

Anopheles aquasalis vs. *Anopheles tarsimaculatus* as the name for the brackish water anopheline of Central and South America and the Caribbean islands*

Causey, O. R.

Deane, L. M.

Deane, M. P.

Laboratory of the Serviço de Malaria do Nordeste at Fortaleza, Brazil and
International Health Division of The Rockefeller Foundation

The controversy pertaining to the validity of the name *tarsimaculatus* has assumed prominence with the recognition that the mosquitoes so designated constitute several valid species. A brief resume of the origin and early application of the name *tarsimaculatus* will facilitate a comprehension of the problem involved. The mosquitoes to be considered are those of the subgenus *Nyssorhynchus* which have a black ring on the fifth hind tarsal segment. The first mosquito of this group to be described was *Anopheles albimanus* Wiedemann 1821. Theobald (1901) later described the same mosquito as *Anopheles argyritarsis* variety *albipes* thinking that it was a variety of *Anopheles argyritarsis* Robineau-Desvoidy 1827. Theobald (1903) raised *hisalbipes* to specific rank and placed it in the genus *Cellia*. Goeldi (1905) published a collection of four papers under the title "Os Mosquitos no Pará. Reunião de quatro trabalhos sobre os mosquitos indigenas, principalmente as especies que molestam o homem" in which he followed the nomenclature of Theobald. In the first of these papers Goeldi (1902) also (1905) states that the Anophelines of principal interest in Pará are *Anopheles argyritarsis* and *Anopheles argyritarsis* var. *albipes*. In a third paper of the same series Goeldi (1905) designated the Anophelines of Pará as *Cellia argyritarsis* var. *albitarsis* and *Cellia*

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argyritarsis var. *albipes*. Since *albitarsis* and *albipes* both mean white feet, and since the mosquito called *albipes* in reality had a black band on the fifth hind tarsi Goeldi proposed to change this latter to *tarsimaculatus*. No description, however, was made of the mosquito which Goeldi thus designated as *tarsimaculatus* except for an illustration of the posterior tarsi and photographs of eggs at very low magnification, and of first stage larva. Other photographs of eggs at much higher magnification are also shown, probably from the same oviposition but Goeldi does not make a specific statement to this effect. The photographs are either badly reproduced or were retouched. It is obvious that the frill at each end of the egg in Fig. 123 of Plate O does not protrude over the tips, while the frills of those in Fig. 131 extend considerably over the tips and can be seen from the ventral side of the egg (dorsal side of the larva). The eggs depicted in Fig. 131 are similar to the eggs of *Anopheles goeldii* Rozeboom and Gabaldon (1941). The Fig. 123 resembles the egg of *Anopheles aquasalis* Curry (1932) while that in Fig. 133 is unlike any known anopheline egg in Brazil. The tarsal segments shown in Fig. 10b, Plate 2, can be associated with several species. In the areas studied by Goeldi the mosquitoes with tarsi similar to this drawing are *Anopheles goeldii*, *Anopheles aquasalis* and *Anopheles triannulatus*. Goeldi states in his first paper that the Anophelines which he was describing as var. *albipes* (later called *tarsimaculatus*) were from Macapá where collectors of the museum had worked for three years. Recent investigations by the authors to determine what species now exist in Macapá reveal the prevalence of large numbers of *Anopheles goeldii* and *Anopheles triannulatus* but no *Anopheles aquasalis*. In Belem, another region studied by Goeldi, *Anopheles aquasalis* is now prevalent, but *Anopheles goeldii* is not found. In addition to these three species which have hind tarsi corresponding to Goeldi's diagram, there exist in Pará *Anopheles oswaldoi*, and *Anopheles konderi* which have a narrower ring on the second hind tarsi but due to the presence of a black ring on the fifth hind tarsi would certainly have been identified by Goeldi as *albipes* (or *tarsimaculatus*). From these observations it may be deduced that Goeldi not only collected but designated several species of Anophelines

as *albipes* (*tarsimaculatus*).

