In *S. columella cybira* (Johnson & Matusik 1988, fig. 5D), the valvae taper much as in *amonensis* but are not incurved. Furthermore, the saccus, not always a reliable genitalic character in *Strymon*, is consistently broad, blunt and laterally displaced *S. amonensis*; in *S. andrewi*, it is again asymmetric but longer and more acute while in *S. toussainti* and in *S. columella cybira* (Hewitson, [1874]), the saccus is narrower than in *S. amonensis* but generally more or less symmetric with respect to the genital capsule in the former and asymmetric in the latter. The aedeagus in *S. amonensis* is undulate and differs insignificantly from that of the other species considered here.

Female genitalia: The ♀ genitalia of *S. amonensis* exhibit the most outstanding structural feature characterizing the species: a heavily sclerotized 'cupola' on the distal end of the corpus bursae (Fig. 7), near the base of which the ductus seminalis is inserted, followed immediately caudad by a sharp declination of the ductus bursae into a compact spiral. No Antillean congener possesses this 'cupola'; instead they show the thin, sclerotized struts typical of most *Strymon* (Johnson et al. 1990). *Strymon toussainti* (Johnson & Matusik, fig. 5G) possesses a more compact ductal spiral than either *S. columella cybira* or *S. andrewi* (Johnson & Matusik 1988, figs. 5H & 5F), but the ductus bursae in all three species is evenly contoured throughout, as is typical of most other *Strymon* species, and in each, the ductus seminalis is inserted on the membranous cuticle at the origin of the ductus bursae.

Etymology: Although the island has generally been referred to as 'Mona' by cartographers and in common usage, Wadsworth (1973) reports that the Taino people resident at the time of visits by Columbus and Ponce de Leon, respectively in 1494 and 1507, called their island 'Amoná'. In naming this butterfly we preferred to recognize the term used by the last people to inhabit the island continuously, to the year of their removal to the colony of San Juan Bautista (Puerto Rico) in 1578, in preference to the hispanicized version.

Types: Holotype ♂, on footpath 0.5 km N of Las Caobas towards Cabo Barrionuevo, NW plateau of Mona Island (Puerto Rico), nectaring on *Croton discolor*, 1100 hrs 8 December 1986; allotype ♀, Uvero, S coast of Mona Island, nectaring on *Lantana involucrata* in abandoned field site beneath plateau cliff, 1200 hrs 7 December 1990, both deposited Hope Entomological Collections, Oxford, England. Paratypes, same Uvero data and coastal dunes E of Sardinera nectaring on *Suriana maritima*, December 5-8, 1989: 4 ♂, 4 ♀ Allyn Museum of Entomology, Sarasota; 4 ♂, 4 ♀ American Museum of Natural History, New York; 4 ♂, 4 ♀ British Museum (Natural History) London; 2 ♂, 2 ♀ Carnegie Museum Natural History, Pittsburgh; 1 ♂, 1 ♀ collection Albert Schwartz; 4 ♂, 4 ♀, collection Stuart Ramos, University of Puerto Rico, Mayaguez; 2 ♂, 2 ♀, National Museum of Natural History (USNM); 22 ♂, 48 ♀ Hope Entomological Collections.

DISCUSSION

Strymon amonensis is, at times, a common, even an abundant butterfly, and in our experience occurs more widely and in far greater numbers than its congeners *S. bubastus* (Stoll, [1780]) and *S. columella arecibo*, which fly with it. The former, present on Mona at the western limit of its known range, has been found in small numbers on disturbed land, in April 1988 and December 1989, while *S. columella* was sought on each of five visits, without success, until two specimens were found in December 1990, in a long-

abandoned plantation, in the company of quite large numbers of *S. amonensis*. We are unable to account for the apparent rarity of *S. columella* on Mona, but its eventual discovery underlines the hazard of presuming the absence of a butterfly from a relatively small island after even repeated visits at different times of the year. We hesitate to regard *S. amonensis* as 'dominant' over its relatives, in the absence of information on larval foodplants used on Mona by any of the three species. We are aware of the possibility that *S. bubastus* and *S. columella* may be common insects at times between our all too infrequent periods of work on the island.

