Ethiop. J. Agric. Sci. 24(2):59-67 (2014)

The Dynamics of TseTse Fly in and Around Intensive Suppression Area of Southern Tsetse Eradication Project Site, Ethiopia

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Abstract

This study was carried out in and around intensive suppression area of the Southern Tsetse Eradication Project in Gamo Goffa Zone, Southern Nations, Nationalities and people`s Region of Ethiopia. Assessment of the dynamics of the vector tsetse was done by entomological survey between December-Jan, 2008 (dry season) and April-May, 2009 (wet season) in and around the intensive suppression area of the project site. The entomological survey revealed the presence of **Glossinapallidipes** *as the only* **Glossina** *species in the study area. Total catch of flies were 95 and zero with averages of apparent densities of 1.6 and zero flies per trap per day during dry and wet seasons, respectively in ISA and a total catch of 8417 and 2028 with averages of apparent densities of 280.6 and 67.6 flies per trap per day in dry and wet seasons, respectively in Nech Sar National Park. In conclusion, results of seasonal and spatial dynamics of tsetse flies in intensive suppression areas and Nech Sar National Park, would be useful in planning an eradication program in the project area. Large population of tsetse flies in the Nech Sar National Park poses a risk of reinvasion and the uncontrolled animal movements in the project area may challenge the efficiency of the project.Generally continuous control and monitoring activities in the project area should be evaluated periodically and effectiveness of each control measures in specified sites must be seen in a favor of eradication program.The study would help in dynamic approach of the project planning, implementation, monitoring and evaluation.*

Key words: *Apparent density, Cattle, Intensive Suppression Area, Nech Sar National Park, Tsetse dynamics.*

Introduction

Control strategies in trypanosomsis concentrate on vector control, parasite control with chemotherapy and chemoprophylaxis and use of the inherent trypanotolerant trait in some breeds of animals (Holmes, 1997). Previous control techniques included vegetation clearing, ground and aerial insecticide spraying and selective game destruction. These methods have been discouraged due to the high costs involved in addition to being environmentally un-friendly (FAO, 1992). The Sterile Insect Technique (SIT) is a biological method of control in which sterilised male tsetse are released and compete with wild male tsetse for mating with females (Dame and Schmidt, 1970). The principles of this method state that it becomes more economical when the natural population is low. The technique has been used successfully in some parts of Africa e.g. eradication of three species of flies in Burkina Faso and in Zanzibar, Tanzania (Clair *et al.*, 1990).

In 1997, the Ethiopian Government, assisted by the International Atomic Energy Agency (IAEA) - initiated a project in the Southern Rift Valley called the Southern Tsetse Eradication Project (STEP) with its long-term objectives to create a tsetse-free zone in a 25,000 square kilometer area under agricultural development, and to develop adequate national capacity for applying the concept of area-wide integrated pest management (AW-IPM) with a sterile insect technique (SIT) component to other parts of the country affected by the tsetse and trypanosomosis (T and T) (Temesgen, 2007).

In sight of the above initiative this study was proposed with the objective of assessing seasonal dynamics of tsetse fly in Nechi Sar National Park and in Intensive Suppression Area.

Materials and Methods

Study area

The study was carried out in the Southern Tsetse Eradication Project (STEP) area with in and around intensive suppression area of the Southern Rift Valley of Ethiopia, located between $4^0$45` and $7^0$15` northern latitudes and $36^0$40`and $38^0$20` eastern longitudes in the country. The project is situated in the Southern Nations Nationalities and Peoples Regional State, Gamo Goffa Zone, Arba Minch Field operation site of the project area surrounded by highlands, Lakes and the Nechi Sar National Park. Intensive suppression area (ISA) (Figure 3) covers about 100km^2 areas. It is located between 6^0 05′and $6^0$14` latitude and $37^0$53` and $37^0$62` longitude (STEP, 2007). The natural vegetation is predominantly wooded savannah grass land and large portion of the area is well irrigated cultivated land. The area is characterized by hot climatic condition with low and unevenly distributed rainfall patterns (wet season) and regularly high temperature (long dry season). Annual average rainfall ranges between 800 and 1000mm. The annual mean maximum temperature is about 34.3$^o{}_C$ and the annual mean minimum temperature throughout the year is 12.5^{o}C (Krubel, 1985).

