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An updated list of Tabanidae (Diptera: Insecta) in Ivory Coast

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ABSTRACT. The inventory of tabanids of Ivory Coast includes both a review of historical datasets as well as the results of recent targeted field investigations in the North of Ivory Coast from 2000 to 2002 and Banco forest in 2012. The family Tabanidae known as horse flies has been estimated to consist of 4,500 existing species throughout the world. Four genera are known to be of medico-veterinary importance and include: *Haematopota, Tabanus, Atylotus* and *Chrysops*. The documented results of 28 sites provide significant information to update on the Tabanidae list of Ivory Coast. 70 species and 14 genera have been identified till date such as genus *Tabanus* with 40 species (57.14 %), genus *Haematopota* with 10 species (14.29 %), genera *Atylotus, Chrysops* and *Hippocentrum* with three species (4.29 %), genera *Ancala, Rhigioglossa* with two species (2.86%). Seven genera with only one species identified. *T. taeniola, T. besti, T. secedens, T. thoracinus, H. decora, H. griseicoxa* and *H. torquens* were captured in at least five regions.

Key words: Tabanids, Diptera, inventory, Ivory Coast

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Introduction

Sub-Saharan Africa is an area with multiple ecological regions. There are forests (primary, secondary, gallery forest and flooded forest), Savannah, mangroves, with environmental conditions that favour the survival of various species of insects.

These invertebrates cause nuisance and are also vector of many pathogens (Protozoa, bacteria and viruses), common to humans and animals. These pathogens represent a major challenge in terms of public and economic health. Among insects, tabanids are mechanical vector of diseases throughout the world and this feature is maintained by the usual interruptive feeding on more than one host (Rodhain and Perez 1985). They are important vectors of protozoan diseases caused by

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Trypanosoma vivax in South America (Desquesnes and Dia 2004) and *Trypanosoma evansi* in Mauritania (Dia 1997). The importance of mechanical vectors is felt in Africa especially in the humid tropics in tsetse-free areas. The resurgence of trypanosomosis on livestock reared areas suggests the existence of mechanical transmission of trypanosomes. The mechanical role of vectors has long been controversial.

Almost 90% of the cattle are found in the north of eighth parallel in the Sudan-Guinean zone, with grazing taking place in the natural savannah in an extensive system. The north, which is a major cattle rearing zone is less affected by tsetse fly also there is a considerable cattle trade in the south. Sedentary crop-farmers that form a group in this zone do not rely on cattle-keeping but focus only on agriculture. The study of horse flies is very difficult due to the vast number of species present in all types of environments and also due to the complexity or robustness of identification keys. The voluminous works of Oldroyd in the 1950s (Oldroyd 1952, 1954, 1957) with identification keys in three volumes, represents more than a thousand pages of incomparable knowledge about tabanids of the Afro-tropical region. Among the many species described by this author, it is difficult to determine in principle, which one could play a significant role on livestock health.

In Ivory Coast, the first research on Tabanidae was carried out by Ovazza *et al*. (1956), Doucet *et al.* (1958) and Taylor and Chainey (1994) who established a list of species for this family. The main aim of the present work was to update the list of tabanids from our surveys in the North, the forest of Banco and review on the pre-existing list of tabanids of Ivory Coast in 28 localities.

Material and methods

Study area

Ivory Coast is a sub-Saharan nation that is found in the Southern West of Africa located at 8 00°N and 5 00°W. The country is approximately square in shape. Its southern border is 515 km (320 mi) coastline on the Gulf of Guinea on the North Atlantic Ocean. On the other three sides, it borders five other African nations by a total of 3,458 km (2,149 mi): Liberia to the southwest by 778 km (483 mi), Guinea to the northwest by 816 km (507 mi), Mali to the north-northwest by 599 km (372 mi), Burkina Faso to the north-northeast by 545 km (339 mi) and Ghana to the east by 720 km (447 mi). Ivory Coast comprises 322,463 km^2 (124,500 sq mi), of which 318,003 km^2 (122,780 sq mi) is land and 4,460 km^2 (1,720 sq mi) is water, which makes the country about the size of Germany.

