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Élevage et
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Vétérinaire
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IICA
OFFICE IN GUYANA

HORSEFLIES OF THE GUYANAS

Biology, Veterinary Significance

&

Control Methods

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HORSEFLIES OF GUYANAS; BIOLOGY, VETERINARY SIGNIFICANCE AND CONTROL METHODS

This work complements the document "The cattletick *Boophilus microplus*": previously distributed to cattle producers in French Guiana. It was produced within the framework of livestock production support activities of the CIRAD-EMVT for the fight against the vectors of cattle hemoparasites. If the importance of the horsefly is now clearly understood, that of the Stomoxes (stable and hornflies) is not yet and could form the subject of subsequent studies.

The horsefly is a pest attacking herds in the dry season; it is also the principal vector of Anaplasmosis and of Trypanosomiasis. Due to its veterinary and economic impact, the horsefly represents a source of growing concern for French Guianese cattle rearers.

After reviewing the morphology and the biology of the horsefly, its importance as a nuisance and vector of disease, we shall present the control methods currently available, which continue to be inadequate for controlling the parasites, then outline research projects which EMVT-French Guiana has undertaken in the field.

Our work is a continuation and completion of work carried out by the late Dr Hugues Raymond, who, within the framework of the INRA livestock production activities, has studied the importance of the horsefly in French Guiana, and proposed methods of chemical control. Several of the data presented in this document are derived from publications by Dr Raymond.

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PREFACE TO THE ENGLISH EDITION

This document, originally published in French by CIRAD/EMVT in French Guiana was entitled "Les Taons de Guyane: Biologie, Importance Veterinaire et Methodes de Lutte".

The English version of this document is the product of a collaborative effort between CIRAD/EMVT in French Guiana and the IICA Office in Guyana. The research and authorship belong entirely to CIRAD/EMVT in French Guiana. IICA provided translation, editing, and publication of the English version, under its national project "Strengthening of the Veterinary Services in Guyana". The calculation of the economic impact of horseflies on cattle production was adapted to Guyana and Suriname.

CIRAD/EMVT has been a longstanding friend to government veterinary services in the Caribbean region, both by providing veterinary diagnostic laboratory support and by sharing the useful information generated through their animal health research projects.

IICA's Program V, Agricultural Health, has a mandate to strengthen the animal health services departments of the governments of Guyana and Suriname through national technical cooperation projects. Dissemination of practical technical information is an important objective of these projects.

It is expected that the information contained in this publication will be of practical benefit to animal health professionals and livestock producers in the Guyanas: French Guiana, Suriname and Guyana. It is hoped that this will be the first of a series of collaborative efforts between CIRAD/EMVT and IICA.

Animal diseases and pests do not recognise geographic, political and language boundaries. Animal health professionals in French Guiana, Suriname and Guyana share many common concerns, problems and goals. The exchange of veterinary information among these three countries can serve to assist these technicians and producers in their struggle to improve animal health and livestock productivity.

I wish to thank Dr. Desquesnes of CIRAD/EMVT in Cayenne for sharing this document. I also wish to thank Mrs. Cicely John of the University of Guyana for translation services.

Sandra Vokaty
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MORPHOLOGY AND CLASSIFICATION

A. MORPHOLOGY

The horsefly, belonging to the order Diptera, a sub-order of the Brachyceriae, is a biting insect. Of these only the female bites to procure the nutrients necessary for oogenesis.

The adult, grossly resembling a fly (figure 1) possesses buccal structures adapted to blood sucking. Its length varies between 5 and 25 mm, according to species and developmental conditions. The colour is variable, generally dull, it can be brown, grey, greenish etc.

figure 1: Adult Horsefly

The oblong eggs, measuring approximately 2 mm, are laid on grass in groups of 200 to 500 in heaps of varying shape (figure 2).

figure 2: Eggs

The larvae, fusiform and ringed (figure 3) possess no differentiated appendages; they are dull in colour. Their size varies from 2 to 30 mm according to their stage of development. They live underground and are rarely observed.

figure 3: Larvae

The nymph is cylindrical in shape, possesses a cephalic bulb and prickly skin (figure 4); its size corresponds to that of the adult.

figure 4: Nymph

B. CLASSIFICATION

There exist approximately 70 species of horsefly in French Guiana, but only about a dozen species are of veterinary importance;

genus Tabanus: *Tabanus importunus*, *T. occidentalis dorsovittatus*, *T. olivaceiventris*, *T. wilkersoni*;

genus Phaetotabanus: *Phaetotabanus cajennensis*, *P. fervens*;

genus Cryptotylus: *Cryptotylus unicolor*;

genus Chlorotabanus: *Chlorotabanus mexicanus*;

The species most commonly found near cattle farms are: *Tabanus importunus*, one of the largest species, brown in colour; *T. occidentalis dorsovittatus*, smaller in size,whose abdomen is brown with a lighter medial streak; *Phaetotabanus cajennensis*, a small species with the abdomen bearing transverse streaks of wide black and narrow light coloured bands; *Chlorotabanus mexicanus*, a small species, light yellowish green in colour; and finally *Cryptotylus unicolor*, of medium length, with globular head and body, dark brown in colour.

II. BIOLOGY OF THE HORSEFLY

GENERAL BACKGROUND

Like mosquitoes, only female horseflies bite and suck blood, usually from domestic or wild mammals, sometimes from reptiles. As a result of the protein rich components of the blood, egg development takes place in approximately one week. The female lays the eggs on grass or shrubs, then seeks out a host for a new meal and a new reproductive cycle. Thus, she can take up to four meals at intervals of one week or longer, according to whether or not she finds a host. In the meantime, she can subsist like the male by feeding on nectar from flowers. The maximum lifespan of an adult female is two months.

