

International Journal of Research in Biosciences  
Vol. 6 Issue 3, pp. (1-8), July 2017  
Available online at <http://www.ijrbs.in>  
ISSN 2319-2844

## Research Paper

# Glossines Fauna of North, South and Center Divisions of Ivory Coast

Acapovi-Yao Geneviève L.<sup>1</sup>, \*Sevidzem Silas Lendzele<sup>2</sup>, Cisse B.<sup>3</sup>

<sup>1</sup>Université Houphouët-Boigny, UFR Biosciences, Laboratoire de Zoologie & Biologie Animale, 22 BP 582 Abidjan 22, Côte d'Ivoire

<sup>2</sup>University of Dschang, Faculty of Science, Department of Animal Biology, BP 67 Dschang, CAMEROON

<sup>3</sup>Institut Pasteur de Côte d'Ivoire

(Received April 08, 2017, Accepted May 30, 2017)

## Abstract

In order to organise a sustainable vector intervention activity in Ivory Coast, long term entomological field collections about the vector and region in question is required. Such surveys include: recording species-types and monitoring their apparent densities over time and space in order to map-out the various regions or sites at risk. In Ivory Coast, a preliminary inventory on tsetse flies reported 10 species. However, this study was designed to update on the information on current glossines fauna of Ivory Coast by collecting data along a North-South-Center transect in the recent past. The capture was made using the Vavoua trap whose numbers varied with the sites prospected. All the glossines species recorded were riparian types and their numbers as well as apparent densities varied with the sites prospected: in the North, 709 glossines were recorded and consisted of *Glossina tachinoides* Westwood, 1850 (n=379) and *Glossina palpalis palpalis* Robineau-Desvoidy, 1830 (n=329) with Ouangolodougou Division having the highest glossines apparent density (T.A.D= 28.3 g/t/d). In the Center, 150 glossines were collected all *G. palpalis palpalis* and Toumodi Division recorded the highest apparent density (T.A.D= 1.96 g/t/d). In the South, 190 flies were recorded with *Glossina palpalis palpalis* as the most abundant type and Azaguié Division had the highest glossines density (T.A.D=3.166 g/t/d). The species of glossines captured in the recent collections already figured in the list of Brunhes and collaborators. However, Ouangolodougou (in the North), Toumodi (in the Center) and Azaguié (in the South) represented sites of highest glossines risk.

**Keywords:** Glossines, Transect-survey, Vavoua, Ivory Coast

## Introduction

Tsetse flies are Diptera, Brachycera and Cyclorrhapha of the family *Glossinidae*. They belong to one genus *Glossina* Wiedmann, 1830. Newstead and Potts divided into 3 groups of species commonly accepted as sub-genus<sup>1</sup>. These sub-genera are Nemorhina (Palpalis group), *Glossina* (Morsitans group) and Austenina (Fusca group). They are blood-sucking insects with both sexes capable of biting humans, pets, wild and domestic as well as vectors of diseases. They transmit trypanosomes which are flagellated protozoan responsible for African trypanosomiasis. That is Human African Trypanosomiasis (H.A.T) or sleeping sickness in humans and Animal African Trypanosomiasis (A.A.T) also referred to as nagana.

The World Health Organization (WHO) estimates that 55 million people are at risk of H.A.T and only 4 million are under surveillance. In addition, statistics show that 500,000 people are infected annually in 36 African countries<sup>2</sup>. Although H.A.T still remains a public health problem in many countries including Ivory Coast, it is still considerably neglected<sup>3</sup>. From the socio-economic point of view, Animal

Trypanosomosis (A.T.) is a major obstacle to the economic development of areas infested by tsetse flies in sub-Saharan Africa through its direct and indirect impacts in the field of animal husbandry and agriculture<sup>4,5</sup>. Thirty one species and sub-species of tsetse are listed to be confined in Sub-Saharan Africa (SSA), occupying an area of about 10 million square kilometers and found between Latitude 15° North and Latitude 29° South<sup>6</sup>. In Ivory Coast, ten (10) species and sub-species of tsetse flies have been described in different ecological zones<sup>7</sup>. These are Riparian flies of group palpalis and Nemorhina, the savanna flies of group morsitans, subgenus Glossina and forest flies of the fusca group and sub genus Austenina. The objective of this study was to obtain entomological data of tsetse along a North-South-Center transect in Ivory Coast in the recent past, following the rapid population growth and climate change in order to compare this data to those obtained twenty (20) years ago.