Tsetse fly surveys were conducted twice in the Intensive Suppression Area (ISA) and at the selected sites in the Nechi Sar National Park in Dec-Jan, 2008 (Dry season) and in April-May, 2009 (Wet season).To determine the apparent tsetse densities, odor-baited NGU traps (Figure 4) were deployed at various sampling points where tsetse infestation was suspected (FAO, 1992). Selection of trapping sites was based on vegetation cover, proximity to drainage systems and areas with human/animal activities e.g., grazing areas and watering sites. All coordinates of trap positions and blood sampling sites were geo-referenced using Global Positioning System (hand held Garmin-48) (Figure 2).

All the traps were baited with phenol sachets and deployed for seventy-two-hours. After 72hrs, traps were collected and flies caught were identified, classified, sexed using a modified entomological key described in Brunhes*et al*. (1994). Flies were counted and recorded from each trap top cage. The tsetse fly apparent density (AD) was defined as the mean number of tsetse flies caught (regardless of species) per trap per day.

Data management and analysis

Data were analyzed by using SPSS version 15.0 and for GPS records on the map, ArcView GIS 3.2 was used.

Results and Discussion

Entomological survey was done in Intensive Suppression Area and Nechi Sar National Park during the study period in dry and wet seasons. A total number of 20 and 10 NGU traps were deployed in ISA and UCA respectively in each season considering the ecology of each trap positions.

There was high variation in fly catch in dry and wet seasons in the study area. The total number of tsetse fly caught during the dry season in intensive suppression area was 95 out of which 22 were males and 57 were females and 13 unidentified tsetse flies with an average apparent density of 1.6 FTD. Total catch of Tabanus and other biting flies were 416 and 274 respectively. In the wet season no single tsetse fly was caught and Tabanus and other biting flies were caught with the count of 56 and 150 respectively. There was a great altitudinal variation in tsetse apparent densities in each trap positions. During dry season the distribution of tsetse flies limited with in the altitude range 1177-1201 masl. Highest AD was recorded at 1181masl altitude. But in wet season no single tsetse fly was caught in the area.

Average apparent density in dry season was reduced from 1.59 FTD to 0 FTD in wet season. Implementation of intensive suppression program was carried out by deploying insecticide impregnated targets and by pour-on treatment of animals with insecticide.

Apparent density of tsetse flies was reduced from 1.6 FTD in dry season to 0 FTD in wet season. In the same manner prevalence of trypanosomosis was reduced from 5.5% in dry season to 3.5% in wet season. Entomological survey was also done in Nech Sar National Park during the study period in dry and wet seasons. A total number of 10 traps were deployed during each season within selected part of the Park averagely 300m apart depending on the ecology of the site.

A total number of tsetse fly caught during the dry season in NNP was 8417 out of which 3129 were males and 5043 were females and 245 unidentified tsetse flies with an average apparent density of 280.54 FTD. Total catch of Tabanus and other biting flies were 302 and 303 respectively. A total number of tsetse fly caught during the wet season in NNP was 2028 out of which 691were males and 1008 were females and 328 unidentified tsetse flies with an average apparent density of 67.6 FTD. Total catch of Tabanus and other biting flies were 435 and 20 respectively.

Apparent density of each trap was calculated for that specific location in each season. Total catch during the dry season was much larger than the wet season catch. Possible reasons for this were that during high temperature and low humidity of the dry season flies accumulated around the river and shady areas.

The apparent density of tsetse flies at each trap position during dry season was higher than in the wet season. Similarly in ISA, average apparent density of tsetse flies in dry season in the area was higher than in the wet season (Figure 1).

