

## IDENTIFICATION OF VECTOR SPECIES (DIPTERA: SIMULIIDAE) OF HUMAN ONCHOCERCIASIS IN THE AMAZONIA FOCUS OF BRAZIL AND VENEZUELA

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*The taxonomic status of three Amazonian simuliid species, Simulium guianense Wise, S. oyapockense Flock & Abonnenc and S. yarzabali Ramirez Perez is reviewed. Simulium cuasisanguineum Ramirez Perez, Yarzabal & Peterson is synonymized with S. oyapockense, and S. yarzabali is revalidated from its synonymy with S. incrustatum Lutz. The role of these three species in the transmission of human onchocerciasis and mansonelliasis in Amazonia is reviewed.*

Key words: Simuliidae – vector species onchocerciasis – Amazonia

Since Goeldi's original description of *S. amazonicum* in 1905 from material collected in the Brazilian Amazon this species has been the most misidentified simuliid in the region. Interest in *S. amazonicum* and other black fly species grew when simuliids rather than ceratopogonids were suspected as vectors of *Mansonella ozzardi* from Cerqueira's work (1959) and later confirmed as vectors in both Brazil (Shelley et al., 1980) and Colombia (Tidwell et al., 1980). Recent work in Brazil (Shelley et al., 1979b) and Venezuela (Rassi et al., 1977) also implicated a simuliid species related to *S. amazonicum* as vector in the Amazonia onchocerciasis focus. A persistent problem during work on the transmission of these human filariae has been the difficulty in accurately identifying the simuliid vector species.

It is now clear (Shelley et al., in press) that there are at least two main vectors of *Onchocerca volvulus* in the Amazonia focus of northern Brazil and southern Venezuela. *Simulium guianense* Wise in the highland areas and *S. oyapockense* Flock & Abonnenc in lowland localities, as well as a potential third vector variously identified as *S. limbatum* Knab, *S. incrustatum* Lutz or *S. yarzabali* Ramirez Perez that also mainly occurs in highland localities. Considerable difficulty has been encountered in distinguishing *S. guianense* from closely related taxa in the *S. guianense* group and the latter three species from their relatives in the *S. amazonicum* group.

Misidentifications of this fauna has occurred primarily for two reasons. First, the area in which these species occur had been poorly prospected prior to the discovery of the onchocerciasis focus nearly twenty years ago resulting in the simuliid fauna being superficially studied and described. Consequently, characters that were thought to be species diagnostic are now seen to be polymorphic as a result of population sampling from a broader geographic range. Secondly, the lack of an integrated study by workers in the focus has resulted in the publication of a profusion of new names from Venezuela for already described morphospecies. In order to facilitate identification of these vector species and their relatives this paper attempts to clarify their taxonomic status by discussing the relevant literature.

### *Simulium guianense* Wise

Identification of the highland vector is difficult because the females of three species, *S. guianense* Wise, *S. pinto* d'Andretta & d'Andretta and *S. orbitale* Lutz are morphologically very similar. The last two species are easily separated from one another on pupal gill filament number and configuration and also on male scutal patterns, but *S. guianense* is not reliably known in the pupa or male having been described from anthropophilic females collected in Guyana (Wise, 1911).

In the onchocerciasis focus in Brazil biting females identical to the types of both *S. pinto* and *S. guianense* were collected and judged to be conspecific with females reared in localities where the species is totally zoophilic. In Venezuela this species is regarded as *S. pinto* (Ramirez Perez, 1983, 1984, 1985, 1986; Ramirez

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Perez et al., 1982; Rassi & Monzon, 1981; Rassi et al., 1977; Tada et al., 1983 and Takaoka et al., 1984) and is found both within and to the north of the focus. Ramirez Perez (1971) described material from the state of Bolivar, outside the focus, as a new species *S. ortizi* but later (Ramirez Perez et al., 1982) synonymized this name with *S. pintoi*. In Brazil Rassi (1974) identified *S. guianense* as *S. pintoi* and *S. orbitale*. It was then cited as *Simulium* species B by Shelley et al. (1976) and later identified as either *S. pintoi* or *S. guianense* in Moraes et al. (1979). In 1979 Shelley et al. referred to this species as *S. guianense* which was later misquoted as *S. pintoi* (? = *guianense*) in Tidwell et al. (1981).

We prefer to use the name *S. guianense* because it predates that of *S. pintoi*. *S. guianense* is a well known anthropophilic species in western Guyana, whereas *S. pintoi* is generally regarded as a zoophilic species of large rivers of Amazonia and Southern Brazil. The relationship between these two species will be further investigated using morphological and cytological methods when males, pupae and larvae of *S. guianense* are obtained from the type locality for comparison with the *S. pintoi* types.