Ivory Coast consist of forest with a Guinean climate, south of the eighth parallel with two rainy seasons from May to mid-July and October to November and an annual rainfall between 1200 and 2400 mm. In the north, the climate is Sudano-Guinean with a single rainy season from July to November and an annual rainfall between 1100 and 1600 mm. Two climatic zones are created by the alternating wind patterns.

In the north, tropical conditions delineate two major seasons. Heavy rains occur between June and October, with an average of 110 centimeters annually. Along the equatorial coast, the following conditions prevails: rain falls in most months, with an average of 2,000 mm annually, but four seasons are generally distinguishable; heavy rains fall between May and July in most years and shorter rains in August and September; the minor dry season still brings sparse rain during October and November, followed by the major dry season from December to April.

Temperatures and humidity generally follow the same pattern, with average temperatures between 25 °C and 30 °C and ranges from 10 °C to 40 °C. Temperatures are higher in the south but may exceed 30 °C even in the far north. Annual and daily ranges of both temperature and humidity are small along the coast but increase progressively toward the north. Average relative humidity is 85 percent in the south and 71 percent in the north.

There are three main climatic regions: coast, forest and savannah. The highest rainfall recorded between 2,032 mm to 3,048 mm and the least range of average temperature between 23 °C to 26.6 °C occur in the coastal region which has a long dry season from December to April, followed by the great rains between mid-May to mid-July. The short dry season is from mid-July to October and the short rains witnessed in October and November. In the central forest region, rainfall is high that is between 1,346 mm to 2,540 mm. Humidity is continuous and the seasons are less clearly marked. The earlier shorter dry season (November to mid-March) is followed by a short wet season (mid-March to mid-May). A short dry season from mid-May to mid-July and heavy rains from mid-July to mid-November. Temperatures reach their maximum in the northern savannah between 32 °C to 24.4 °C and minimum around 14 °C. There is a long wet season from June to October and the dry season extends to six or seven months.

During the first half of the year, warm maritime air masses push northward. Ahead of it, a low pressure belt or inter-tropical front brings warm air, rain and prevailing winds from the southwest (Handloff 1988). As the solar cycle reverses at mid-year, the continental air mass moves southward over the nation and this permits the dry northeast harmattan to dominate. Surface winds are gentle and seldom exceeds fifteen to twenty kilometers per hour.

Agro-ecological zones

There are three geographical regions roughly parallel to the coast-lagoon region, forest region and savannah region and the vegetation of Ivory Coast is distributed among the three geographical regions. These ecosystems are often transformed directly or indirectly by man into agro-ecosystems which furnish food, fiber and other products such as textiles, wood, oil, etc. Four major river systems follow meandering courses from north to south and drains into the Gulf of Guinea. From west to east, these rivers include: Cavally, Sassandra, Bandama, and Comoé. All of them are relatively untamed rivers navigable only short distances inland from the coast. In the north, many smaller tributaries are dry streambeds between rains. The various agro-ecological regions of Ivory Coast are described in the following paragraphs:

Prospected sites

The following sites were prospected: Adiopodoumé, Assinie, Bondoukou, Bouaké, Danané, Dabou, Daloa, Dimbokro, Divo, Duékoué, Ferkessedougou, Gagnoa, Grand-Lahou, Katiola, Korhogo, Man, Odienné, Oumé, Sinfra, Tabou, Touba, Parc National Assagny, Parc National du Banco, Parc National de Tai, Vavoua, Sassandra, Zuenoula, Bingerville (Fig. 1).

Tabanid sampling and identification

In a nutshell, all publications and input data on the list of Tabanidae obtained from a variety of sources were collected and stored in a centralized data repository. The techniques and equipment used for the capture of Tabanidae differed from that of Ovazza *et al*. (1956) and Doucet *et al*. (1958) who captured tabanids on cattle and pig farms using hand nets and vehicles.

