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A NEW SUBSPECIES OF *HERACLIDES* *ARISTODEMUS* FROM CROOKED ISLAND, BAHAMAS, WITH A DISCUSSION OF THE DISTRIBUTION OF THE SPECIES

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Heracles aristodemus (Esper) and its subspecies long have been highly prized by collectors, not only for their striking beauty, but also for their relative rarity in collections. One of these, *H. a. ponceanus* (Schaus) from the Florida Keys, has become a cause of great concern among conservationists because of its actual and potential extirpation chiefly because of habitat destruction and/or degradation in its limited range. The insect and its habitat are under active scrutiny by a number of workers who are studying ways that it might be preserved. More recently, similar concerns have been voiced for the continued existence of the strikingly beautiful *H. a. bjorndalae* (Clench) from Great Inagua, but the situation has been confirmed as not critical for this taxon (Simon and L. Miller 1986). The Hispaniolan race, nominate *aristodemus*, is rather common in the hammocks where it flies, and it is the exception in that it has never been considered to be in any danger. While recent data are lacking, it is likely that the Cuban *H. a. temenes* (Godart) also is under little pressure, this conclusion being based on the large numbers of old specimens in collections. Simon and L. Miller (1986) have suggested that the Androsian *H. a. driophilus* (Clench) is synonymous with *ponceanus*, and therefore the latter taxon cannot be endangered throughout its total range since it is surviving well on North Andros and apparently several other islands of the Great Bahama Bank.

Dr. Mark J. Simon of Lighthouse Point, Florida, an Associate of this museum has made a long-term study of *aristodemus*, both in the United States and in the West Indies. He has collected specimens of all known subspecies, with the exception of *temenes*, and has made his material along with his extensive observations available for this study. This information has been exceedingly valuable. I am confident that he has observed as many of these insects in nature as has anyone.

Simon and I have undertaken to fill in some of the lacunae in Harry Clench's yet-unpublished study of Bahamian butterflies, so it was natural that we would

seek *aristodemus*. In the course of this activity we encountered that insect on virtually every visit.

While neither Clench nor Donald J. Harvey located *aristodemus* during their investigations of Crooked and Acklins Islands (both of which share their own small, isolated bank), Simon was convinced, on the basis of the available vegetation, that there would be a population of this species on Crooked (and presumably, Acklins). I was equally convinced, on the basis of biogeographic considerations, that the *aristodemus* population, if there were one, would be distinctive. We were both correct, and the taxon described below is the result of this search. I would have preferred to name it for Dr. Simon, but *Papilio simoni* Aurivillius refers to an African *Graphium*, and while this taxon is not named in *Papilio*, following instead the revision by Hancock (1983), there is still some thought that *Heraclides* is a subgenus or even a synonym of *Papilio*. Therefore, while the following name is a patronymial, it cannot be construed as a homonym of the African insect.

***Heraclides aristodemus majasi*, new subspecies**

Figures 1-6

Male: Head, thorax, abdomen and appendages as in other *aristodemus* subspecies, though the yellow striping on lateral part of the abdomen is broader than in most and most closely approximates the condition noted in *temenes*.

Ground color of upper surface of both wings blacker than in other subspecies and not as brown. The yellow bands vary from pale lemon yellow to slightly ochreous (this latter color perhaps a function of age?) and broader than in other Bahamian examples; the subapical forewing spot is much larger than the spots just adjacent to it; and the hindwing submarginal spots are large and subquadrate, as in *bjorndalae*, not crescentic as in *temenes*, *ponceanus* and nominate *aristodemus*. The ground color of the subapical region of the forewing is not, or only very slightly, paler than the surrounding areas, in sharp contrast with the situation in *bjorndalae*, the only other small subspecies. Most specimens have the hindwing veins from Sc + R, through Cu₂, narrowly yellowed distad of the discal band, a situation not noted in other subspecies. Only one of six males has any trace of red postdiscal markings on the hindwing, and this only a small stain. These red markings are absent in *temenes* and nominate *aristodemus*, irregular, though quite well defined when they are present, in *ponceanus* (particularly Andros material), and are characteristic of *bjorndalae*. The tails are long and thin, but not quite so narrow as in *bjorndalae*. The tails further are broadly outlined with yellow. Under surface of both wings fuscous and yellow, rather than ochreous, and marked similarly to that of other subspecies. The submarginal forewing spots are not as extensive as in *temenes* and *aristodemus*, about equally well-developed as in *ponceanus*, and slightly heavier than those of *bjorndalae*. The postdiscal rusty patch on the hindwing is less extensive than that of *bjorndalae*, about equal to that of *ponceanus* and *aristodemus*, and more extensive than that of *temenes*. The blue hindwing markings between the postdiscal rusty patch and the yellow submarginal spots are about as in other subspecies. For comparison, the other Bahamian subspecies, *bjorndalae* and *ponceanus* (= *driophilus*) are illustrated in Figures 7-10.