#### *Simulim oyapockense* Floch & Abonnenc

This species was first described by Floch & Abonnenc (1946) from the River Oyapock between Brazil and French Guiana. It remained a relatively little known species until Shelley and co-workers (World Health Organization, 1982) discussed its taxonomic status and relationship with onchocerciasis transmission in the Amazonia focus. Misidentifications of the lowland vector species *S. oyapockense* from the Brazilian side of the focus had occurred before 1984 when Shelley et al. were able to clarify the situation based on better material in the form of reared topotypes. Shelley et al. (1982) had provisionally assigned the vector species at Toototobi to *S. minusculum* Lutz, after examining the syntype series of this species and suggested a possible synonymy with *S. roraimense*. However, the syntype series was then shown (Shelley et al., 1984) to include a second species, *S. oyapockense* with which the primary vector species at Toototobi was considered to be conspecific. Variations in adult scutal pattern and in pupal gill length and configuration were noted in relation to the female lectotype and reared topotypes of *S. oyapockense*. Furthermore, *S. roraimense* was also regarded as distinct from *S. minusculum* but a close relative of *S. oyapockense* being distinguishable only in the male. Py-Daniel (1983) working independently arrived at the same

conclusion with reference to the taxonomic status of these three species.

In Venezuela three nominally new species, *S. pseudosanguineum*, *S. sanchezi* and *S. cuasisanguineum* were described and keys to the simuliid fauna of Amazonas Territory of Venezuela, in which the onchocerciasis focus lies, were given by Ramirez Perez & Peterson (1981) and Ramirez Perez et al. (1982). Of the three species only *S. sanchezi* is not recorded in the onchocerciasis focus by these authors. In 1983, *S. pseudosanguineum* was accepted as a synonym of *S. oyapockense* by Ramirez Perez as was originally proposed by Shelley and co-workers (World Health Organization, 1982) and further detailed in Shelley et al. (1984). The latter authors at the same time synonymised *S. sanchezi* with *S. oyapockense* but reserved judgement on the taxonomic status of *S. cuasisanguineum*.

The vector status of these new nominal species has been referred to by Ramirez Perez in several publications. *S. cuasisanguineum* is cited (Ramirez Perez, 1983, 1984, 1985, 1986; Ramirez Perez et al., 1982) as the vector of onchocerciasis both in Venezuela and in Brazil based on material from Rassi's earlier collections described in Rassi et al. (1977, 1978). This assessment is inaccurate because although Ramirez Perez et al. (1982) correctly accept that *S. roraimense* Nunes de Mello and *S. cuasisanguineum* are inseparable in the female they base their identification of the latter species on reared material collected outside the onchocerciasis focus at Tama Tama. It is therefore questionable how such a precise identification of wild females of the species incriminated as a vector could be made when no reared material was collected by Rassi that could be associated with these adults.

A further complication arises over the identification of the filarial larvae. Ramirez Perez (1983), states that the infective larvae [only one reported by Rassi et al., 1977, 1978] from Rassi's work in Venezuela are probably of *Mansonella ozzardi* but later the same author (Ramirez Perez, 1984, 1985, 1986) cites them as *O. volvulus*.

We have now re-evaluated the existence of variation in granulosity in pupal integuments of various species in the *S. amazonicum* group and now regard the lack of granulations on the frontoclypeus and the reduced number on the thorax of the pupa as insufficient on their own to warrant the creation of a new taxon. Consequently *S. cuasisanguineum* is here synonymised with *S. oyapockense*. Integrated cytological and morphological studies currently underway may clarify whether such morphological charac-



teres are of greater importance as diagnostic criteria for species identification.

We therefore accept the existence of a polymorphic species *S. oyapockense* with a wide distribution in the upper Amazon and Orinoco basins and in the Guianas in which variations exist in scutal pattern and leg colouration of the adults, and gill length, form and integument granulosity of the pupae. Formal naming of species based on these variations is considered premature until specific morphological characters can be linked to chromosomal differences in specimens reared from single egg batches or from adults reared from pupae from cytospecies-pure localities. In support of this approach is recent taxonomic work on the *S. damnosum* complex in West Africa. Male scutal patterns, which were supposedly diagnostic for separating six of the cytospecies of *S. damnosum* (Dang & Petterson, 1980) have subsequently been found to exhibit considerable intraspecific variation when integrated morphological and cytological studies on adults reared from single egg batches of two of the cytospecies were carried out (Meredith et al., 1983).