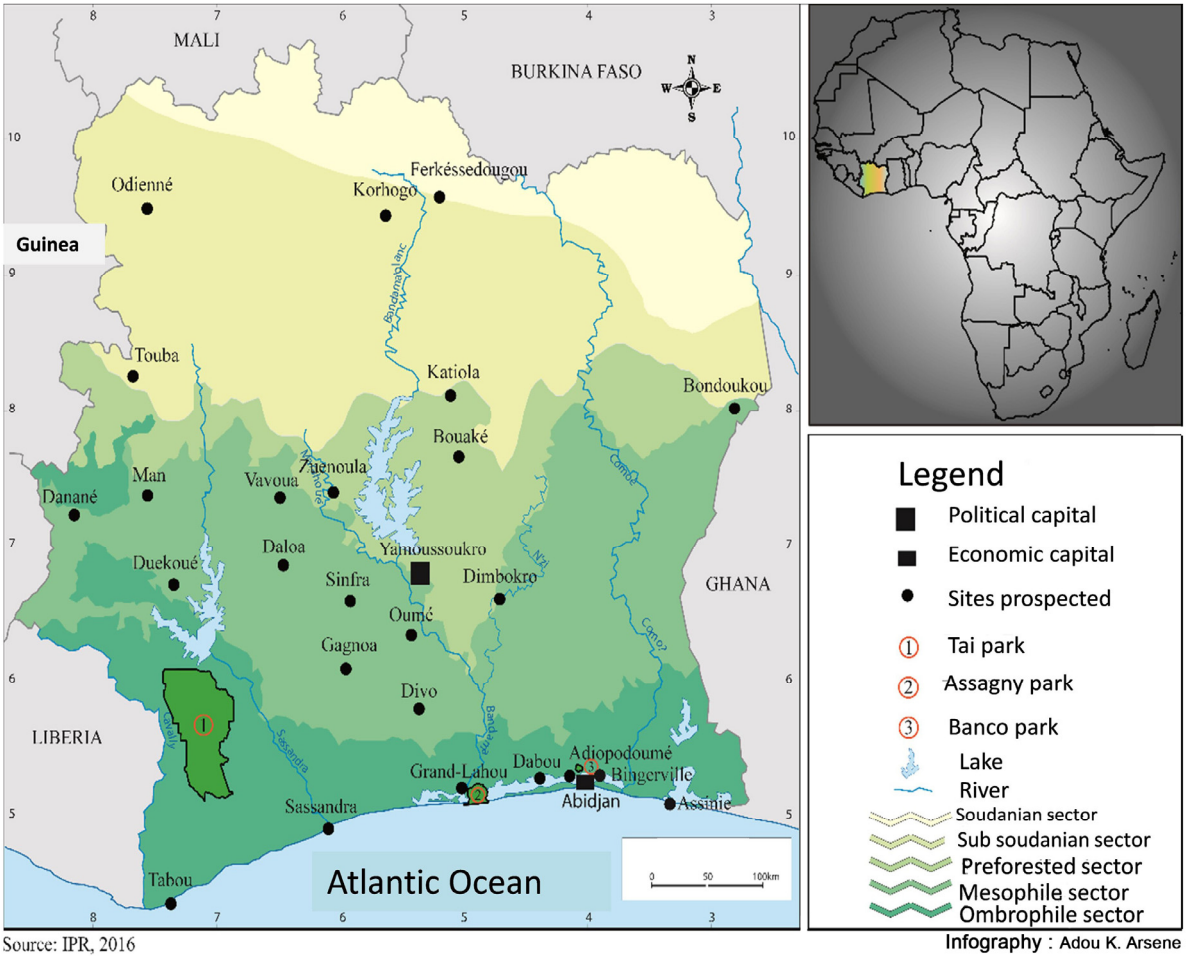

Figure 1. Prospected sites in which the horse flies (Diptera: Tabanidae) have been collected in Ivory Coast.

From the Taï National Park which is located in South-west of Ivory Coast, adult horse flies were collected during a four month period (December 1989 to April 1990) by Malaise trap (Gressitt and Gressitt, 1962), Manitoba trap (Thorsteinson *et al.* 1965), hand nets and vehicles. In the North and south, adult horse flies were also collected with the use of 12 Nzitraps (Mihok 2002) and 10 Vavoua traps (Laveissière and Grébaut 1990) traps. The identification keys of Oldroyd (1954, 1957) enabled the identification of most common African tabanid flies up to species level. Collected samples were stored in 70% ethanol and some kept as dry specimens in the laboratory.