The male genitalia are similar to those of other subspecies.

Length of forewing of Holotype male 39.9 mm, those of the five male paratypes 38.0, 38.3, 40.0, 44.4 and 45.0 mm.

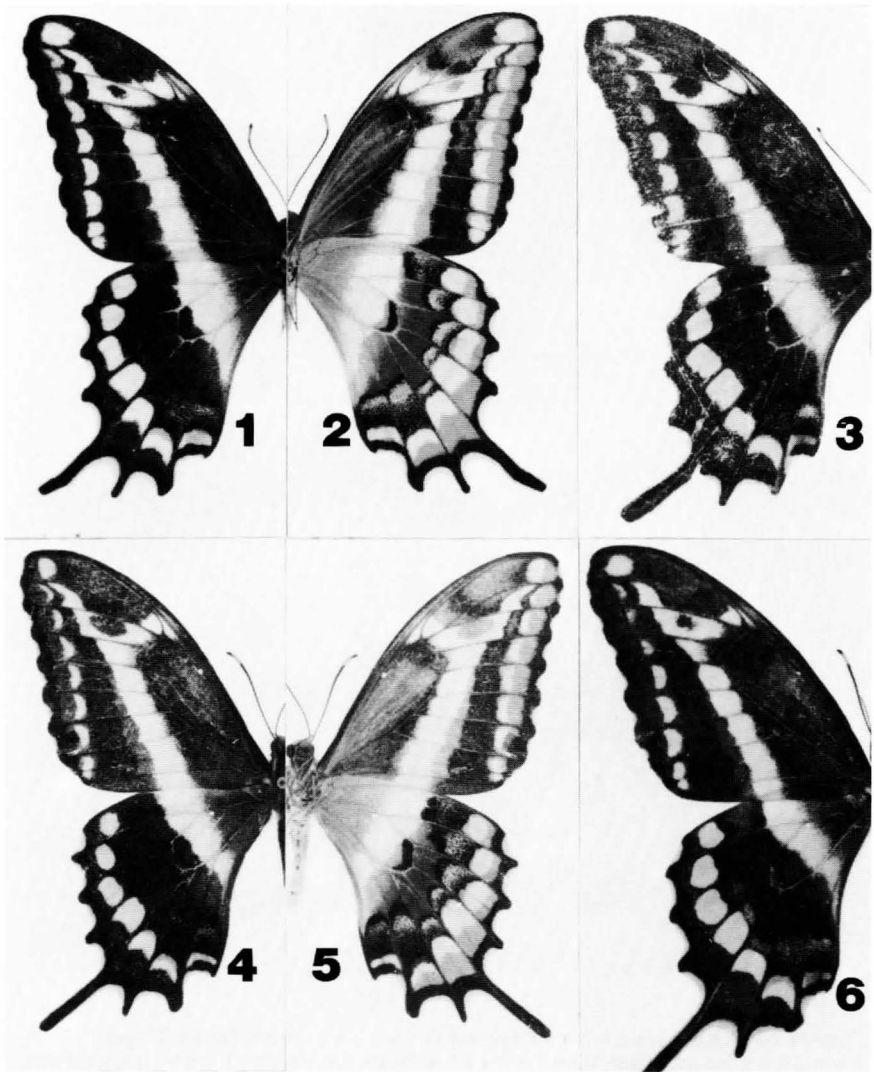
Female: No specimens captured, but the two that were seen appeared to differ little from the male except in size, being somewhat larger than the average male.

Described from six specimens, all males, from Crooked Island, Bahamas.