The geographical isolation of Mona is reflected in the degree of endemism shown by several animal groups. Two-thirds of the extant reptiles, and the only amphibian known from the island are endemic (Weiwandt, 1973); of the 12 land snails considered to be native, six species and three subspecies are endemic (Thompson, 1987). Among the terrestrial arthropods other than insects, 10 of 52 spiders are endemic (Vélez, 1973), while of the 526 insect species included in the only general account of Mona's insect fauna yet published (Ramos, 1946), 24 species distributed within eight orders were considered to be endemic, the sole lepidopteran being a geometrid moth. These levels of endemism have been achieved on a relatively small and ecologically somewhat monotonous island, separated from Puerto Rico by only 42 miles (67 km), and 37 miles (59 km) from the nearest point of the land mass of Hispaniola. It is against this background that presence on Mona of an endemic *Strymon*, together with two widely distributed congeners, may be considered.

As noted previously (Smith *et al.*, 1988), where supposedly infraspecific phenotypic divergence has occurred between butterfly populations on Puerto Rico and on the much larger island of Hispaniola to the west, those present on Mona are clearly derived predominantly from the former. This asymmetry, in the absence of evidence that Mona has at any time been attached to either neighbor, was interpreted as reflecting the role of predominantly easterly winds in the Mona Passage in overriding, perhaps annulling, the much greater area of Hispaniola as a potential donor source. While it seems probable that this asymmetric derivation may equally be true for many other butterflies on Mona, in the absence of phenotypic indicators the question awaits genetic assessment of relatedness, in the laboratory rather than in the field.

The relationship of the Mona *Strymon* to other members of the '*columella* complex' as a whole should be considered against the uncertainty surrounding the island's early and more recent geological history. Kaye (1959) concluded that the Mona Passage existed in the Miocene, more or less in its present position, a view consistent with the reconstruction based on tectonic movements that places the Greater Antillean islands in substantially their present configuration by the late Tertiary (Miller & Miller, 1989). However, he suggested that "in all probability Isla Mona was submerged during a part of the Pliocene or Pleistocene" and thus that "the entire terrestrial biota must postdate this event", while leaving open the possibility, which he considered unlikely, that "a former extension of Isla Mona, now eroded away, might have remained emergent" affording a sanctuary for the late Tertiary animals and plants. More recently, Heatwole, Levins and Byer (1981) similarly viewed Mona as long isolated, unconnected to other islands "since at least the Pliocene, if then". Heatwole and Mackenzie (1967) proposed that fluctuations in sea water level during the Pleistocene, which at times have linked Puerto Rico, Culebra and the present Virgin Islands (other than St. Croix), are thought to have left Mona unaffected in its deep water setting in the Mona Passage, other than causing relatively small changes in the area of what they considered a continuously emergent island.

In our earlier account, the insect then regarded as *Strymon toussainti* represented an anomaly, in being the only apparently Hispaniolan component of the island's butterfly fauna and a less obvious candidate for statistically improbable easterly dispersal than other species, occurring commonly in eastern Hispaniola, with seemingly more obvious dispersive potential.

The relationship between *S. amonensis*, its apparent close relatives on Hispaniola, *S. toussainti* and *S. andrewi*, and *S. columella* may be viewed with a broader historical perspective. It is possible to see, in the present distribution of these hairstreaks, a pattern that reflects the early geological history of this part of the Caribbean. The sympatry