## Materials and Methods

### Study Areas

This study was conducted in several Divisions of the North, Center and South of Ivory Coast indicated in the following paragraphs:

#### North Ivory Coast

In the North, eight (8) sites (Divisions) were surveyed known as Tengrela, Ouangolodougou, Ferkessedougou, Boundiali, Sinematiali, Korhogo, Niakaramadougou and Dabakala (Figure 1). These Divisions belong to the sub-soudanaise area which is subject to sub-humid tropical climate (transitional sub-soudanian). Rainfall is around 1300 mm of rain per year. Vegetation consists of woodlands and savannah that receive different names according to their importance or lack of forest stand<sup>8</sup>. The hydrographic network consists of the following rivers: Bagoue, Babani, Bou, Bandama, Bandenou, Solomougou and Lopkoho<sup>9</sup>. These rivers have a seasonal pattern. They dry up, mostly in the dry season and experience flash floods with the first rains. A special feature of this region is the existence of at least one forest patch called "Sacred Wood" in the neighborhood of most villages. These are sites or places where ritual ceremonies of people living in this region take place, including the "Poro". These groves are often genuine "benchmarks" of tsetse<sup>10</sup>.

#### Central Ivory Coast

In the center of Ivory Coast, 3 sites (Divisions) were surveyed namely-Katiola, Béoumi and Bouaké. These communities are located in the Sudano-Guinean zone and are characterized by a transition climate between the Guinean zone in the south and the Sudanese zone in the north. Average rainfall varies between 1000 mm and 2500 mm<sup>11</sup>. Vegetation consists of deciduous forests and Guinea savanna. The main rivers are Bandama, Kan, Sagbo, N'bé, Kinkéni, Niarga, Lopkoho and Lonreni<sup>12</sup>.



Figure 1: Study area and location of the sampling areas

## South of Ivory Coast

In southern Ivory Coast, the following 3 sites (Divisions): Toumodi, Azaguié and Abidjan (Banco forest and Anguédédou) were visited. In the South, that is to say below a horizontal line through Yamoussoukro, the climate is equatorial and very wet. The temperature is relatively constant, between 29 and 32°C. There are four main seasons- April to mid-July (long rains with frequent rainfall and numerous storms), mid-July to September (short dry season, the sky may remain covered), September-November (short rainy season) with little rainfall, December-March (long dry season) marked by the north-east trade winds (Harmattan).

## Tsetse capture

Flies were captured following a North-South-Centre transect survey. In the North, surveys were conducted in 2009 in areas where livestock is an important activity of the population and cases of trypanosomosis were signaled. In total, 277 Vavoua traps were deployed<sup>13</sup>. All these capture sites were geo-referenced (Figure 1) using a portable GPS (Garmin) device. Trap exposition period in the field was 24 hours because of the number of sites visited and the distance between the sites in the North.

In 2009, entomological prospections were also conducted in the following Divisions of Central Ivory Coast using Vavoua traps (n=53) in unequal numbers-Katiola (n=15), Béoumi (n=13), Bouaké (n=10) and Toumodi (n=15).

In the South, in 2009, 10 Vavoua traps were placed in the forest of Anguédédou, 20 traps were placed inside the Banco and Azaguié forest (in a 10:10 ratio). However, in these sites, four consecutive days were dedicated for capture and cages changed every day. Flies were captured using Vavoua traps. Varying trap numbers were deployed at each site following the ecological landscape.

## Identification

Identifications of flies and species distinction was conducted in the laboratory. Morphological discrimination between different tsetse species was made using the identification key of Pollock<sup>11</sup>. After identification, flies were counted by species and sex.

## Data analysis

The abundance of *Glossina palpalis palpalis* in each of the study areas was defined by its Trap Apparent Density (T.A.D) that is number of *Glossina* caught per trap per day (g/t/d), calculated using the following formula:

$$\text{T.A.D(glossina/trap/day)} = \frac{\text{total glossina (males and females) captured during n days}}{(\text{number of traps}) \times (\text{n capture days})}$$

T.A.D average comparisons were made using analysis of variance (ANOVA) (significance level of  $p < 0.05$ ). The Newman-Keuls test was used to separate and classify homogeneous groups. The software used for analysis was SPSS.