This interim action of synonymy of the three species proposed by Ramirez Perez means that only two common anthropophilic species, *S. oyapockense* and *S. roraimense*, are now recorded for Amazonia in place of the previous five. Since females of the two species are indistinguishable it is not known whether both are vectors of onchocerciasis in the lowland areas

of the Amazonia focus. Similarly, *S. oyapockense* or *S. roraimense* is also the vector of *M. ozzardi* in Guyana (Nathan et al., 1982 as *S. minusculum*) Brazil (Moraes et al., 1985) and Venezuela (as *S. sanchezi*, Ramirez Perez et al., 1982; Yarzabal et al., 1983; as *S. sanchezi* and *S. amazonicum* in Ramirez Perez, 1983) and Colombia (Tidwell et al., 1980 as unnamed member of the *S. sanguineum* [= *S. amazonicum*] group).

Table lists names previously used for *S. oyapockense*.

#### *Simulium yarzabali* Ramirez Perez

Identification of this species has been problematical and its taxonomic status has still not been adequately resolved. Rassi (1974) first identified this species as *S. incrustatum* Lutz from two localities on the Brazilian side of the Amazonia onchocerciasis focus. Later Moraes et al. (1979) cited *S. incrustatum* as a potential vector of either onchocerciasis or mansonelliasis at one of these localities, Auaris, because wild caught flies contained sausage stage filariae. Ramirez Perez (1980) then described a new species, *S. yarzabali* from material collected at a highland locality on the Venezuelan side of the focus. We have examined this material and judge it to be conspecific with Amazonian *S. incrustatum sensu* Rassi (1974), *sensu* Moraes et al. (1979), but not with *S. incrustatum* from southern Brazil from where the species was first described.

TABLE

List of previous names used for *S. oyapockense*

Identification	Country	Source
<i>S. amazonicum</i> complex (amazonicum + minusculum)*	Brazil	Rassi, 1974
<i>S. amazonicum</i> *	Brazil Venezuela	Moraes et al., 1979; Rassi et al., 1975 a, b. Ramirez Perez, 1983; Rassi & Monzon, 1981; Rassi et al., 1977, 1978.
<i>S. cuasisanguineum</i> syn. n.	Venezuela Brazil	Ramirez Perez et al., 1982 Ramirez Perez, 1983, 1984, 1985, 1986; Tada, 1983; Takaoka et al., 1984; World Health Organization, 1982
<i>S. minusculum</i> of amazonicum complex*	Brazil	Rassi, 1974
<i>S. minusculum</i> *	Brazil	Shelley et al., 1982
<i>S. pseudosanguineum</i> syn.	Venezuela	Ramirez Perez & Peterson, 1981
<i>S. sanchezi</i> syn.	Venezuela	Ramirez Perez et al., 1982; Yarzabal et al., 1983
<i>S. sanguineum</i> *	Brazil	Shelley et al., 1979 a, b, 1980
<i>S. sanguineum</i> group forms A & C	Brazil Venezuela	Tidwell et al., 1981 a
<i>S. simulium</i> sp. A	Brazil	Shelley et al., 1976

\* Denotes misidentification.

In 1983 Ramirez Perez synonymised *S. yarzabali* with *S. incrustatum* and in more recent reviews (Ramirez Perez, 1984, 1985, 1986) cites *S. incrustatum* as a vector of *O. volvulus* in Venezuela. We believe their synonymy to be premature based on an examination of reared *S. incrustatum* topotypes and *S. yarzabali* paratypes and therefore revalidate *S. yarzabali*. The former species possesses hairing on the subcostal wing vein and is zoophilic whereas the converse is true for *S. yarzabali*. Furthermore, biting females of *S. yarzabali* and *S. limbatum* are indistinguishable, separation only being possible on reared material using the configuration of the pupal gill. Our reared material from within the focus at Auaris is insufficient to establish whether both species are present. New material therefore needs to be collected for detailed morphological and cytological analyses in order to establish the relationship between zoophilic *S. incrustatum* from southern Brazil, anthropophilic *S. yarzabali* from the highland areas of the focus and *S. limbatum*, a common anthropophilic species in the savanna adjacent to the focus. The suspected role of *S. yarzabali* as a vector of onchocerciasis in the highland areas of the focus still requires confirmation.

#### RESUMO

**Identificação das espécies vetoras (Diptera: Simuliidae) de oncocercose humana no foco da Amazônia do Brasil e da Venezuela** – Revisamos as posições taxonômicas de três espécies de simuliídeos da Amazônia, *Simulium guianense* Wise, *S. oyapockense* Flock & Abonnenc e *S. yarzabali* Ramirez Perez.

Sinonimizamos *S. cuasisanguineum* Ramires Perez, Yarzabal & Peterson com *S. oyapockense*, revalidamos *S. yarzabali* que estava em sinonímia com *S. incrustatum*.

Discutimos os papéis destas três espécies na transmissão de oncocercose e mansonelose humana na Amazônia.

Palavras-chave: Simuliidae – espécies vetoras de oncocercose – Amazônia

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