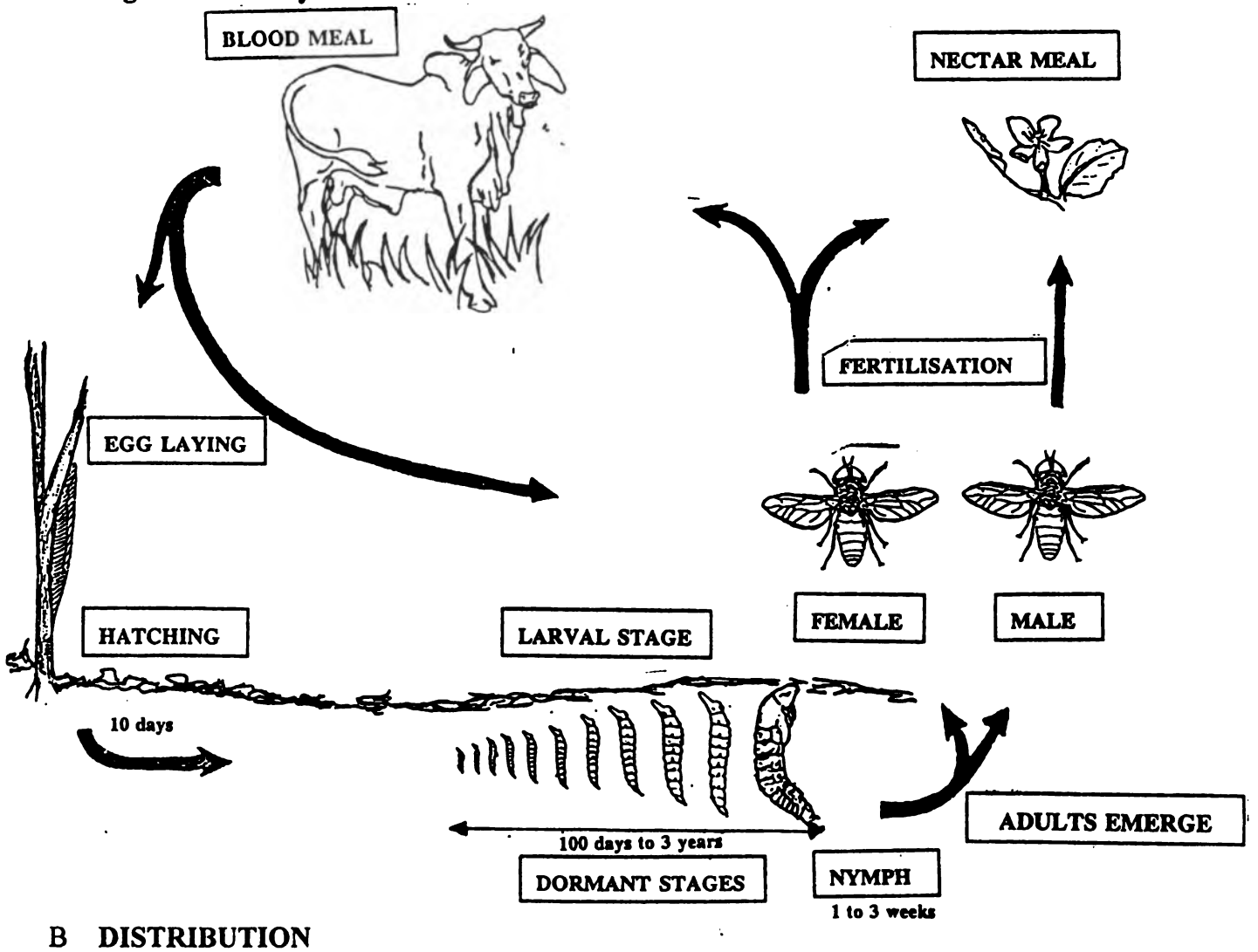
The larvae, which emerge approximately ten days after laying, have a complex aquatic and subterranean life cycle (9 to 10 stages). They are predatory or saprophagous, depending on species. The briefest stages last 10 days, the longest up to 300 days. The total larval phase extends from 100 days to 3 years. The larvae are scattered widely; their density in the environment is only 1.2 to 1.5 per square metre. During this stage, if environmental conditions are unfavourable (cold, flood, drought etc) the insect enters into a state of larval dormancy until conditions become favourable again. Therefore, in the Guyanas, the rainy season brings on larval dormancy which ends at the beginning of the dry season. This explains the abundance of horseflies from the month of August for the earliest species, until the beginning of the rains, in December for the latest species.

The nymphs are usually found underground but can sometimes be found in the air. The nymph stage lasts from one to three weeks.

The males feed on nectar, live in groups and are difficult to observe.

The life cycle of the horsefly is illustrated in figure 5.

Figure 5: Life cycle of the Tabanid



B DISTRIBUTION

Horseflies are present in every type of environment: savanna, river banks, seashore and forest, according to species. They are found in large numbers along creeks and in savannas around cattle rearing areas, where they multiply greatly due to the abundance of hosts.

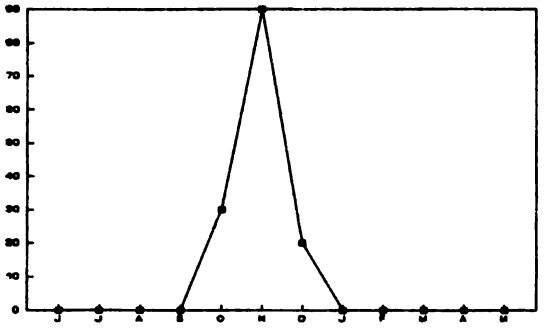
C PERIODS OF ACTIVITY

1. SEASONAL VARIATIONS

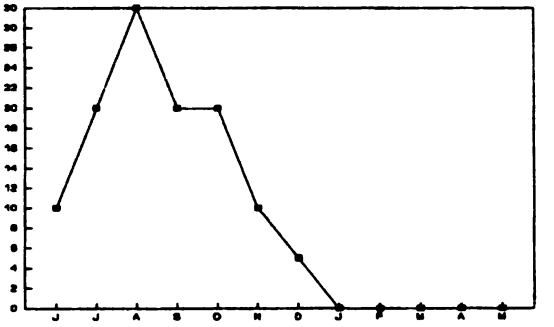
In the Guyanas, certain species such as the *Tabanus occidentalis dorsovittatus* are found throughout the year. However, most species display strongly seasonal activity with a marked peak in the dry season, particularly the end of this season in November (figure 6).

From the time of the first rains, activity diminishes abruptly, becoming almost nonexistent in December. If rainfall is low during the first rainy season (December to February), some degree of activity may persist until March, but to a lesser extent. During the rains, the larval stage becomes longer, allowing for the insects' survival until the following dry season.