Dyar and Knab (1906) realized that the anophelines of Pará were not *Anopheles albipes* Theobald 1903 as assumed by Goeldi, but constitute a different species for which they used Goeldi's new name *tarsimaculatus*. Theobald (1907), however, placed both *albipes* and *tarsimaculatus* in synonymy with *albimanus* because he had discovered that his original *albipes* was the same as *albimanus* and he thought that the specimens from Pará were identical with them. Peryassu (1922) recognized that the mosquitoes with a narrow black ring on the second hind tarsi formed an entity distinct from those that had a large ring. For the former he proposed the name *Anopheles oswaldoi*. Root (1926) did not consider *oswaldoi* a valid species and continued to use the name *tarsimaculatus*, not only for *oswaldoi* but for other mosquitoes subsequently shown to constitute several species. Rozeboom and Gabaldon (1941), reported finding four distinct species among the specimens labelled *tarsimaculatus* in the collection of the late Dr. F. M. Root. Two additional species have been found among specimens mounted on four slides that were given to one of the authors by Dr. Root. Townsend (1933) called attention to the fact that the name *tarsimaculatus* was illegally proposed and should not be used. For the mosquito so designated by Dyar and Knab he proposed to revalidate *Anopheles gorgasi* Dyar and Knab, 1907, which, however, Rozeboom and Gabaldon (1941) consider to be a synonym of *albimanus*. Curry (1932) separated two varieties of *tarsimaculatus* on the basis of biological and morphological characteristics. These he called *Anopheles tarsimaculatus* var. *aquasalis* and *Anopheles tarsimaculatus* var. *aquacoelestis*. The first has been raised to specific rank by Rozeboom and Gabaldon and the latter placed in synonymy with *oswaldoi*. It is of interest to note that this is the first time the name *tarsimaculatus* had been associated with descriptions which served to characterize accurately the mosquitoes designated.

Several workers in Brazil also recognized that the mosquitoes commonly referred to as *Anopheles tarsimaculatus* constituted several varieties or species. Galvão and Lane (1938)

proposed the revalidation of *Anopheles oswaldoi* Peryassu 1922 and described two varieties of the species as *Anopheles oswaldoi oswaldoi* and *Anopheles oswaldoi noroestensis*. Galvão (1940) continued the discussion of these varieties. Unfortunately the descriptions in both of these papers were not based on homogeneous material. In the first paper Galvão and Lane created the variety *metcalfi* for the mosquitoes that oviposited the peculiar type of egg described by Root (1926). It is now generally recognized that Root's description was erroneous. Meanwhile Coutinho (1942) has published data obviously pertaining to Curry's *aquasalis* under the name of *Anopheles oswaldoi* var. *metcalfi*. Unti (1940) described an additional variety as *Anopheles oswaldoi* var. *ayrozai*. His descriptions of the eggs, larvae, pupae and adult were made on material reared in the laboratory from females captured on animal bait. Galvão and Damasceno (1942) raised *noroestensis* to the rank of species and at the same time verified that Unti's *ayrozai* is a synonym of *noroestensis*. Komp (1942) described *Anopheles clarki* which is also a synonym of this species. Our dissections on numerous male genitalia of mosquitoes collected in northeast Brazil confirm the synonymy of *clarki* with *noroestensis*.

Galvão and Lane (1938) considered Goeldi's name *Anopheles tarsimaculatus* valid but realized that no known mosquito could be recognized by this name on the basis of recorded descriptions. In an attempt to clarify the issue they described an Anopheline from the interior of the Amazon Valley and designated it as *Anopheles tarsimaculatus* Goeldi, 1905. To support their claim for the validity of this name they quote article 21 of the International Rules of Zoological Nomenclature, as follows:

“Article 21. – The author of a scientific name is that person who first publishes the name in connection with an indication, a definition, or a description, unless it is clear from the contents of the publication that some other person is responsible for said name and its indication, definition, or description”.