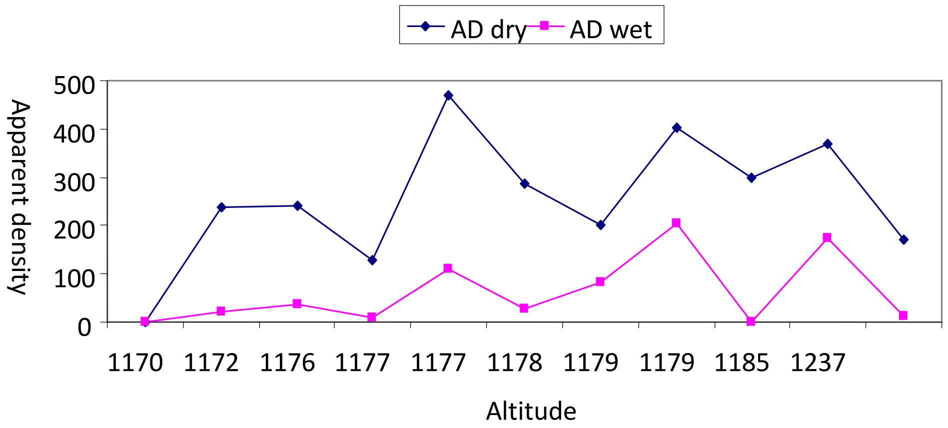

Figure 1. Tsetse dynamics with season and altitude in NNP.

The total number of tsetse fly caught during the dry season in intensive suppression area was 95 out of which 22 were males and 57 were females and 13 unidentified tsetse flies with an average apparent density of 1.6 FTD. Total catch of Tabanus and other biting flies were 416 and 274 respectively. In the wet season no single tsetse fly was caught and Tabanus and other biting flies were caught with the count of 56 and 150 respectively. A study conducted in an agro-pastoral zone of Burkina Faso, showed that the epidemiology of bovine trypanosomosis in areas where only the *Palpalis* group (Nemorrhina) occurred was intimately linked to livestock management and fly dispersal patterns (De la Rocque*et al*., 1999).

Data and information collection on tsetse fly diversity, distribution and abundance, at different altitudes and vegetation, prevalence and distribution of animal trypanosomosis and socioeconomic status and potential of the region for economic development was conducted. A total of 7733 traps were deployed at different altitude and vegetation classification in 63 grids. A total of 1066 traps were deployed in 58 grids 12,298 tsetse flies (*G.pallidipes*) were caught at the preliminary survey. The highest apparent density of 68.6 FTD was recorded. The least apparent density was 0.013 FTD. The altitude at which tsetse were trapped varied from 786 masl to 1992 m.a.s.l (STEP, 2000). Tsetse workers in some parts of Africa have reported the presence of trypanosomosis in the apparent absence of tsetse. These observations have led some people to conclude that the disease is transmitted mechanically by biting flies, such as *Stomoxys,* in Africa. Tsetse flies can however, survive at very low densities (<10 per square kilometer) and a single trap catches only ~1% of a local tsetse population per day. Thus, even the most effective traps need to be operated continuously for many weeks to provide compelling evidence that there are no tsetse flies (FAO, 1993). Apparent density of *G. pallidipes* species up to 1.35 F/T/D were reported from the low land category of southern Rift valley of tsetse eradication and control program area (Jembere, 2004). In the Rift Valley area the highest fly density (54.6 F/T/D) was recorded from North Omo and Meirab Abaya woredas. *Glossinapallidipes* was found to be one of the most common flies in the area.