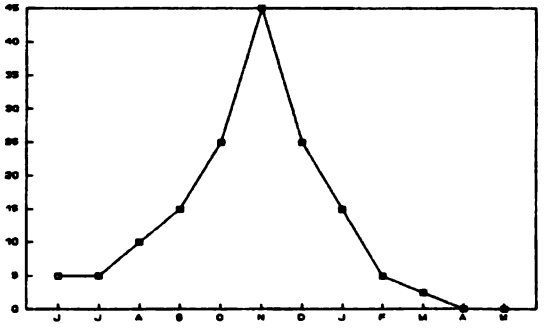
Figure 6 (a,b.c.d.e): Seasonal variations in Horsefly activity (number of insects per Malaise trap per day.)



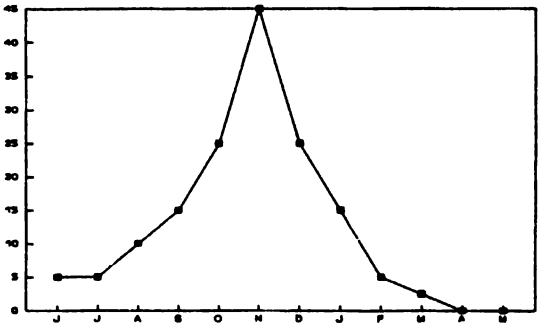
a: ***Tabanus importunus***



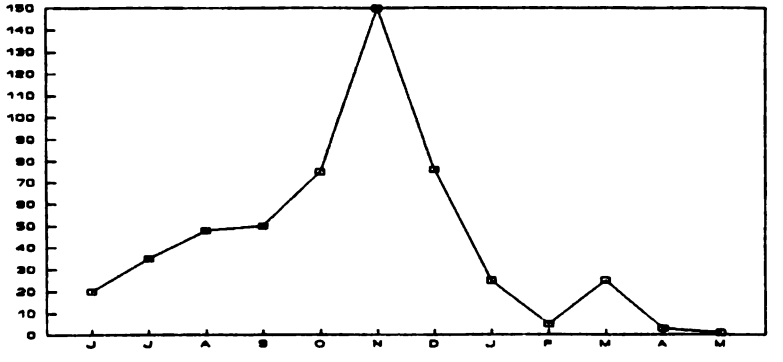
b: ***Cryptotylus unicolor***



c: ***Phaeotabanus cajennensis***



d: ***Tabanus occidentalis var. dorsovittatus***

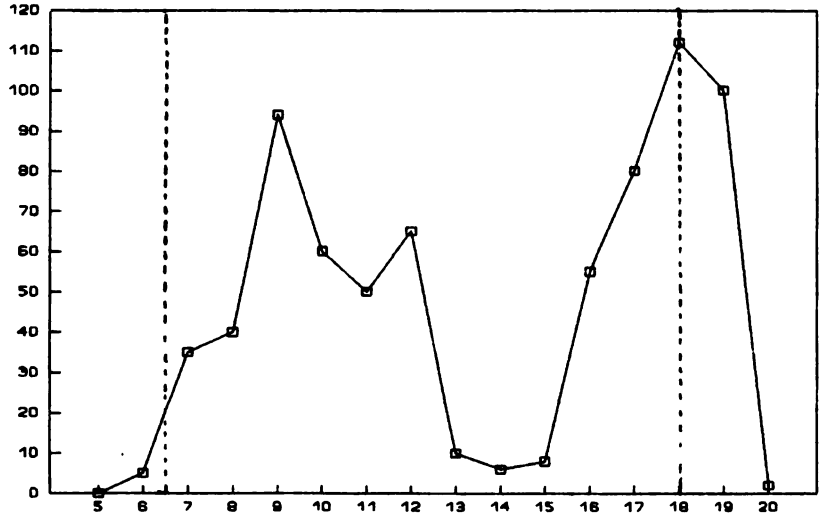


e: **All Species Combined**

2. CIRCADIAN RHYTHM

For several so-called "twilight" species, maximum activity takes place at sunrise and at sunset, in fair and dry weather (figure 7). For others, like *Tabanus importunus*, there is marked activity in the morning and the evening, but they remain active all day.

Figure 7: Activity cycle of the "twilight" horsefly



Aggressive behaviour cycle of the Horsefly.
X axis : time of day (vertical broken lines: sunrise and sunset).
Y Axis: number of horseflies caught per Malaise trap (baited with carbon dioxide) per hour

III NATURAL CONTROL OF THE HORSEFLY POPULATION

The horsefly population around cattle farms is very large due to the abundance of hosts, ie horses and cattle. Nevertheless, natural control of horsefly populations is exerted by various predators, at varying stages of horsefly development.

A. EGG STAGE

Nearly 74% of the eggs laid by *Tabanus importunus* can be destroyed by microhymenopterans (minute membranous four winged insect) parasites. Although this method alone is insufficient to control horsefly populations, it is not negligeable. One should take it into consideration in the possible application of insecticides for horsefly control, which would also destroy the microhymenopteran population.

B. LARVAL STAGE

Several enemies of horsefly larvae are well known, including fungi, nematodes, Tachinid flies and birds, but it has hitherto been impossible to evaluate their impact and therefore to control them.

C. ADULT STAGE

Two types of predators of the adult horsefly exist in the Guyanas, wasps and birds.

1. SAND WASPS

In French Guiana, these are commonly known as "lizard-flies". In English speaking countries, they are known as "horse guard wasps" or "cowfly tigers"; in Spanish speaking countries as "insectos policia". Several species have been identified:

genus Stictia: *Stictia signata, S. maculata, S. heros;*

genus Rubrica: *Rubrica surinamensis*

genus Bicyrtes: Bicyrtes variegata, B. angulata

These insects prey on the Diptera, and in particular on horseflies. The female hovers around cattle and captures a horsefly which she kills by her venomous sting. She then carries it off to her burrow where she has laid her eggs beforehand. The wasp larva is fed on horsefly or other Diptera captured by the adult wasp.

A wasp may capture up to 3 to 9 insects per day, and raise up to 10 larvae. One larva may devour up to 40 insects. One wasp could theoretically eliminate up to 300 insects during its lifetime.

Unfortunately these insects show little activity during the evening, when the horsefly are most numerous, and are rare in November, the maximal nuisance period of the horsefly.