Rozeboom and Gabaldon (1941) do not agree that article 21 is applicable, and to disprove the validity of the name *tarsimaculatus* as applied by Goeldi to the variety *albipes* they quote article 32 of the International Rules of Zoological Nomenclature, as follows:

“Article 32 – A generic or a specific name, once published, cannot be rejected, even by its author, because of inappropriateness. Examples: Names like *Polydon*, *Apus*, *albus*, etc., when once published, are not to be rejected because of a claim that they indicate characters contradictory to those possessed by the animals in question”.

Along with a review of the *tarsimaculatus* complex Rozeboom and Gabaldon (1941) described an Anopheline from the Amazon Valley as *Anopheles goeldii*. This mosquito incidentally is undoubtedly the same species described by Galvão and Lane (1938) as the type material for *Anopheles tarsimaculatus* and by Townsend (1933) as the revalidated *Anopheles gorgasi*. Komp (1941) in a discussion concerning the validity of *tarsimaculatus* presents an argument similar to that of Rozeboom and Gabaldon, and states that no one had taken into consideration the possibility that the species from Belem, Pará might be different from anything so far described from the area. In order to investigate this possibility he made a visit to Belem for a few days in April 1941 to obtain material of Goeldi's species. He collected specimens which he considered different from *oswaldoi*, *nunez-tovari*, *rangeli* and *aquasalis*. He described the species and for it proposed the name *Anopheles emilianus*. Galvão, Damasceno, and Marques (1942) who were working in Belem at the time of Komp's visit and assisted Komp in collecting his material, still retain the name *tarsimaculatus* for this species in Belem. These observers after an extensive study of the mosquitoes of Belem report that *A. tarsimaculatus* (*A. emilianus* Komp 1941) is chiefly found in breeding places with relatively high chloride concentration, on the low lands which are invaded by the tide. It is unfortunate that these investigators used the name *tarsimaculatus* in their excellent study of the biology of this brackish water mosquito as they realized it to be different from the mosquito Galvão and Lane 1938, had described and designated as *Anopheles tarsimaculatus* from

the Rivers Parauarí, Maués, and Manacapurú, and which is now recognized as *Anopheles goeldi* with an entirely different biology. Ramos (1942) described *Anopheles oswaldoi* var. *guarujaensis* which is evidently *Anopheles aquasalis* and which was placed in synonymy with *tarsimaculatus* by Galvao and Damasceno (1942).

During the past four years the authors of this paper have worked constantly with this coastal species variously known as *tarsimaculatus*, *guarujaensis*, *metcalfi*, *emilianus* and *aquasalis*. It has been collected along the coastal region from Rio de Janeiro to the French Guiana border, always in areas influenced by tidal sea water. Extensive searches for this mosquito in the Amazon region have revealed that the species does not exist in the interior from Belem. The biology of *aquasalis* in Brazil will be discussed in a separate paper in the near future. It will suffice to state here that the chloride content of many breeding places has been determined and the type of water collections preferred by *aquasalis* noted. Although the species can and does mature in fresh water it is usually found in brackish water. The species is particularly resistant to salt water. Under laboratory conditions larvae can mature in sea water. In one experiment when sea water was permitted to evaporate until it reached a concentration of 7.4 percent sodium chloride, larvae continued to grow and pupated.

In making the distinction between *Anopheles emilianus* and *Anopheles aquasalis* Komp states that "the male terminalia are not particularly distinctive although the mesosome of *aquasalis* has a shorter and broader tip than that of *emilianus*, and that the hairs fringing the free margins of the basal lobules of the fused claspette lobes are shorter than in *emilianus*. These differences are variable and are rather indefinite. The species are most easily separated in the egg stage and it is by this criterion that the presence of *aquasalis* and *emilianus* in any locality should be judged".