Figure 2. Geo-referencing trap positions

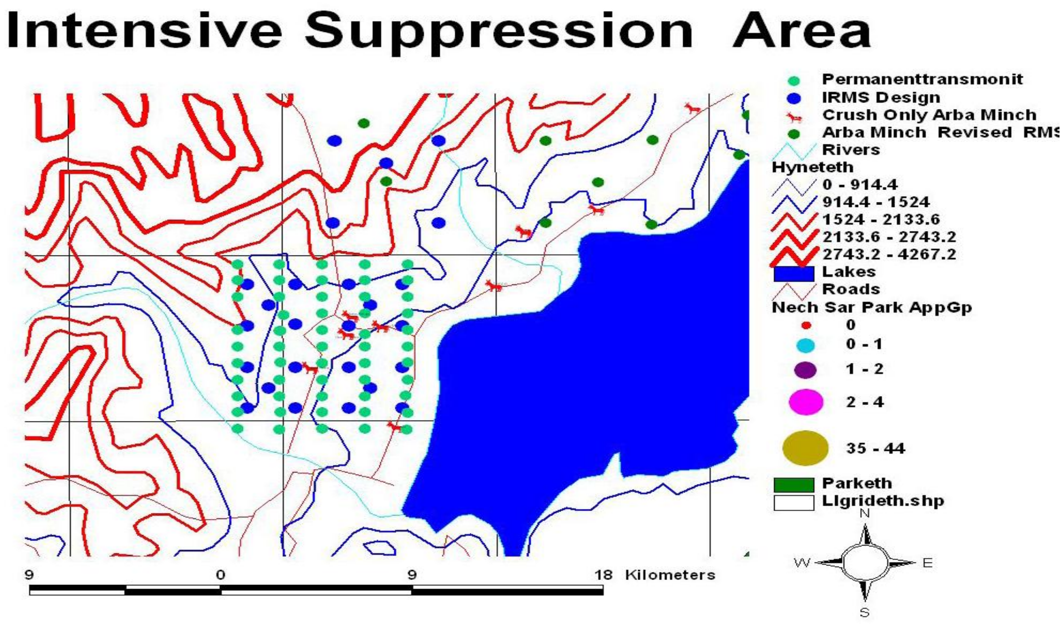

Figure 3. GIS map of intensive suppression area

Apparent density of each trap is calculated for each trap for that specific location in each season. During the dry season flies accumulated around the river and shady areas following favorable temperatures and relative humidity. During the wet season similar climate was noticed and flies dispersed to the favorable locations in the Park. The findings of this study are in contrast with the findings of Yeshitila (2006).

Transmission is host-specific, with some hosts good transmitters and others poor transmitters, simply as a result of the biochemical characteristics of their blood (Mihok*et al.*, 1993). Herd management, daily activity patterns of tsetse species involved and the grazing patterns of the herds are of great influence on the transmission of the disease between tsetse flies and domestic ruminants (Uilenberg, 1998). In agreement with the above the animal management practices in the study area at vicinity of Nechi Sar National Park puts the area at risk. Cattle, sheep, goats, pigs, horses, camels, dogs, cats, and monkeys are susceptible to African animal trypanosomes (AAT) and may suffer syndromes ranging from subclinical mild or chronic infection to acute fatal disease. Rats, mice, guinea pigs, and rabbits are useful laboratory species. More than 30 species of wild animals can be infected with pathogenic trypanosomes, and many of these remain carriers of the organisms. Ruminants are widely known to be active reservoirs of the trypanosomes. Wild Equidae, lions, leopards, and wild pigs are all susceptible and can also serve as carriers of trypanosomes (Mulla*et al.*, 2005).

Thus, tsetse and trypanosomosis appears to afflict communities inhabiting areas close to conservation areas. Environmental alterations resulting from land use changes such as settlements and agricultural activities may have brought about reduced tsetse habitats causing low vector density and its distribution (Olubayo*et al*., 1990). Cattle-infective trypanosomes circulate in a variety of wildlife hosts, which generally tolerate infections or have a state of pre-immunity. The wildlife surveys have shown that some favored hosts of tsetse such as bushbuck, buffalo, warthog and waterbuck are major reservoirs of trypanosomes, with many animals infected. Many savannah species such as wildebeest and Zebra also harbor trypanosomes despite little overlap with tsetse distributions feeding habits (Olubayo*et al*., 1991). NechisarNational park is one of the best National parks in the country in terms of its splendid biodiversity. It is important because it contains an impressive variety of mammals and birds. It contains about 46 species of large mammals and 41 species of small mammals (Duckworth, 1992). These mammals can be infected and serve as reservoirs for nearby domestic animals.