Stictia signata is active from July to January, with the maximum activity from August to September; 5 to 15 individual wasps may hover around each cow (figure 8)

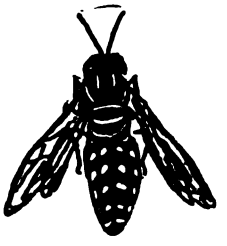
figure 8: Stictia signata

figure 9 and 10

Stictia heros and *Stictia maculata* show a low level of activity (less than one wasp per head of cattle), from November to January, with a maximum in December. (figures 9 and 10).

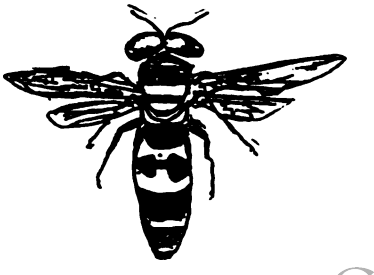
Stictia heros

Stictia maculata



Rubrica surinamensis hovers at the rate of ten wasps per head of cattle, from August to January, with a peak in October (figure 11).

figure 11: Rubrica surinamensis



In order to promote the settlement and the development of these predatory insects, if the pasture is not already sandy, it is recommended to provide mounds of sand in which the sand wasps may dig their burrows .

Finally these natural predators must be protected. Prior assessment must be made of the risks of destroying them before initiating any insecticide treatment to eradicate horseflies for such treatment would prove equally destructive to the sand wasps.

2. INSECT-EATING BIRDS

Few birds are truly efficient in the destruction of horseflies. The most effective is undoubtedly the cattle egret ("gaulin/gaulding") which captures horseflies alighting on the cattle to bite them. Some herds of cattle are continually escorted by these white birds, up to 3 or 4 birds per head of cattle, more often only 1 or 2 .

If there is a lack of water in the pasture at the end of the dry season, the egrets prefer to migrate to swamps, abandoning the cattle to their fate. The provision of a permanent year-round water supply for cattle is recommended; perhaps it might be enough to keep the egrets in the pastures.

It is necessary to educate the public about these birds which are useful cattle rearing companions.

Less effective, but still useful, are the smooth billed ani (*Crotophaga ani*, bluish black birds) which capture horseflies, not directly on the cattle, but on fence or corral posts.

Finally, chickens are also efficient in catching horseflies, once cattle are accustomed to their presence in the herd.

IV. MEDICAL IMPORTANCE

A. HUMAN HEALTH

Horseflies often attack human beings, in the forest or the savanna, particularly around cattle stations, but the bite is generally relatively harmless. In other countries, however, they may be carriers of deadly diseases such as filaria, transmitted by the *Chrysops* in Africa. They may also mechanically transmit tularemia (*Francisella tularensis*) and Lyme disease (*Borrelia burgdorferi*), in the United States.

The horseflies' capability to mechanically transmit those diseases whose agents are present in the hosts' bloodstream is not limited to these diseases, but epidemiological conditions (proximity of the hosts, prevalence of organisms) generally limit their role in human disease transmission.

B. ANIMAL HEALTH

Horseflies play an important role in animal health, both by direct effect on cattle and by acting as mechanical vectors for hemoparasites.

1. THE MOST FREQUENT HOSTS

Horses are very attractive hosts; they are the most seriously affected of the domestic animals. Their attractiveness is probably due to their size and to their odour. Their skin is also finer than that of cattle. Horses are very sensitive to horsefly bites and have very violent reactions. A horse placed in the middle of a cattle herd attracts more horseflies.

Cattle are also very significantly affected. Although all mammals including man, are potential horsefly hosts, the most appreciable economic impact of the horsefly applies to cattle rearing.

Pigs raised outdoors are subject to violent attacks by the horsefly.

Sheep and goats are not preferred targets of these insects.

2. THE BITE

a. Description

The bite is generally directed at the feet, the head, or the belly of the animals. The buccal structure of the horsefly is adapted to biting the skin, even thick skin such as cattle hide. The insect alights on the host and begins to bite by boring the cutaneous tissue in search of a blood vessel.

As soon as blood reaches the insect's mouth, it injects a little saliva. The horsefly's saliva possesses anticoagulant properties; without it the blood would coagulate, causing obstruction of the insect's proboscis. After injecting a little saliva, the insect sucks blood until the point of satiation, then flies off heavily. The largest species can extract up to 700 mg of blood in one meal. Total uninterrupted feeding time is approximately 3 minutes. The bite often leaves some skin bleeding.

The mouth parts of the horsefly are quite large, and the saliva irritating. The first phases of the bite, boring and inoculation of saliva, are painful. The animal usually reacts by chasing the insect, by quivering, lashing the tail, butting or kicking. The insect then flies off, and alights once more on the same or a neighbouring animal, making new attempts to bite until the host ceases to react (a less sensitive area of the skin or extreme fatigue of the host.)

The obvious cutaneous reactions in man (ie inflammation and itching) are less pronounced in animals. They may sometimes experience similar discomfort.

B. DIRECT CONSEQUENCES

i). Harassment of cattle

At the end of the dry season, the horsefly density is so great that the harassment of cattle may prevent them from grazing.

The cattle stay together for mutual protection. The animals are recumbent during peak hours of insect activity (from 6 to 10 o'clock in the morning and from 5 to 7 in the evening) to protect their lower parts and limbs which are favourite horsefly targets. Cattle that have access to the edges of the forest seek shelter there.