## Results and Discussion

### In the North

In the North of Ivory Coast, eight Divisions were surveyed and fly capture revealed that Ouangolodougou had the highest glossines (708) with *Glossina tachinoides* (379) and *G. palpalis palpalis* (329) resulting in a T.A.D of 28.32g/t/d. The least fly catch was recorded at Sinématiali (8) with *Glossina palpalis palpalis* and no *Glossina tachinoides* resulting in a T.A.D of 0.8g/t/d (Table 1).

### Spatial distribution of the vector

Flies collected differed with the localities surveyed. They were highest in the localities of Ouangolodougou Division with T.A.D of 28.3 g/t/d and Korhogo (16.28g/t/d) but lower in Dabakala (1.25 g/t/d) and Sinematiali (0.8 g/t/d) (Table 1).

Dabakala Division is in the transition zone between *Glossina palpalis palpalis* and *Glossina palpalis gambiensis*. *G. tachinoides* (20.5%) was collected from the sites surveyed but was highly represented

in all sites of the Ouangolodougou Division (75.6%) and low in all sites of the Ferkessedougou (7.4 %) and Tengrela Division (5.78%).

### Species composition

The species composition includes two (2) species of tsetse *Glossina palpalis* sl and *Glossina tachinoides*. The species *G. palpalis* sl was captured on all sites surveyed with representation rates that vary from 36 percent to 0.6 percent. Considering the species distribution map, two subspecies of *Glossina palpalis* are known: *Glossina palpalis gambiensis* and *Glossina palpalis palpalis* as already defined by Challier *et al.*<sup>8</sup>. This result shows that *Glossina palpalis gambiensis* is present on the sites of the Korhogo, Ferkessedougou, Ouangolodougou, Boundiali, Tengrela, Sinématiali and Niakaramadougou Divisions with 62.7 % prevalence. It was realised throughout the survey period that, *Glossina tachinoides* was present in most of the Northern Divisions except Dabakala, Sinématiali and Niakaramadougou Divisions. There was no *Glossina tachinoides* among flies collected from the Center and South of Ivory Coast.

**Table 1: *Glossina* apparent density in Northern Divisions of Ivory Coast**

Divisions	Traps N	<i>Glossina</i> captured	<i>G. palpalis palpalis</i>	<i>G. tachinoides</i>	T.A.D
Tengrela	10	142	140	2	14.2
Ouangolodougou	25	708	329	379	28.3
Ferkessedougou	100	182	180	2	1.8
Boundiali	20	340	294	46	17
Dabakala	35	44	44	0	1.3
Sinématiali	10	8	8	0	0.8
Korhogo	60	977	969	8	16.3
Niakaramadougou	17	57	57	0	3.4
Total	277	2458	2021	437	83.1

### In the Center

The results of glossines captured in the Center of Ivory Coast revealed that 150 glossines were collected and all were *Glossina palpalis palpalis* with no *Glossina tachinoides* captured. Toumodi Division recorded the highest fly catch (118) with apparent density of 1.96g/t/d, followed by Katiola Division with 32 *G. palpalis palpalis* with apparent density of 2.1 g/t/d. Also, tsetse fly was recorded in Béoumi and Bouaké Divisions of the Center region of Ivory Coast (Table 2).

**Table 2: Glossines apparent density in the Center Divisions of Ivory Coast**

Divisions	Traps	<i>Glossina</i> captured	<i>G. palpalis palpalis</i>	<i>G. tachinoides</i>	T.A.D
Katiola	15	32	32	0	2.1
Béoumi	13	0	0	0	0
Bouaké	10	0	0	0	0
Toumodi	15	118	118	0	1.9
Total	53	150	150	0	4.0

### In the south

During entomological surveys, a total of 190 flies were collected with a total T.A.D of 4.8 glossines/ per/trap/day observed in 2 sites surveyed in this Division. During entomological surveys in the Azaguïé, Abidjan-Banco and Abidjan-Anguédedou forests, *Glossina palpalis palpalis* was more abundant in Azaguie because more than half of the catches were found in this site with T.A.D of 3.166 g/t/d followed by Abidjan-Banco (0.7 g/t/d) and Abidjan-Anguédedou with no fly catch throughout the survey in this region (Table 3).