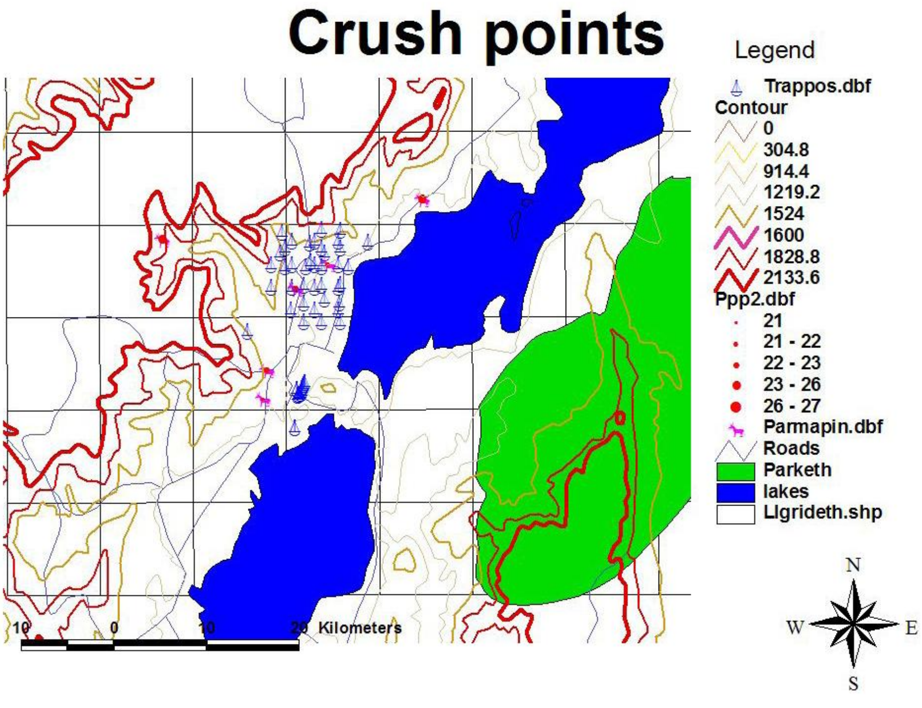

Figure 4. GIS map of Crush points and trap positions in the ISA

Spatial and temporal distribution of tsetse flies in the study area of the Nechi Sar National Park which was seen during the study period may help for future plan to collect live flies as a sources for rearing large colony establishment for SIT or to design tsetse control program specially in the Park to avoid the risk of reinvasion to the vicinity of tsetse free (controlled) area. Mulla*et al*. (2005) stated the carrier state reservoirs of trypanosomes were found in many wild animals and in domestic ones that were affected by the chronic disease. Tsetse fly caught in and around game reserves tends to have relatively high infection rates. For this reason, animal grazing close to game reserve or park are at high risk.

The presence of densely populated tsetse flies in the Nechi Sar National Park remains a great potential risk for reinvasion of cleared areas at the vicinity of the Park. Contrary to tsetse flies the number of Tabanus species total catch was increased during wet season. Factors limiting tsetse distribution are temperature, humidity, availability of food, vegetation cover, and combination of these factors.

The negative opinion of antagonists regarding tsetse control and eradication should be addressed well in discussing the trade-off of tsetse eradication from fertile land among different institutions and scientists before starting a large scale sterile male tsetse fly release.

In conclusion, the entomological survey provided information on apparent densities of tsetse flies in intensive suppression area and NechiSar National Park. The absence of tsetse flies in wet season in ISA could not be guarantee for the absences of infection in the area, similarly, zero prevalence most probably would not mean any tsetse flies in the area. Apparent densities of tsetse flies during dry season was higher than wet season in ISA and NNP. Release of sterile male tsetse flies is now possible provided that the natural tsetse population in the ISA is reduced to the minimum level. Uncontrolled animal movement among different areas of the project site creates Achilles'-heel feedback about the suppression and monitoring activities of eradication of tsetse fly. The problem caused by tsetse and trypanosomosis was not only that of disease but also a significant negative impact on natural resource conservation and sustainable utilization. If once, eradication is achieved in intensive suppression area, the area-wide strategy would gradually be expanded to all Southern Rift Valley and all other tsetse-infested regions in the country, bringing enormous benefits to agricultural development in Ethiopia.High tsetse fly population in NNP should be controlled to reduce risk of reinvasion to the vicinity areas.The use of most effective but simple techniques such as pour-on application of insecticides, insecticide impregnated screens and traps are some of such simple techniques which are of ready application by an average livestock farmers and this will go a long way to complement large scale effort at controlling tsetse fly and trypanosomosis.

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