The animals graze by night, but never as much as usual. In every case, it is imperative to pasture them at night to prevent marked weight loss.

ii) Blood Meal

The volume of blood extracted by the horseflies from a single bovine is estimated at 200 ml per day (the equivalent of 400 bites by *T. importunus*). It can be even higher in the case of super-infestation, particularly if one adds the volume of blood oozing from the wounds after each bite.

iii). Skin lesions

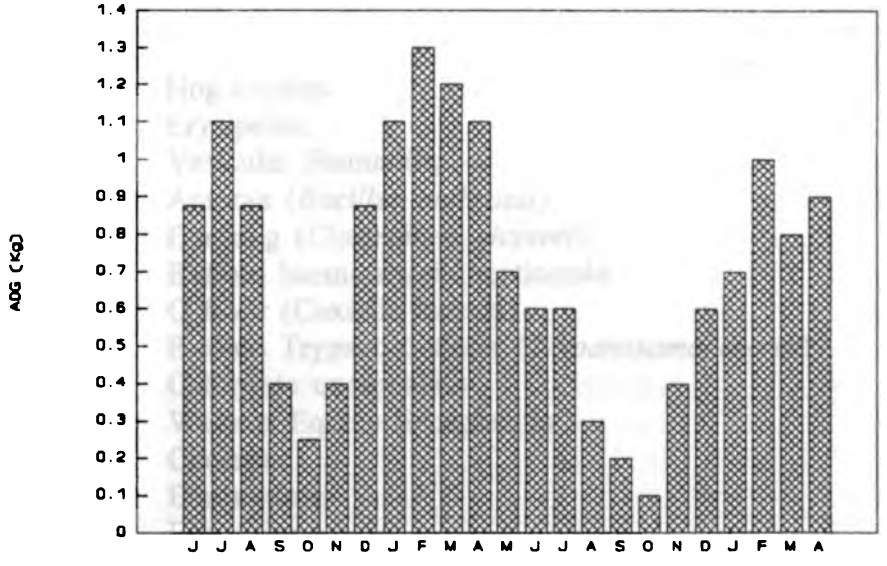
When the bites are very numerous, the skin is injured, and can easily become infected. In addition, these wounds attract the common fly which disturbs the animals, but especially the screwworm *Cochliomyia hominiviorax*, whose carnivorous larvae invade the wounds and enlarge them to a dangerous extent. The consequences of screwworm infestation can be disastrous.

iv). Effects

The loss of appetite, discomfort due to skin wounds, increased energy expenditure from reactions to bites, and blood loss combine to cause a reduction in weight gain. The animals may become thin as a result of horseflies alone.

Figure 12 shows the changes in average daily gain of cattle over the year on a farm where forage supply is always sufficient and prophylactic hemoparasite treatment is applied regularly. The fall in ADG in November, the maximum period of horsefly activity, is noteworthy.

Figure 12: Change in ADG of cattle over the course of the year



c). INDIRECT CONSEQUENCES

i). Mechanical disease transmission.

Due to the painful nature of the bite, the animal's reaction usually compels the horseflies to bite several times before satisfying their appetite. The multiple aborted bites may take place on a single or neighbouring animals. The change of host is facilitated by the increased herding together of the cattle under the influence of horsefly attacks. During the first bite attempt, the horsefly absorbs a little blood. If it is chased off, it makes a new attempt on another animal. A small quantity of blood from the first host is inoculated into the second host with the insect's saliva. In this manner, the horsefly mechanically transmits numerous diseases between cattle, including parasites, viruses, bacteria.

In addition, if two farms border by adjacent pastures, horseflies may transmit the disease from one herd to another. The safe distance beyond which the disease has little chance of being transmitted is approximately 200 to 300 metres.

ii). DISEASES TRANSMITTED

In The Guyanas, the principal diseases transmitted by the horsefly are:

- Trypanosomes: *Trypanosoma vivax, Trypanosoma evansi*
- Anaplasmosis (*Anaplasma marginale*)
- Bovine leukosis

The horsefly may also transmit Leptospirosis, Brucellosis and Equine Infectious Anemia.

In other countries, the horsefly has been implicated in the transmission of the following diseases:

- Hog cholera
- Erysipelas;
- Vesicular Stomatitis;
- Anthrax (*Bacillus anthracis*)
- Blackleg (*Clostridium chauvei*)
- Buffalo haemorrhagic septicemia
- Q fever (Coxiella burneti)
- Buffalo Trypanosomiasis (*Trypanosoma evansi*)
- California encephalitis
- Western Equine Encephalitis
- Cholera
- Bestnoitiosis
- Ehrlichiosis
- Dirofilariosis (Dirofilaria repens)
- Pasteurellosis (Pasteurella multocida)
- Clostridiosis (Clostridium perfringens)

V. ECONOMIC IMPACT

We shall discuss the direct impact of the horsefly on livestock, the local and general veterinary consequences, as well as related manpower costs.

A. DIRECT ACTION

The harassment of cattle causes:

- decreased appetite and consequently decreased feed consumption
- considerable expenditure of energy due to defensive movements of the animals
- blood loss estimated at 200 ml per day per animal. [When the blood lost through the small cutaneous hemorrhages which continue after the bite is added, a daily loss of 250ml of blood results.]

1. CATTLE

The direct action of the horsefly alone can cause a loss of more than 300 grams per day in average daily gain. That is, a failure to gain 9 kg per month. At the current price of beef on the hoof, that represents, for one animal, an economic loss per animal of approximately 180F[1] (French Guiana), G$900[2] (Guyana), Sf180[3] (Suriname) per month. The horsefly's intense activity is usually limited to 6 weeks per year, resulting in annual losses of 270 F (French Guiana), G$1350 (Guyana), Sf270 (Suriname) per animal per year, lost between mid-October and the end of November. See **Table I.**

On a 100 cattle head farm, this failure to gain weight accounts for losses of 27,000 F (French Guiana), G$135,000 (Guyana), and Sf27,000 (Suriname) per year.

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[1] French francs, based on beef live weight price of FF20 per kilogram.

[2] Guyana dollars, based on beef live weight price of G$45 per pound

[3] Suriname guilders, based on liveweight price of Sf20 per kilogram of beef

Table I - Economic Impact of Horseflies in the Guyanas

	French Guiana	Guyana	Suriname
Average weight loss per bovine per month	9 kg	9 kg	9 kg
Economic loss per bovine per month	180 FF[1]	G$900[2]	Sf 180[3]
Economic loss per bovine per year	270 FF	G$1350	Sf 270
Economic loss per 100 cattle herd per year	27,000 FF	G$135,000	Sf 27,000

In French Guiana, of 8000 cattle surveyed, approximately 4000 cattle were found to have this production loss. Extrapolating this rate of weight loss to the whole of French Guiana, the annual economic loss in cattle production alone was estimated at one million francs (equivalent to US$200,000)[4]. This estimate does not include losses incurred to other species of livestock.

2. HORSES

Without treatment, a horse can lose up to one third of its weight during the horsefly season. Even when protected by smoke, the annual loss is estimated at 40 kg.