Tabanidae apparent density determination

Apparent density of tabanids was defined by the number of tabanids caught in each site per trap per day (F/T/D). This is mathematically represented as such:

$$\frac{NFC}{NTs \times TDs} = TAD$$

Where:

TAD=Tabanids apparent density;

NFC=Number of tabanid flies captured;

NTs=Number of traps;

TDs= Number of trapping days;

Distribution of all tabanid flies caught in each site was presented in distribution Tables 1–4.

Results

Qualitative analysis reveals 70 species of Tabanidae belonging to 14 genera (Table 1) captured and identified in the 28 prospected sites. Quantitative analyses reveal the dominance of the genus *Tabanus* 57.14% with 40 species. Species *T. taeniola, T. besti, T. secedens, T. thoracinus* have been captured in at least five sites. The genus *Haematopota* 14.29% with 10 species. Species *H. decora, H. griseicoxa* and *H. torquens* were frequently collected in the different prospected sites. The genera *Atylotus, Chrysops* and *Hippocentrum* contributed up to 4.29% in the collection with three species; genera *Ancala, Rhigioglossa* with 2, 86% and two species. Seven genera were identified with only one species signaled (Table 1). All of these genera are weakly represented at the species-level.

List of tabanid species

Subfamily Chrysopsinae Lutz

Tribe Chrysopsini Lutz
Genus *Chrysops* Meigen, 1803

Chrysop sdistinctipennis Austen, 1906
Chrysops longicornis Macquart, 1838
Chrysops langi Bequaert, 1930

Tribe Rhinimyzini Lutz
Genus *Thaumastocera*
Thaumastocera akwa Grünberg, 1906

Genus *Thriambeutes* Grunberg 1906
Thriambeutes singularis Grünberg, 1906

Genus *Sphecodemyia* Austen, 1907
Sphecodemyia infuscata Oldroyd, 1957

Genus *Tabanocella* Bigot, 1856
Tabanocella stimulans Austen, 1910

Genus *Hinea* Adams 1905
Hinea rodhaini Bequaert, 1913

Subfamily Tabaninae Latreille

Tribe Haematopotini Enderlein
Genus *Haematopota* Meigen, 1803

Haematopota adami Ovazza, 1956
Haematopota decora Walker, 1850
Haematopota brucei Austen, 1908
Haematopota griseicoxa Oldroyd, 1952
Haematopota guineensis Bigot, 1891
Haematopota pallidipennis Austen, 1908
Haematopota torquens Austen, 1908
Haematopota bowdeni Oldroyd, 1952
Haematopota grabami Austen, 1908
Haematopota tenuicnis Macquart, 1834

Tribe Haematopotini Enderlein
Genus *Hippocentrum*

Hippocentrum murphyi Austen, 1912
Hippocentrum versicolor Austen, 1912
Hippocentrum strigipenne Karsch, 1889

Tribe Tabanini Latreille
Genus *Atylotus* Osten-Sancken, 1876

Atylotus albipalpus Walker, 1850
Atylotus agrestis Wiedemann, 1828
Atylotus fuscipes Ricardo, 1908

Genus *Ancala* Enderlein, 1922

Ancala fasciata fasciata Fabricius, 1775
Ancala fasciata typicus Fabricius, 1775
Ancala necopina Austen, 1912

Genus *Euancala* Enderlein, 1922

Euancala maculatissima Macquart, 1838 *irrorata* Surcouf, 1909.

Genus Rhigioglossa Macquart, 1850

Rhigioglossa cincta Enderlain, 1925
Rhigioglossa montonenae Wiedemann, 1828

Genus Tabanus Linnaeus, 1758

Tabanus argenteus Austen, 1908
Tabanus besti Surcouf & Ricardo, 1909
Tabanus biguttatus Wiedemann, 1830
Tabanus boueti Surcouf et Ricardo, 1909