**Table 3: Glossina apparent density in Northern Divisions of Ivory Coast**

Divisions	Traps	<i>Glossina</i> captured	<i>G. palpalis</i> <i>palpalis</i>	<i>G.</i> <i>tachinoides</i>	T.A.D
Azaguié	20	190	190	0	3.2
Abidjan-Banco	20	56	56	0	0.7
Abidjan-Anguédédou	10	0	0	0	0
Total	50	246	246	0	3.9

### Discussion

Based on the already documented data on *Glossina* spp. of Ivory Coast, it is clear that some species already signaled in past surveys still exist in the current field collections. Their apparent densities significantly differ with region of collection. This updated list may be used for the implementation of a vector control program. It may also be used for further studies on the seasonal dynamics of these insects. The traps that were used in this work seemed selective and advantageous in that it captured tsetse flies. However, the low catches recorded could be explained partly by the fact that many sites were not visited and only 18 capture points were explored during a relatively short period.

10 species of tsetse have already been documented in Ivory Coast<sup>7</sup> and they include:

#### Riverine flies

##### Group of *palpalis* subgenus *Nemorhina*

- *G. palpalis palpalis* Robineau-Desvoidy, 1830
- *G. palpalis gambiensis* Vanderplank, 1911
- *G. pallicera pallicera* Bigot, 1891
- *G. tachinoides* Westwood, 1850

#### Savanna flies

##### Group of *morsitans* subgenus *Glossina*

- *G. morsitans submorsitans* Newstead, 1910
- *G. longipalpis* Wiedemann, 1830

#### Forest flies

##### Group of *fusca* subgenus *Austenina*

- *G. fusca fusca* Walker, 1849
- *G. nigrofuscanigrofusca* Newstead, 1911
- *G. medicorum* Austen, 1911
- *G. tabaniformis* Westwood, 1850

Three species and sub-species of tsetse were captured in different Divisions surveyed. The results of this study showed that *G. palpalis* sl was captured in all the sites surveyed. The species *Glossina palpalis* sl includes two subspecies: *Glossina palpalis gambiensis* present in northern Ivory Coast upto Burkina and *Glossina palpalis palpalis*, further south following the limit defined by Challier *et al.*<sup>8</sup>. That limit lies for example at Gansé (South limit Comoé National Park). Challier and Goutteux [14] showed that the two subspecies of *Glossina palpalis* sl were present throughout the Ivorian territory. *Glossina palpalis gambiensis* is present in the north of Ivory Coast upto Burkina while *Glossina palpalis palpalis* is present further south. In the transition zone between the two species, further studies based on genetic characterization should enable us to say exactly the difference in the collected subspecies of Biankouma, Seguela, Touba, Dabakala and Katiola sites.

The distribution of *Glossina tachinoides* is much more limited than *G. palpalis* sl, and most of our catches were made in savannah areas of Bouna in Sudan Sudanese sector and sub-sector. These same observations had already been made by Challier and Gouteux (1980)<sup>14</sup>. The reduction in species diversity of flies in these areas were suggested to be due to the ecological changes in recent years caused by human actions and climate change which impact on the biology of living organisms causing changes in their distribution<sup>15</sup>. *Glossina palpalis* sl is an anthropozoophilic type and has a high adaptability to various environments such as human environments<sup>10,16,17</sup>. It thus becomes the most dangerous vector in the Southern forest half of the country<sup>14,18</sup>, especially in the West Centre

where it is responsible for the transmission of sleeping sickness in H.A.T foci, which are increasingly urban<sup>19</sup>.

Surveys have confirmed that the major vector of H.A.T in Ivory Coast is confined in urban areas, this species adapts to urban, yet much polluted environments caused by industrial discharges and motorized vehicles<sup>20</sup>. The work of Bosson and Kaba in Azaguié, showed the presence of this species<sup>21</sup>. They captured 7972 *Glossina palpalis palpalis* in their survey with an apparent density (T.A.D) of 17.61 Gpp/trap/day. Thus the presence of this species in town is not safe for the inhabitants of Ivory Coast and the socio-political crisis has displaced many populations from endemic areas to cities including Abidjan Azaguié. Tsetse flies near pig and cattle are a real risk to human populations. Animals such as pigs can harbor human parasite<sup>22</sup>. The adaption of *G. palpalis palpalis* in human encroached areas is dissimilar to that of the morsitans group that tends to disappear when human population density increases<sup>23</sup>. Some species that belong to the palpalis group like *G. p. palpalis* are able to adapt in urban and peri-urban environments<sup>8, 24</sup>. In fact, this species has been collected from the Southern site of Abidjan in the municipality of Port-bouët<sup>25</sup> and described in various West African capitals like Bamako and Dakar<sup>26</sup>. The distribution of *Glossina tachinoides* is much more limited than *G. palpalis*. Most of the catches were made in the section and sub-section of Sudan (defined limits by Guillaumet and Adjanohoun<sup>12</sup> above latitude 80°30'). However, we find this species beyond this limit in Guinea savannah, which is known as V Baoulé and semi-deciduous forest (captured on Marahoué Bouaflé by Laveissière and Challier)<sup>27</sup>. These exceptional catches are interesting because they show a progression of the species to the south (from the map of Potts Rickenbach). This phenomenon had already been reported in Nigéria<sup>28</sup>.