of *S. columella* with *S. andrewi*, *S. toussainti* and separately with *S. amonensis* suggests that the ancestral assemblage comprising the last three species could conceivably have differentiated from the ancestral '*columella* assemblage' on the original unfragmented landmass of the proto-Greater Antilles (Miller & Miller, 1989). A similar vicariant argument, in a tectonic context, is discussed by Johnson (in press) for the Caribbean hairstreak genera *Nesiostrymon* and *Terra* and (Johnson, 1990) for high Andean *Chlorostyrymon*. While this view plausibly suggests the ancient evolutionary separation of *S. andrewi*, and *S. toussainti*, the place of *S. amonensis* in the evolutionary scheme is rendered very shadowy by the present lack of information on the position of Mona Island with respect to the redistribution of fragmented components of the original landmass that accreted to form present Hispaniola. The rock composition of Mona suggests that the island was submerged for much of its history. Aaron (1973) states that the limestone/dolomite of which the island is composed date from Lower-Middle Eocene to Holocene, while the assessment by Heatwole, Levins and Byer (1981) may place the emergence of the island during, perhaps before the Pliocene. In the absence of any evidence that places Mona as emergent during the period when Hispaniola is thought to have been formed (Miller & Miller, 1989), the relationship between *S. amonensis* and its Hispaniolan relatives must remain enigmatic. That it is derived, with *S. toussainti* and *S. andrewi*, from a common ancestral stock seems very probable, but when and where it diverged remain obscure. If current geological views are broadly correct, *S. amonensis* could have evolved on Hispaniola or on Mona, but in either instance we must assume that the butterfly (or the putative stock) reached Mona by over-water dispersal, a circuitous arrival at the conclusion reached when this hairstreak was misidentified as *S. toussainti*!

Strymon toussainti has a rather wide though discontinuous distribution on Hispaniola. It occurs in southern Haiti and probably more widely in xeric areas of the country and from a number of localities in southwestern Dominican Republic including the Barahona Peninsula. In northwestern Dominican Republic it ranges from Monte Cristi towards Puerto Plata, with outlying colonies in the northeast, at Rio San Juan, and in the southeast from Rio Chavón and elsewhere near the south coast (Schwartz, 1989). We have searched for it, without success, in dry forest not unlike that of the Mona plateau above Boca de Yuma and elsewhere in the dry lowlands of the extreme east of the island. Schwartz (*in litt.*) indicated that specimens from widely separated localities, on both the north and south 'palaeoislands' are identical in pattern. *Strymon andrewi*, on the other hand, is at present known only from a cluster of upland sites near Aceitillar, in the Sierra de Baoruco/Massif de la Selle region of southwestern Dominican Republic (Johnson & Matusik, 1988; Schwartz, 1989), generally flying in pine-transitional deciduous forest approaching, though not overlapping with *S. toussainti*. *Strymon amonensis* is not only geographically well separated from both of the above species but differs further in displaying no defined habitat preference. Our field work on Mona suggests that the distribution of several butterflies, including this hairstreak, is determined more by opportunistic use of sporadically available nectar sources than preference for a botanically defined habitat; thus at different times we have found *S. amonensis* at *Croton discolor* on the northwestern plateau towards Cabo Barrionuevo, on *Coccoloba krugii* at the edge of the plateau on the south coast above Playa de Pajaros, on *Suriana maritima* on the shore of the southwest lowland plain and again on *Croton* and on *Lantana camara* and *L. involucrata* on land probably cleared for cultivation many years ago, near Uvero, where the plateau cliff arises from the plain.

Strymon bubastus ponce occurs on Mona at the westernmost extent of its range; it is a generally common insect on Puerto Rico, the Virgin Islands and through the Lesser Antillean chain to Grenada. It represents an identifiably easterly component of Mona's fauna (Smith *et al.*, 1988) and its apparent sparsity there may suggest it to be a relatively recent arrival with only a limited bridgehead on the island or, perhaps equally probably, a common butterfly whose periods of emergence have yet to coincide with field study on the island. *Strymon columella (sensu lato)* is a widespread and generally common butterfly in the Bahamas, throughout the Greater Antilles, the Virgin Islands and into the northern Lesser Antilles. A strikingly abrupt phenotypic transition in populations