Tabanus brumpti Surcouf, 1907
Tabanus chevalieri Surcouf, 1906
Tabanus combustus Bigot, 1891
Tabanus conformis Walker, 1848
Tabanus flavicoxa Oldroyd, 1954
Tabanus fuscipleuris Oldroyd, 1954
Tabanus gabonensis Macquart, 1855
Tabanus gratus Loew, 1858
Tabanus kingsleyi Ricardo, 1908
Tabanus laverani Surcouf, 1907
Tabanus lubutuensis Bequaert 1930
Tabanus marmorosus Surcouf, 1909
Tabanus martini Surcouf, 1907
Tabanus menoensis Taylor & Chainey, 1994
Tabanus obscurehirtus Ricardo, 1908
Tabanus par Walker, 1854
Tabanus pluto Walker, 1848
Tabanus postacutus Oldroyd, 1947
Tabanus regnaulti Surcouf, 1907
Tabanus ricardae Surcouf, 190
Tabanus ruficrus Palisot de Beauvois, 1807
Tabanus secedens Walker, 1858
Tabanus simpsoni Austen, 1912
Tabanus socialis Walker, 1850
Tabanus sticticolis Surcouf, 1906
Tabanus subangustus Ricardo, 1908
Tabanus taeniola Palisot de Beauvois, 1807
Tabanus taïensis Taylor & Chainey, 1994
Tabanus tenuipalpis Austen, 1912
Tabanus thoracinus Palisot de Beauvois, 1807
Tabanus triquetornatus Carter, 1915
Tabanus vitata Surcouf, 1922
Tabanus zoulouensis Ricardo, 1908
Tabanus zuluensis Taylor & Chainey, 1994

Subfamily Pangoniinae Loew, 1860

Tribe Philolichini Mackerras, 1954
Genus *Philoliche* Wiedemann, 1828

Philoliche semilivida Bigot, 1891.

The maximum number of tabanid species occurred in the Tai forest with 30 species followed by Odienne, Man and Korhogo with 19, 16 and 15 species, respectively (Fig. 2). *Haematopota decora, H. griseicoxa* and *H. torquens* were captured in at least five regions and the other species were sparsely observed (Table 2). The above different species were mostly collected in the forest of Tai situated in the west of Ivory Coast.

The species of the following genera *Hippocentrum*, *Rhigioglossa, Sphecodemyia*, *Tabanocella, Thriambeutes, Thaumastocera, Thaumastocera, Philoliche, Hinea* and *Euancala* were also identified in the different sites prospected (Table 3).

Table 1. Apparent density of genera of tabanids captured in Ivory Coast.

Genera	Apparent Density (tabanids/trap/day)
Thriambeutes	1.43
Tabanocella	1.43
Sphecodemyia	1.43
Philoliche	1.43
Hinea	1.43
Euancala	1.43
Ancala	2.86
Rhigioglossa	2.86
Atylotus	4.29
Chrysops	4.29
Hippocentrum	4.29
Haematopota	14.29
Tabanus	57.14