The violent reactions of horses, which are particularly sensitive to horsefly bites, precludes any equestrian activities during this period, although climatic conditions are favorable for this type of activity.

In horse production, the economic impact is thus very difficult to estimate, but is far from negligible.

B. VETERINARY CONSEQUENCES

1. LOCAL

As a result of numerous bites on the limbs of cattle and horses, secondary skin infections often appear, requiring treatment. In addition, screwworm (*Cochliomyia hominivorax*) is attracted by the wounds, and infection by these carnivorous larvae often has dire consequences, particularly in horses, whose limbs are very delicate.

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[4] Based on an exchange rate of 5 francs to 1 US dollar.

One should take into account the cost of veterinary products used for disinfection and removal of insects from wounds due to bites.

2. GENERAL (IN FRENCH GUIANA)

The horsefly is a vector of both Anaplasma (gall sickness) and Trypanosoma. These are chronic diseases, causing fever, anemia, and weight loss in cattle, sometimes resulting in death. Anaplasmosis occurs all year round as it is transmitted and/or exacerbated by the horsefly, the fly and the tick. On the other hand, the symptoms of trypanosomiasis have usually been observed during or just after horsefly season. Trypanosome transmission is only possible when vector pressure of the insects is high.

The additional costs of prophylactic or therapeutic treatment for anaplasmosis and trypanosomiasis must be considered in the calculation of general losses due to the horsefly.

The horsefly is also a vector of Bovine Leukosis Virus, which was found to be very prevalent in French Guiana according to a recent survey carried out by the Veterinary Services Dept[5]. Although clinical signs of this infection are not evident in French Guiana, enforcement of health regulations is certainly extremely costly as national legislation requires the compensated destruction of the infected animals.[6]

With respect to horses, in 1982 it was necessary to slaughter approximately 80% of the horses in French Guiana due to Equine Infectious Anemia (swamp fever)[7], the main vector being the horsefly. Once again, strong vector pressure is necessary for virus transmission. If the vector population were partly controlled, this disease spread could probably have been prevented.[8]

C. ADDITIONAL LABOUR COSTS

Up to the present time, the only commonly used method of horsefly control in the Guyanas is building fires near animal shelter areas during the hours of maximum horsefly activity.

---

[5] J. Favre, Chief Veterinary Officer, French Guiana, Pers. Comm.

[6] French Guiana has an eradication program for Enzootic Bovine Leukosis. The prevalence rates of EBL in Guyana and Suriname are unknown; these countries do not have eradication programs.

[7] French Guiana has an eradication program for EIA.

[8] Editors Note: Stable flies (*Stomoxys calcitrans*) and mosquitoes may also be mechanical vectors of Equine Infectious Anemia.

The direct and indirect effects of the horsefly result in the following additional labour costs.

- increased surveillance of the cattle;
- application of local treatments;
- prophylaxis and treatment of hemoparasites

D. EFFECTS

1. CATTLE

It is difficult to accurately assess the total losses caused directly or indirectly by the horsefly. After gathering information from farmers, we offer the following estimate of annual expenses:

Table II - Estimated average economic loss per bovine per year caused by horseflies

Average Economic Loss per Bovine per Year (Estimated)	French Guiana (FF)	Guyana (G$)	Suriname (Sf)
Loss of average daily gain[9]	270	1350	270
Cost of veterinary drugs (local and general)[10]	50	500	450[11]
Production loss due to hemoparasites	18	90	18
Additional labour costs per head of cattle (supervision, handling, treatments, building fires)[12]	30	50[13]	9[14]
TOTAL	368	1990	747

[9] Loss of 300 grams/day X 45 days X cost of beef

[10] Drugs per 100 cattle: Screwworm/insecticide spray (1 liter), Antibiotic spray (1.5 liters), Oxytetracycline (90 grams), Imidocarb (10 grams). Prices vary widely depending on manufacturer, country of origin and exchange rate used. Veterinarians also vary widely in choice of medication prescribed.

[11] Drug costs very difficult to estimate, due to exchange rate fluctuations.

[12] Estimated as 100 hours additional labor over 6 weeks horsefly season per 100 head herd of cattle.

[13] Based on farm labour price of G$400 per day for 8 hour day.

[14] Based on farm labour price of Sf1700 per month for 24 days, 8 hours per day.

2. HORSES

It is much more difficult to quantify the losses caused by horseflies in horse breeding. Let us recall that an animal can lose about 40 kilos each year, in spite of the regular use of bonfires.

On the other hand a horse owner who plans for equestrian events will experience a considerably reduced level of performance from October 15 to November 30.

VI. HORSEFLY CONTROL

The methods currently in use are few, ineffective and/or costly

A. SMOKE

This is the technique traditionally used in Guyana, which consists of fumigating the area where cattle take shelter. The horseflies are driven away by the smoke. The cattle quickly recognise the importance of the fire and huddle near it, but when the grass in the fumigation zone is finished, the animals stop feeding so as not to expose themselves to the insects. For this method to be effective, it would be necessary to relocate the fires during the entire day to allow the cattle to feed sufficiently. This would require unfeasibly high labour costs.

B. INSECT REPELLANT TREATMENTS

Preparations which repel insects (mostly mosquitoes) are available for humans in lotions, aerosols and sprays. These products have little residual effect, and their use requires them to be reapplied approximately hourly.

In livestock production, no insect repellant designed for animals is available, for the following reasons:

a. Economic reason: the cost of repellants is very high (for human repellants, approximately 30F (G$750.00, Sf420) per 125 ml container

b. Technical reason: at the moment no preparation exists with sufficient residual activity to be useful for animal production. A residual action of at least one to two weeks would be necessary for such a treatment to be useful to livestock.

However, the repellants constitute one of the research areas for chemical and pharmaceutical industries.

C. INSECTICIDE TREATMENTS

An insecticide sprayed directly onto an insect can kill it in a few minutes or seconds. This method allows houses and stables, but not pastures to be free of insects.

An insecticide placed on an animal's skin can intoxicate the insects but will kill them only in minutes or hours, according to the quantity of insecticide which has been in contact with the insect. These treatments do not prevent biting nor harassment of the cattle. They cause the insect's death after it contacts the treated animal. This technique permits a slow gradual reduction of the insects over a few weeks; an immediate insect population reduction after the treatment must not be expected. Nevertheless, the reduction over one year will have obvious consequences in the reduction of the population of the following year.