## Conclusion

The species of glossines identified in the 2009 entomological prospection were: *Glossina tachinoides* Westwood, 1850 and *Glossina palpalis palpalis* Robineau-Desvoidy, 1830 and these species already exist in the list of preliminary surveys on glossines of Ivory Coast. The overall glossines catch in all the sites prospected was 1049. The sites with highest glossines apparent abundance included: Ouangolodougou Division having the highest glossines apparent density (T.A.D= 28.3g/t/d). In the Center, 150 glossines were collected and all were *G. palpalis palpalis* and Toumodi Division recorded the highest apparent density (T.A.D= 1.96 g/t/d). In the South, 190 flies were recorded with *Glossina palpalis palpalis* as the most abundant sub species and Azaguié Division showed the highest glossines density (T.A.D=3.166 g/t/d). If glossines intervention was to be applied or planned in Ivory Coast, sectors like those with highest flies apparent densities will be targeted with urgency while others with low apparent intensities not rolled-out in Ivory Coast. Such sites or Divisions at risk include: Ouangolodougou, Toumodi and Azaguié.

## References

1. Newstead E and Potts W. H., A handbook for the identification of insects of medical importance, J. Smart., 72 (1956)
2. WHO Control and Surveillance of African Trypanosomiasis. Report of a WHO Expert Committee, WHO Technical Report Series 881 (1998)
3. Jannin J.G., Sleeping sickness: a growing problem, British Med. J., 331(7527): 1242 (2005)
4. Holmes P.H., New approaches to the integrated control of trypanosomiasis. Vet Parasitol., 71: 121-135 (1997)
5. FAO, Agristat, Rome, 140 (1990)
6. Ford J. and Katondo K.M., The distribution of tsetse flies (*Glossina*) in Africa 1973. Nairobi, OAU/STRC Bureau of Animal Resources (1973)
7. Brunhes J., Cuisance D., Geoffroy B. and Hervy J.P., Les Glossines ou Mouches Tsé-Tsé. Logiciel d'Identification et d'Enseignement. Editions ORSTOM : Montpellier, France (1998)