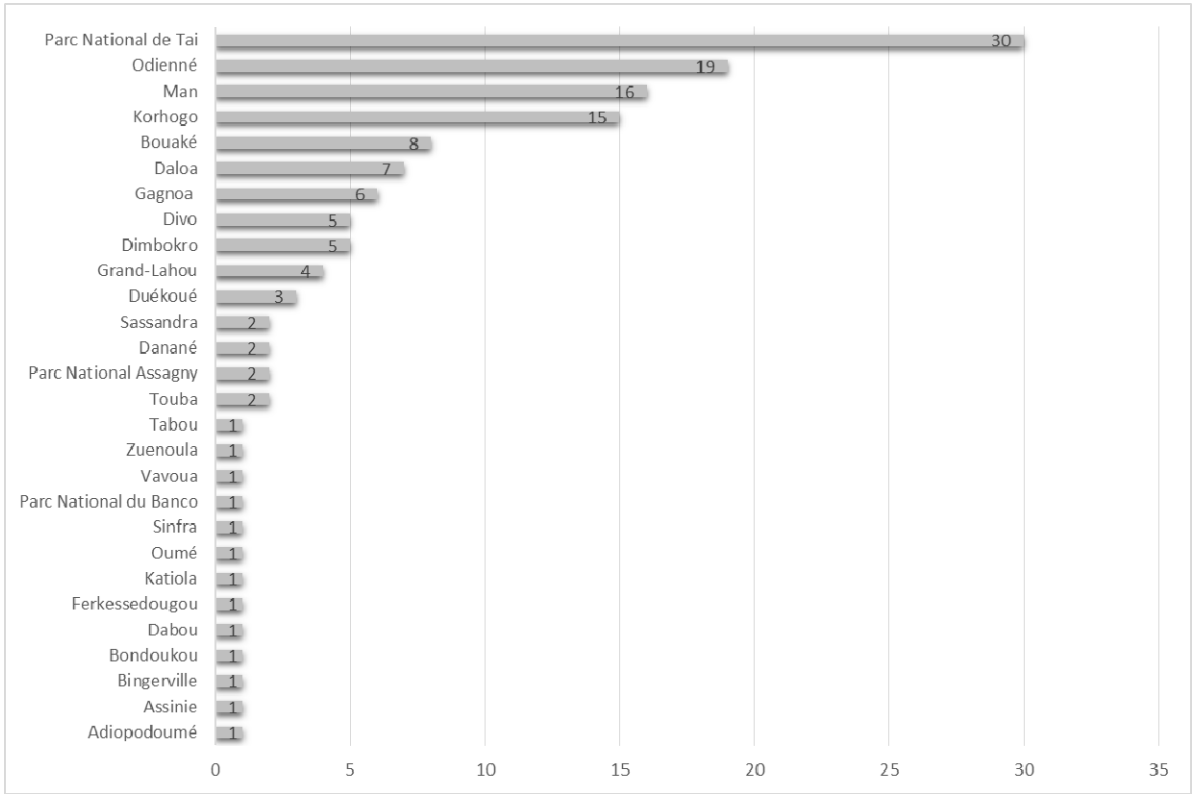

Figure 2. Number of species of horse flies (Diptera: Tabanidae) collected from each site in Ivory Coast.

Table 2. List of *Haematopota* species collected per site in Ivory Coast.

Species	TB	Tai	Man	KO	OD	BK	DA	DL	GA	Tba	Dké	Div	Vav
H. adami						*							
H. decora			*	*	*	*	*						
H. brucei								*					
H. griseicoxa		*						*	*	*	*		
H. guineensis								*				*	
H. pallidipennis			*										
H. tenuicnis						*							
H. torquens	*	*	*				*		*				*
H. bowdeni		*											
H. grabami		*											

Tabou: TB; Parc National de Tai: Tai; Man, Korhogo: KO; Odienné: OD; Bouaké: BK; Danané: DA; Daloa: DL; Gagnoa: GA; Touba: Tba; Duékoué: Dké; Divo: Div; Vavoua: Vav

Table 3. List of Tabanid species collected by site in Ivory Coast.

Species	Tai	Man	Div	Kla	Dko	Sas	Agny	Bing	Adiop	Zla	Asnie
Hippocentrum versicolor		*			*						
Hippocentrum strigipenne						*					
Hippocentrum murphyi			*								
Rhigioglossa cincta	*										
Rhigioglossa montonenae	*										
Sphecodemyia infuscata	*										
Tabanocella stimulans	*										
Thriambeutes singularis	*										
Thaumastocera akwa							*	*	*	*	
Philoliche semilivida											*
Hinea rodhaini									*		

Parc National de Tai: Tai; Man, Divo: Div; Katiola: Kla; Dimbokro: Dko; Sassandra: Sas; Parc National Assagny: Agny; Bingerville: Bing; Adiopodoumé: Adiop; Zuenoula: Zla; Assinie: Asnie

Table 4. List of species of genera *Ancala, Atylotus* and *Chrysops* collected from each site in Ivory Coast.

Genus	Species	Tabou	Danané	Gagnoa	Tai	Man	Korhogo	Odienné
Ancala	*fasciata*	*	*	*	*	*		*
Ancala	*necopina*						*	*
Atylotus	*albipalpus*						*	*
Atylotus	*agrestis*						*	*
Atylotus	*fuscipes*						*	
Chrysops	*distinctipennis*						*	*
Chrysops	*longicornis*				*		*	*
Chrysops	*langi*				*			

The different species belonging to the genera-*Ancala, Atylotus* and *Chrysops* were mostly found in the regions of Odienné and Korhogo, situated in the North and North-east of Ivory Coast (Table 4). *Tabanus taeniola, T. besti, T. secedens* and *T. thoracinus* were captured in at least five regions. The other species were only signaled.