Several techniques of application and several insecticide/acaricide preparations can be utilized.

1. EXISTING PREPARATIONS

a. Dip/Spray - Insecticide /Acaricide

Most products on the market have a residual action of between 2 and 10 days. The construction of a dip tank for horsefly treatment alone will rarely be justified in the Guyanas, considering the short period of horsefly activity. Therefore, spray application is more practical. Recent studies have shown that spraying of cattle, particularly the most severly affected areas (limbs, head and belly) with BUTOX 50 (50g/litre, 2 litres/animal) will kill horseflies feeding on this animal during a period of more than ten days.

b. Insecticide-impregnated eartags

These are used against flies, but their effectiveness is very limited. Although the concentration of the product is sufficient on the forelegs, it is not so for the rest of the body. This method of horsefly control should be discontinued.

c. Pour-on

This is an acaricide/insecticide preparation which is placed on the animal's back. Its duration of activity against ticks is longer than that of dips/sprays. Recent studies have shown that the duration of activity against horseflies is shorter, probably due to the fact that the insecticide spreads very poorly to the most severely affected areas: limbs, head and abdomen. The cost of these preparations is significantly higher than that of dips/sprays.

2. STRATEGY

As horseflies can move easily from one herd to another, attracted by sight or odour for distances up to 100 to 200 metres, the producer should utilise some form of treatment. His pastures should be more than 300 meters away from those of a neighbouring farm so that the horseflies do not move from one herd to another.

3. EFFECTIVENESS

In a very isolated herd, one can hope to considerably reduce the horsefly population if treatments are applied regularly during the six weeks of activity of the horseflies. However, the horseflies live in the forests where they feed on wild mammals. They can fly long distances in search of a host if the density of wild animals is too low. A cattle herd, even an isolated one, could thus be reinfested each year by horseflies.

One can nevertheless make the claim that systematic treatment during the period October 15 to November 30 will considerably diminish the horseflies impact on animal production.

VII. AREAS OF RESEARCH INTO HORSEFLY CONTROL

Existing horsefly control techniques are costly and/or inadequate. CIRAD/EMVT has therefore undertaken a research programme into new methods of horsefly control, in accordance with the demands of French Guyanese cattle rearers.

A. IS ERADICATION POSSIBLE ?

Horseflies live in all environments: savannas, forests, streams, seashore. They feed on all types of mammals, wild or domestic and can travel over a distance of several kilometers if no host is to be found in their immediate field of activity (150-200m). Eradication of these insects is thus impossible; control methods should only aim to reduce the population of insects living in the breeding area.

B. CONTROL BY MECHANICAL TRAPS

Insect traps have been used in Africa to reduce the population of tsetse flies particularly the species living near rivers, for their distribution in specific environments permits the placement of traps in strategic locations. For horseflies, traps are effective in capturing insects for study purposes. However, traps are inadequate for cattle protection because the natural prey, (cattle or horses) will always remain more attractive than traps, even the most effective traps. In French Guiana, we use the Malaise trap for the capture and study of horseflies; this trap depends on visual and olfactory attraction.

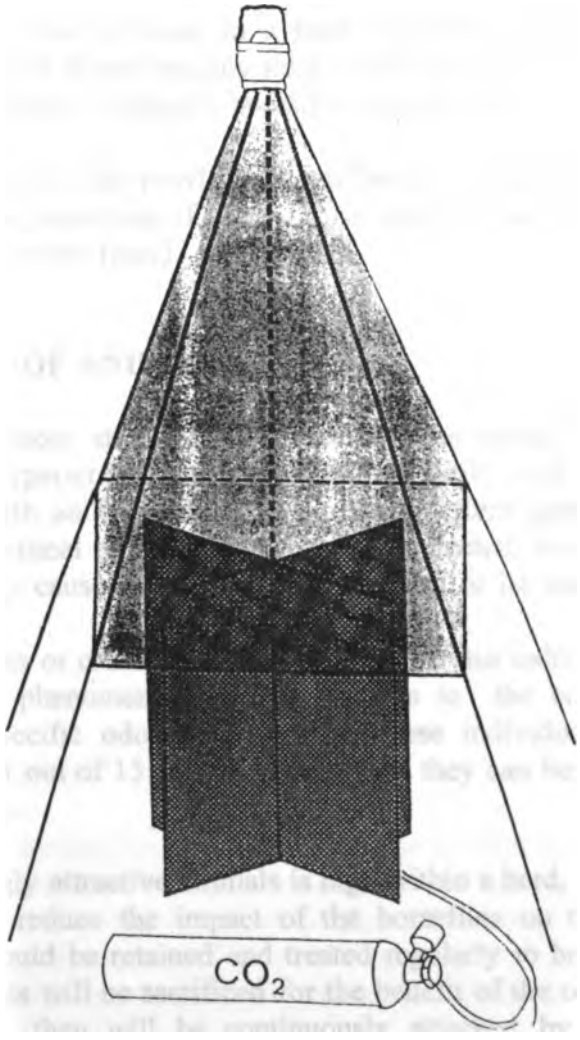
1. VISUAL LURE

The base of the trap consists of two crossed wooden panels, black in colour, each with a surface of approximately 1 square meter. A cone shaped mosquito net (with the apex above), is placed above the panels, approximately 80 cms from the ground. A funnel and a cage or a plastic sack are placed at the top. The panels visually attract the horseflies that alight on the trap. The insect's natural behaviour causes them to fly along the flame, then upwards, entering the cone, then the funnel and finally the receptacle which covers it. The insects do not generally find the trap exit as they fly upwards towards the top. See figure 13.

2. OLFACTORY BAIT

To increase the efficacy of these traps, one can cause carbon dioxide (CO_2) to circulate half way up the trap. In effect CO_2 is a gas expired naturally by mammals, and is a powerful attractant for the horsefly. The insects who detect the gas in the air fly upwards towards the flame, and complete their approach at the sight of the black panels.

Figure 13 : the Malaise Trap.



A trap without carbon dioxide (CO_2) can capture up to 200 horseflies per hour and up to 350 in one day.

With carbon dioxide (CO_2) one can capture 450 insects in one hour, and up to 950 per day.