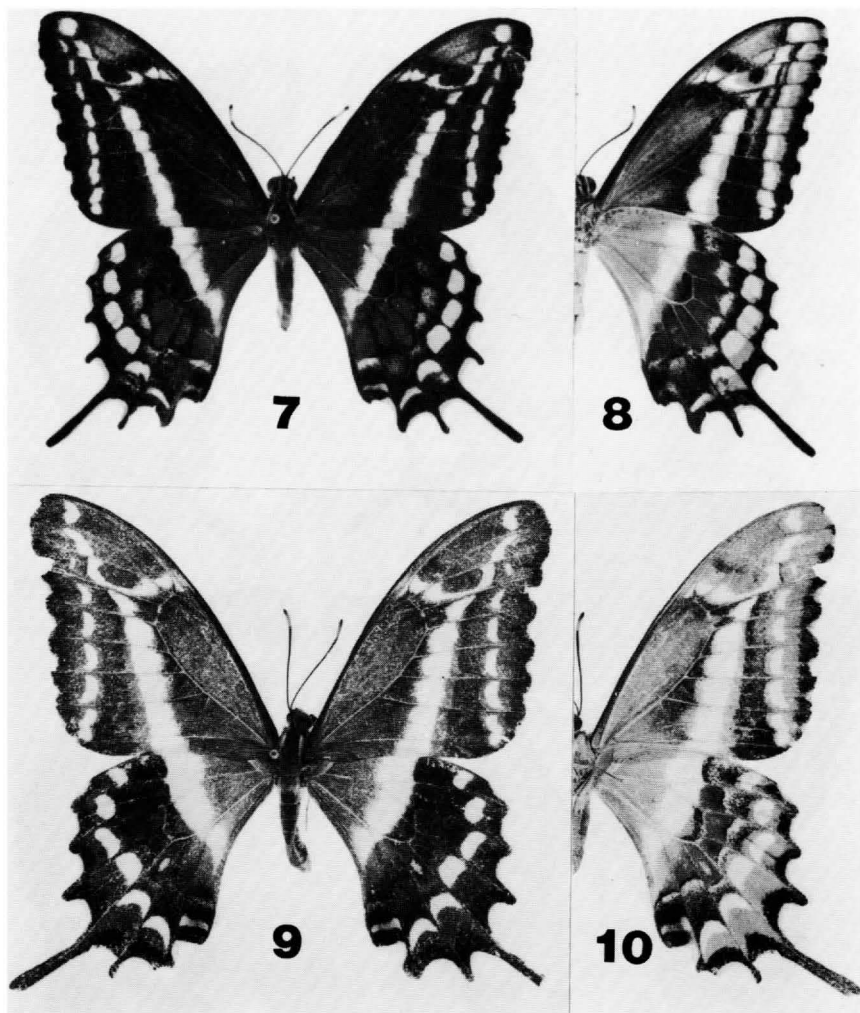
HOLOTYPE male: BAHAMAS: CROOKED ISLAND: vic. Pitts Town, 27.ix.1986 (M. Simon and L. Miller); station number 1986-17.

PARATYPES: same data as Holotype, 1 male; 2-4 mi. E of Pitts Town, 4 males, 23 and 24.ix.1986 (M. Simon and L. Miller); station numbers 1986-3 and 1986-6.

Disposition of type series: Holotype male and two male Paratypes in collection of the Allyn Museum of Entomology; three male Paratypes in collection of M. J. Simon.



Figures 1-6: *Heraclides aristodemus majasi*, new subspecies. 1-2: Holotype male upper (1) and under (2) surfaces; BAHAMAS: Crooked Island: vic. Pitts Town, 27.ix.1986 (M. Simon and L. Miller). 3-6: Male Paratypes upper surfaces; all from BAHAMAS: Crooked Island: Pitts Town or the area just east of that town, 23-27ix.1986 (M. Simon and L. Miller). Specimens in Figures 1-3 in collection of Allyn Museum of Entomology; specimens 4-6 in collection of M. J. Simon.



Figures 7-10: Other Bahamian subspecies of *Heraclides aristodemus* (Esper). 7-8: *H. a. bjoernalae* (Clench) upper (7) and under (8) surfaces; BAHAMAS: Great Inagua: Man-o-War Bay, 7.x.1985 (M. Simon and L. Miller, Allyn Museum collection). 9-10: *H. a. ponceanus* (Schaus) upper (9) and under (10) surfaces; BAHAMAS: North Andros: Fresh Creek, 3.vi.1978 (D. J. Harvey, D. J. Harvey collection).

Etymology: This distinctive butterfly is named for its discoverer, Dr. Mark J. Simon, in appreciation not only of his generous contributions to the Allyn Museum collections, but also for his advancement of knowledge of the Antillean, and particularly the Bahamian, butterfly fauna. The name is derived from the first two letters of each of his names.