8. Challier A., Gouteux J.P. and Coosemans M., La limite géographique entre les sous-espèces de *Glossina palpalis palpalis* (Rob.-Desv.) et *Glossina palpalis gambiensis* Vanderplanck en Afrique occidentale. Cahiers O.R.S.T.O.M., série Entomologie médicale et Parasitologie, 12(4): 207-220 **(1983)**
9. Courtin F., Dupont S., Zézé D.G., Jamonneau V., Sané B., Coulibaly B., Cuny G. and Solano P., Trypanosomose Humaine Africaine: Transmission urbaine dans le foyer de Bonon (Côte d'Ivoire), Trop Med Int Hlth, 10(4): 340-346 **(2005)**
10. Halos L., Lutte contre les glossines: influence d'un régulateur de croissance des insectes, le triflumuron, sur la compétence vectorielle de *Glossina palpalis gambiensis* et *Glossina tachinoïdes* vis-à-vis de *Trypanosoma congolense*. Thèse : Médecine vétérinaire, 120, **(2002)**
11. Pollock J.N., Training manual for tsetse control personnel, Tse-tse biology; systematics and distribution techniques. Rome, FAO. 280 **(1982)**
12. Guillaumet J.L. and Adjanohoun E., La végétation de la Côte d'Ivoire. In : Le milieu naturel de la Côte d'Ivoire (Eds. Avenard J.-M., Eldin M., Girard G., Sircoulon J., Touchebeuf de Lussigny P., Guillaumet J.-L., Adjanohoun E., Perraud A.). Orstom, Paris, France, 161-263 **(1971)**
13. Laveissière C. and Grébaut P., Recherche sur les pièges à glossines (Diptera : Glossinidae). Mise au point d'un modèle économique : les pièges «vavoua». Tropical Medicine and Parasitology, 41: 185-192 **(1990)**
14. Challier A. and Gouteux J.P., Ecology and epidemiological importance of *Glossina palpalis* in the Ivory Coast forest zone. Insect Sci. App., 1: 77-83 **(1980)**
15. Parmesan C. and Gary Y., A globally coherent finger print of climate change impacts across natural systems. Nature, 421 **(2003)**
16. Ebeja A.K., Lutumba P., Molisho D., Kegels G., Bilenge M.M. and Boelaert M., La maladie du sommeil dans la région Ville de Kinshasa: une analyse rétrospective des données de surveillance sur la période 1996–2000. Trop. Med. Int. Hlth., 8: 949–955 **(2003)**
17. Allou K., Acapovi-Yao G., Kaba D., Bosson Vanga H., Solano P. and N'goran K.E., Chorologie et infection par les Trypanosomes de *Glossina palpalis palpalis* dans la forêt du Banco et ses reliques, Abidjan (Côte d'Ivoire). Parasite, 16: 289-295 **(2009)**
18. Gouteux J.P., Laveissière C. and Boreham P.F.L., Ecologie des glossines en secteur préforestier de Côte d'Ivoire. 2). Les préférences trophiques de *Glossina pallicera* et *G. nigrofusca*. Comparaison avec *G. palpalis* et implications épidémiologiques. Cahiers O.R.S.T.O.M., série Entomologie médicale et Parasitologie, 20: 109-124 **(1982)**
19. Fournet F., Traoré S. and Hervouët J.P., Effects of urbanization on transmission of human African trypanosomiasis in a sub-urban relict forest area of Daloa, Côte d'Ivoire, Transactions of the Royal Soc Trop Med Hyg., 93: 130–132 **(1999)**
20. Miaka M.B.C., Kande Betu K.M.V., Louis F.J. and Lucas P., Trypanosomiase humaine africaine en milieu urbain : l'exemple de Kinshasa, République Démocratique du Congo, en 1998 et 1999. Méd Trop., 61: 445-448 **(2001)**
21. Bosson and Kaba, Premiers essais de terrain pour le développement de pièges et écrans de lutte contre le vecteur de la THA. Rapport de mission, 16 **(2009)**
22. Laveissière C., Hervouët J.P., Couret D., Eouzan J.P. and Merouze F., La campagne pilote de lutte contre la trypanosomiase humaine dans le foyer de Vavoua (Côte d'Ivoire), La mobilisation des communautés rurales et l'application du piégeage, Cahiers O.R.S.T.O.M., série Entomologie médicale et Parasitologie, 23: 167-185 **(1985)**

23. Reid R., Kruska R.L., Deitchmann U., Thorthon P.K. and Leak S.G.A., Human population growth and the extinction of the tsetse fly. *Agriculture, Ecosystems and Environment*, 77: 227-236 **(2000)**
24. Itard J., *Les glossines oumouchestsé-tsé. Etudes et Synthèses de l'IEMVT*, Montpellier, CIRAD **(1986)**
25. Kaba D., Dje N.N., Courtin F., Oke E., Koffi M., Garcia A., Jamonneau V. and Solano P., L'impact de la guerre sur l'évolution de la THA dans le centre-ouest de la Côte d'Ivoire, *Trop Med IntHlth*, 11: 136-143 **(2006)**
26. Courtin F., Sidibé I., Rouamba J., Jamonneau V., Gouro A. and Solano P., Impacts observés des évolutions démo-climatiques sur la répartition spatiale des hommes, des tsé-tsé et des trypanosomoses en Afrique de l'Ouest. *Parasite.*, 16(1): 3-10 **(2009)**
27. Laveissière C. and Challier A., Le foyer de trypanosomiose humaine de Bouaflé (Côte d'Ivoire): enquête épidémiologique et entomologique, propositions pour une campagne insecticide. *Documentation Technique OCCGE*: 20 **(1976)**
28. Baldry D.A.T., On the distribution of *Glossina tachinoides* in West Africa. In 11th meeting ISCTR, Nairobi, OAU/STRC Publication, 100: 95-109 **(1966)**.