It should be noted that certain species are poorly attracted by the Malaise trap; for example: *Chlorotabanus inanis, Chl. mexicanus and Cryptotylus unicolor.*

It should be noted that certain species are poorly attracted by the Malaise trap; for example: *Chlorotabanus inanis, Chl. mexicanus and Cryptotylus unicolor.*

By multiplying the number of traps in a herd, one can partially reduce the vector pressure, but this control method alone remains insufficient for achieving total control of the horseflies as they are more strongly attracted by cattle than by traps.

These traps are very useful for providing horseflies for research. Their effectiveness for cattle production could be increased if a new, less time-consuming and more practical attractant than carbon dioxide were found.

C. ATTRACTIVENESS OF ANIMALS

Horses are decidedly more attractive to horseflies than cattle. One can exploit this phenomenon by placing an experienced horse in a herd of cattle, and by treating this horse regularly (every ten days) with an insecticide with residual effect (pour on) throughout the horsefly's active period. An animal of little value should be selected, for exposure to horseflies without smoke protection may cause it to lose up to one third or its weight in 6 weeks.

Within a species, horses or cattle, it is observed that certain individuals are particularly attractive to horseflies. This phenomenon is probably due to the combination of several factors: size, coat colour, specific odours. Locating these individuals is easy, there are generally few within a herd (1 out of 15 approximately) and they can be treated regularly with insecticides (sprays) as above.

If the number of strongly attractive animals is high within a herd, it is advised that these animals should be culled to reduce the impact of the horseflies on the herd. Some very attractive " bait " animals should be retained and treated regularly to bring some relief to the rest of the herd. These animals will be sacrificed for the benefit of the others, for even though they will have been treated, they will be continuously attacked by horseflies, and their production will be adversely affected.

Determination of factors contributing to this attractiveness could lead us to discover a molecule other than carbon dioxide for baiting the Malaise traps and thus make these traps more effective.

D. INSECT REMOVAL FROM BUILDINGS AND LIVESTOCK EQUIPMENT

A large number of horseflies can often be observed on fence posts, around feed and water troughs, and on wooden posts in stables and corrals.

These surfaces could be coated with a residual insecticide or with insecticide paint (retaining a colour similar to faded wood) to destroy the insects that alight on them.

On a large cattle farm, fencing does not play a significant role as a source of horseflies. However, at the cattle gathering points, the food and water troughs could be effectively treated.

On a small cattle farm, the treatment of fence posts, feed and water troughs could be attempted.

On all farms, one could treat the stables, corrals and restraint equipment.

In collaboration with some producers, we will conduct experimental treatment trials, measuring numbers of horseflies captured in the Malaise traps as an outcome. If satisfactory results are obtained, the technique could be extended to other livestock farms desirous of undertaking the fight against horseflies.

E. LONG TERM RESEARCH

Two other research avenues have been initiated by the EMVT: a study of cattle's natural resistance to horseflies, and a study of cattle immunisation against horseflies.

1. NATURAL RESISTANCE

Recent observations, awaiting confirmation, have shown that certain cattle have a form of resistance to horseflies, independent of their attraction. These animals are bitten like others, but a large percentage of horseflies who have fed on them die shortly after their blood meal. No causal relationship has been demonstrated yet, but this study will attempt to confirm these observations and to determine the mechanism underlying this process.

2. CATTLE IMMUNISATION

Immunisation of cattle against the cattle tick (*Boophilus microplus*) has been proven possible; studies carried out in Australia have shown that by immunising cattle against the antigens of tick guts it is possible to induce high mortality in ticks which have fed on these cattle.

On the same basis, the immunisation of cattle against horseflies may also be possible. Research has begun by EMVT- French Guiana in this field. We present the principles below in chronological order.

- Capture of the horseflies in the Malaise trap
- Dissection of the horsefly to extract the guts
- Preparation of gut antigens with an immunization adjuvant
- Immunization of cattle to produce antibodies against the horsefly gut antigens
- Efficacy test: horseflies are captured, placed in cages and allowed to feed on immunized cattle. When they bite, they extract blood containing antibodies. The antibody/antigen reaction can cause intestinal lesions as in ticks in which there is a bursting of the intestinal ceca, or a simple digestive upset which would weaken the digestive and reproductive capacity of the insect.

This immunization, like insecticide control, would not prevent horsefly bites, but if it causes death or prevents reproduction, would gradually diminish the number of horseflies on a cattle station.

Preliminary results do not demonstrate as clear an effectiveness as in the tick/cattle model, but this line of research will be pursued because the progress of discoveries on the tick is very promising, and the horsefly/cattle model is very similar to it.

VIII. CONCLUSIONS

The role of the horsefly in the mechanical transmission of diseases has been long underestimated, particularly in Africa where it has been concealed by that of the tsetse flies. The location of trypanosomes beyond the areas of distribution of the tsetse fly in Africa, and their wide dissemination in South America, have led to a reevaluation of these vectors. Up to the present time, the horsefly has been little studied, and methods of control are very inadequate. We have therefore oriented our efforts in this direction.

The results of the epidemiological survey carried out in 1991-92 have shown the high incidence of hemoparasites in all livestock in French Guiana. Let us repeat the prevalence rates:

- Trypanosomiasis: 29%
- Anaplasmosis: 62%
- Babesiosis: 84%

These diseases are transmitted by ticks and horseflies, and to a lesser degree by stomoxes (stable flies).

Having previously provided producers with a publication on the biology and control methods of ticks[15], we hope that this document provides some useful information for better control of the horsefly. We have particularly stressed their two-fold impact: as a direct scourge of animal breeding, and as vectors of hemoparasites and viruses. (Bovine Leukosis and Equine Infectious Anemia) as well as the need to improve control methods. We continue to be available to livestock producers for any additional information or collaboration in the control of hemoparasites and their vectors.

Thanks to its work in pathology (epidemiological survey: Laboratory at the Institut Pasteur) and on animal production (technical operation of the St.Elie farm: Sinnamary) CIRAD-EMVT-French Guiana has a sufficiently solid base in French Guiana to implement a long term programme in collaboration with livestock production professionals and researchers in the three Guyanas, if the request is clearly expressed and financing obtained by joint agreement.

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[15] La tique du betail, *Boophilus microplus*, CIRAD-EMVT Cayenne 1991

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