More than 7000 ovipositions from isolated females of this species have been obtained and studied. Considerable variation in the type of eggs oviposited by this mosquito has been observed. In Ceará where the climate is dryer the eggs appear closed, with floats more

closely approximated. In Belem the eggs show a greater tendency to appear open with the floats separated. Even among eggs of the same oviposition, however, both open and closed types can be observed. Variations in the male genitalia as great as the differences described by Komp between *emilianus* and *aquasalis* may also be found among mosquitoes from the same oviposition.

After making extensive studies on this mosquito in Ceará and in Belem the authors fail to find any characteristics either biological or morphological that separate the brackish water breeding Anopheline of Brazil from *Anopheles aquasalis* Curry 1932 or to find any other mosquito that conforms to the description given for *Anopheles emilianus*. Therefore *Anopheles emilianus* is considered to be synonymous with *Anopheles aquasalis*.

The following mosquitoes of the subgenus *Nyssorhynchus* with a black ring on the fifth hind tarsi have been described. With the exception of *albimanus* all the valid species have been found in the northeast and Amazon regions of Brazil.

- Anopheles albimanus* Wiedermann, 1821
- argyritarsis* var. *albipes* Theobald, 1901
- albipes* Theobald, 1903
- tarsimaculata* Goeldi, 1905
- gorgasi* Dyar and Knab, 1907
- Anopheles aquasalis* Curry, 1932
- arsimaculatus* var. *aquasalis* Curry, 1932
- tarsimaculatus* Galvão, Damasceno and Maués, 1942
 (not Goeldi, 1905, nor Galvão and Lane, 1938)
- emilianus* Komp, 1941
- oswaldoi* var. *guarujaensis* Ramos, 1942
- oswaldoi* var. *metcalfi* Coutinho, 1942 (not Galvão and Lane 1938).
- Anopheles benarrochi* Gabaldon, Cova-Garcia and Lopez, 1941
- Anopheles dunhami* Causey, in press.

- Anopheles galvaoi* Causey, Deane and Deane, 1944
Anopheles goeldii Rozeboom and Gabaldon, 1941
 tarsimaculatus Galvão and Lane, 1938 (not Goeldi, 1905)
 gorgasi Townsend, 1933 (not Dyar and Knab, 1907)
Anopheles konderi Galvão and Damasceno, 1942
Anopheles noroestensis Galvão and Lane, 1938
 oswaldoi ayrozai Unti, 1940
 clarki Komp, 1942
Anopheles oswaldoi Peryassu, 1922
 tarsimaculatus var. *aquacoelestis* Curry, 1932
Anopheles rangeli Gabaldon, 1940
Anopheles triannulatus Neiva and Pinto, 1922
Anopheles strodei Root, 1926
Anopheles triannulatus Neiva and Pinto, 1922
Anopheles bachmani Petrocchi, 1925
Anopheles, oswaldoi var. *metcalfi* Galvão and Lane, 1938 (nomen nudum?)

SUMMARY

The validity of the name *tarsimaculatus* as used by Goeldi for the Anophelines of the sub-genus *Nyssorhynchus* with black ring on the fifth hind tarsi, is discussed. It is pointed out that at least three species of the *Nyssorhynchus* group corresponding to Goeldi's meagre descriptions are present in the areas from which he collected his material. It is evident that the name was used by him, not for one but for several species. The mosquitoes in Belem designated as *Anopheles tarsimaculatus* by Galvão, Damasceno and Marques (1942), and as *Anopheles emilianus* by Komp (1941) are indistinguishable in morphological and physiological characteristics from *Anopheles aquasalis* Curry 1932. The authors are of the opinion that since *tarsimaculatus* was illegally proposed as an emendation of a name considered inappropriate, and was applied to mosquitoes subsequently differentiated as several distinct species, the name is not available for any Anopheline. *Anopheles emilianus* Komp 1941 is considered to be a synonym of *Anopheles aquasalis* Curry, 1932.

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