Discussion: This subspecies is perhaps more contrastingly marked on its upper surface than any other known *aristodemus*. The subquadrate hindwing submarginal spots are diagnostic, and the usual lack of red on the upper hindwing separates it from most Bahamian specimens. The extension of yellow along the hindwing veins distad from the discal band is shown in no other subspecies. The small size of *majasi* is comparable to that shown by specimens of *bjorndalae* from Great Inagua, and both are smaller than specimens tentatively referred to the latter taxon from North Caicos, Turks and Caicos; hence, size may not be as diagnostic as previously believed.

These butterflies behaved more or less like *H. a. bjorndalae* on Great Inagua, but they were less evasive and flew similarly to individuals assigned to that taxon from North Caicos. However, they are not readily captured (no *aristodemus* is), but they were found outside the hammocks more frequently than were Inaguan specimens. *H. a. majasi* is more avid flower visitor than is *bjorndalae*, preferring flowers of *Bidens*, and it will remain on the blossom for more than a few seconds. One recorded larval foodplant (*Amyris*: Rutaceae) seemed to abound where specimens were taken, but no *Zanthoxylum*, the other recorded known rutaceous foodplant, was seen on the island.

We found other potential localities where the foodplant was present and conditions looked ideal, but we did not collect in these areas for sufficient time, perhaps, to encounter *majasi*. There is no apparent reason why this insect should not be found in all of the many hammocks on Crooked, and we assume that similar areas exist on Acklins. The insect should be there, too, since both islands are part of the same bank (see below). *H. a. majasi* was not rare around Pitts Town, even though it had been extremely dry before our arrival. Based on previous experience with *aristodemus* populations, we assume that *majasi* would be abundant given rains at the proper time.

NOTES ON THE DISTRIBUTION OF *Heraclides aristodemus* SUBSPECIES

A dispersalist explanation for the relatively wide range of *H. aristodemus* suggests that this taxon might be somewhat more vagile than many of its congeners, based on its being found in scattered colonies from the northern Bahamas and southern Florida to Hispaniola, Cuba, and Little Cayman (Riley 1975). That such vagility might be a rather rare event is attested to by the fact that *aristodemus* has subspeciated widely and dramatically throughout its range. The closely related *H. andraemon* (Esper), which has three subspecies in a more restricted range, is apparently also only somewhat vagile; its degree of endemism is comparable to that shown in *aristodemus*. *H. andraemon*, furthermore, is associated less closely with its hammock habitat than is *aristodemus*, so its dispersal potential should be considerably higher, but *andraemon* apparently had not even reached Hispaniola.

The distribution of *H. aristodemus* and its congeners is attributable to an early vicariance event (L. and J. Miller, *in press*) of a *thoas*-like stock from the mainland, which was isolated from the continent during the Eocene. This stock then evolved into an impressive array of closely related endemic species within the complex, all basically from Cuba and Hispaniola. These probably differentiated on the small Oligocene blocks that later accreted to form Cuba and Hispaniola. The taxa all seem to be rather ancient, perhaps dating from the early Tertiary. Many of them evidently are non-vagile and occur on only a single island, such as *H. caiguanabus* (Poey) which is known only from Cuba, probably having evolved on the western and central Cuban block (Pindell and Dewey 1982), and *H. aristor* (Godart) from Hispaniola, which may have evolved after the Miocene division of the eastern Cuba-central Hispaniola block. Other more widespread species include *H. andraemon*, which appears to have evolved on Cuba, possibly as late as the Miocene, and *H. machaonides* (Esper), which perhaps differentiated on the Puerto Rico-central

Hispaniolan block and presumably became distinct during the Oligocene. A model for such vicariance is shown in L. and J. Miller (*in press*: fig. 6).

This vicariance explanation suggests that *aristodemus* evolved originally on the eastern Cuba-northern Hispaniola block (Pindell and Dewey 1982), thus accounting for its presence on both of those islands, but not on Jamaica. Vicariance, however, cannot account for the entire range of the species which also includes Puerto Rico, the Florida Keys, the Caymans, and the Bahamas. To explain this observed range, one must postulate some over-water dispersal, perhaps in late Tertiary to early Quaternary.