of this species separates those on Puerto Rico (described as *S. c. arecibo* by Comstock & Huntington, 1943) from nominate *S. c. columella* present on the small islets of Palominos and Cayo Lobo a short distance off the eastern coast of Puerto Rico, on Culebra and adjoining islets, through the Virgin Islands to Anegada and at least to Antigua. While the distinction between the first subspecies *S. c. cybira* present on Hispaniola (Schwartz, 1989; Riley, 1975) and Puerto Rican populations is generally less than striking, it may be noted that the two Mona specimens conform to *S. c. arecibo* as described, in which the prominent circular black, narrowly orange-capped 'Thecla spot' is replaced by a black marginal bar broadly capped basally with red-orange and pale yellow (Fig. 5). In this respect *S. c. arecibo* approaches the nominate race. Longer series of *S. columella* from Mona are needed to determine whether this hint of the easterly origin of the butterfly on the island has substance. In any event, its eastern phenotypes do not reveal it as the effective dispersalist that its homogeneity elsewhere in its wide West Indian range might suggest.

Whatever the events that placed *S. amonensis* and an as yet inadequately known *S. columella* on Mona, they do not seem to have left an extant *Calisto* there. Moreover, the Pleistocene sea level lowering that may have facilitated the easterly movement of a *Calisto* stock to Anegada Island (Smith, Miller & McKenzie, 1991) is not known to have populated Mona, in accord with the belief that the island has been long isolated. Yet any conclusion on the absence of a butterfly from Mona must be qualified, as noted in the recent discovery of *S. columella*, mentioned previously; despite the relatively small area of the island, its terrain is very inhospitable. Much of the plateau of Mona remains unexplored and, after six periods of work, we have yet to traverse the north coast. Continued field work and further information on its geological history may be expected to play a significant part in extending our understanding of the butterflies of this remarkably preserved and richly endowed island.

Acknowledgements

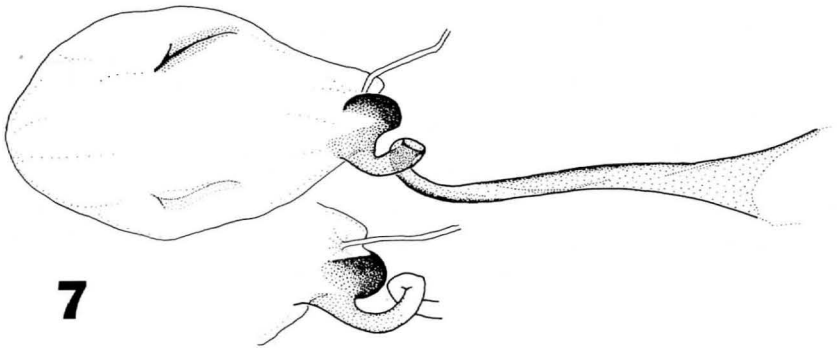
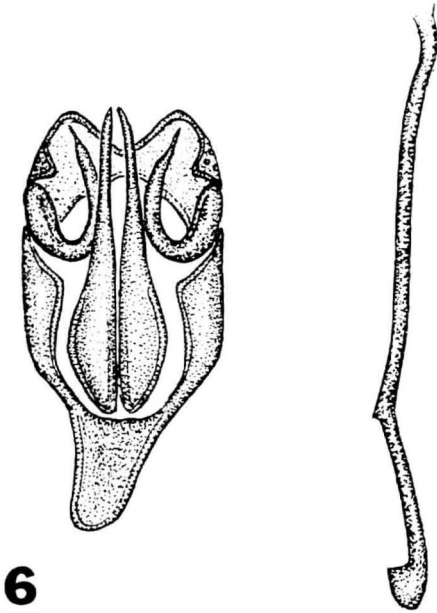
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The two volume work on Mona and Monito Islands, cited several times in the above bibliography, may not be available in many libraries. At the time of writing, we understand that the work is still obtainable from the Dept. of Natural Resources, Old San Juan, Puerto Rico.



Figures 6-7. Genitalia of *Strymon amonensis*. Figure 6, ♂ genitalia, ventral view; aedeagus, lateral view. Figure 7, ♀ genitalia, lateral view.

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