Discussion

The analysis of taxa distribution between different areas of Ivory Coast revealed that the Tai forest consisted of 30 identified species followed by Odienne (19 species), Man (16 species) and Korhogo (16 species). In total, 70 species were identified in all of Ivory Coast. The Tai forest harbours in it almost half of Ivory Coast Tabanidae species count. This means that it stands for the largest Tabanidae species dense region. The Tai National Park in the West of Ivory Coast and near the Guinea and Liberia, covering 3,500 km² around Mount Nienokoue, contains one of the last primary forests of Africa. It is home to 93% of mammal species of the western Guinean forest zone and harbours animals like *Cephalophous jentink*, *Cephalophous zebra* and *Cercopithecus diane* which are endemic in the Western region of Sierra Leone up to Tai (Acapovi, personal communication).

The presence of gallery forest within the forest result in a suitable humidity and

resting places which are important ecological factors for tabanids (Trojan, 1958). In addition, it is in the gallery forest that we can find most animals that constitute the food source of tabanids. Females in search of blood remain unnoticed on trees near herds waiting for a passing susceptible host to feed on (Raymond and Rousseau 1987).

The Tai Forest provides adequate ecological and climatic conditions for tabanids survival. Hence this Forest is a reservoir for tabanids. The regions of Korhogo and Odienne are excellent in livestock and occupy a fairly large place with over 25% of the national cattle herd (Anonymous 1994). This area harbors many ruminants. One feature of these regions is the existence of at least one forest patch called "Sacred Wood" in the neighborhood of most villages. These groves are places where the ritual ceremonies of the local population take place, including the "Poro". Based on their plant structures, these forests patches also constitute the habitat for bloodsucking insects (Diaha 2013). The differences in landscape and environmental structures can create particular microhabitats which are more or less favorable for the development of certain species of tabanids. These observations are consistent with those made by Raymond (1988). The diversity of tabanid fauna remains relatively remarked in these regions compared to other regions mentioned above, which shows the relative specificities of each of the zones, with their own bio-climate which determines the tabanid fauna peculiar to each of the biogeographic areas.

This synthesis study performed throughout Ivory Coast revealed a significant tabanid fauna in terms of species richness which constituted of 70 species belonging to 14 genera. These results contribute to the knowledge of Tabanidae of Ivory Coast and thus enable this dipteran family to be known for their role as mechanical vectors as they are a neglected topic of research. This current inventory is a preliminary taxonomical, entomological and ecological database allowing more access to better knowledge on tabanids fauna of Ivory Coast.

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لیست به روز شده دوبالان خانواده Tabanidae (Diptera: Insecta) در ساحل عاج

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چکیده: فهرست مگس‌های خانواده Tabanidae در ساحل عاج بر اساس مرور اطلاعات تاریخی و نتایج تحقیق حاضربر اساس مطالعات صحرایی در شمال ساحل عاج در سال‌های ۲۰۰۰ - ۲۰۰۲ و جنگل های بانکو در سال ۲۰۱۲ ارایه شده است. دوبالان خانواده Tabanidae که به عنوان مگس‌های اسب شناخته می‌شوند شامل ۴۵۰۰ گونه در سرتاسر دنیا می‌باشد. چهار جنس دارای اهمیت دامپزشکی هستند که عبارتند از: *Haematopota*، *Tabanus*، *Atylotus* و *Chrysops*. نتایج بدست آمده از ۲۸ منطقه اطلاعات مهمی را برای به روز کردن فهرست مگس‌های خانواده Tabanidae در ساحل عاج فراهم نمود. ۷۰ گونه و ۱۴ جنس تا کنون شناسایی شد که جنس *Tabanus* شامل ۴۰ گونه (۵۷/۱۴ ٪)، جنس *Haematopota* ۱۰ گونه (۱۴/۲۹ ٪)، جنس های *Atylotus*، *Chrysops* و *Hippocentrum* سه گونه (۴/۲۹ ٪) و جنس‌های *Ancala* و *Rhigioglossa* با دو گونه (۲/۸۶ ٪) بودند. از هفت جنس فقط یک گونه شناسایی شد. گونه‌های *T. taeniola*، *T. besti*، *T. secedens*، *T. thoracinus*، *H. decora*، *H. griseicoxa* و *H. torquens* حداقل از هفت منطقه جمع‌آوری شدند.

واژگان کلیدی: مگس‌های اسب، دوبالان، لیست، ساحل عاج.