Based on the proximity of continental shelves and other geological evidence, it is fairly easy to account for the observed distributional patterns on a later dispersalist model after accepting an original vicariance event. This distribution of the subspecies of *H. aristodemus* is mapped in Figure 11. In this model, one must attribute nominate *aristodemus* and *temenes* to the vicariance event of the splitting of the eastern Cuba-northern Hispaniola block into its respective smaller blocks that subsequently accreted onto their present islands. Then, it is necessary only explain the distributions of populations that now inhabit Puerto Rico, the Caymans, the Florida Keys, the Bahamas, and Turks and Caicos.

The distance across the Old Bahama Channel is only 25 miles (40 km.) from Cayo Romano, Cuba, to the Great Bahama Bank. Today from Cayo Coco, Cuba, to the southern tip of South Andros Island is 95 miles (145 km.). If one assumes that significant portions of the Great Bahama Bank were emergent in the Quaternary, dispersal of *aristodemus* from Cuba to many of the Bahamian islands would be easy to explain, and in most respects it would be far more logical than the dispersal of *temenes* from Cuba to Little Cayman (specimens from the islands are identical). One must ascribe its presence on Puerto Rico to dispersal on introduction from Hispaniolao.

The problem remains, however, that those *aristodemus* on islands of the Great Bahama Bank are phenotypically much more like, or identical to, those from the Florida Keys (Simon and L. Miller 1986) and far closer to Hispaniolan *aristodemus* than to the Cuban insect. Another dispersal track clearly is needed.

A somewhat longer pathway requires over-water dispersal of typical *aristodemus* from Hispaniola to the Bahamas. The shortest possible distance for this dispersal is about 50 miles (80 km.) from Ile de la Tortue to Great Inagua, and there are no intervening banks to serve as "way stations", even at times of lowered sea level. The prevailing summer winds, however, would favor such a dispersal event over one from Cuba to the Bahamas. The Inaguan subspecies, *H. a. bjoerndalae*, shares the narrowed yellow bands with the other subspecies, including nominate *aristodemus* but excluding *temenes*. The diminutive size of *bjoerndalae* may be a response to the relative harshness of the Inaguan environment: North Caicos specimens attributable to that taxon which I have seen are equal in size to ones from Hispaniolan.

If the invasion of the Bahamas was from Hispaniola, one would expect that Crooked and Acklins might have been populated by an over-water dispersal from the Inaguas (*majasi* approximates *bjoerndalae*, at least in size and in the longer and unusually thin hindwing tails, thus tending to support the hypothesis). The over-water distance is comparable to that from Hispaniola to Great Inagua, and population *via* the typical southeasterly summer winds again should have come into play. The jump from Crooked-Acklins to islands of the Great Bahama Bank is much shorter and even more likely to have occurred.

The striking similarity or identity of *aristodemus* from islands of the Great Bahama Bank island to those from the Florida Keys is easily explained. The distance from North Cat Cay, Bahamas, on the Great Bahama Bank, to the islands of Biscayne Bay, Florida, is a distance of about 60 miles (90 km.). The prevailing winds during the summer are easterlies or southeasterlies, which would favor population from the Bahamas, rather than the reverse. An insect flying from the Bahamas, for example, from Andros, would find a much larger "target" in southern Florida than would an insect on the reverse flight; hence, this pathway is more plausible. The phenotypic resemblance between Andros Island

and Florida Keys specimens argues eloquently for this faunal transport being a relatively common (certainly commoner than that within the islands) and probably often repeated occurrence.

Much of the subspeciation in *aristodemus*, then, must be attributed to rather recent short-range dispersal, presumably when sea levels were depressed. Such a lowering of sea level effectively diminished the distances between islands, facilitating dispersal. Present-day distances doubtless inhibit much additional interchange between areas; therefore, insular populations have evolved into distinct subspecies that have little or no genic interchange. This relatively recent total isolation indicates that Bahamian populations are of Pleistocene age, or perhaps only slightly older.

ACKNOWLEDGMENTS

I am particularly grateful to Dr. Mark J. Simon, Boca Raton, Florida, for his enthusiastic cooperation on this project. He also collected the first specimens of *majasi*, even as I had despaired of finding it. He cheerfully has made the results of his inquiries into the biology of *aristodemus* available to me for this study; these have been indispensable.

Dr. Jacqueline Y. Miller read and commented on the manuscript. Her insights and incisive suggestions have clarified many points and resulted in many improvements of the manuscript that had not been previously considered by me.

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