THE IMPACT OF URBAN DAIRY CATTLE FARMING ON MOSQUITO PRODUCTIVITY IN TANGA, NORTH-EAST TANZANIA

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SUMMARY

A study to assess mosquito breeding potential of cattle water troughs was carried out in Tanga Municipality, north-east Tanzania. Mosquito eggs, larvae and pupae were searched in cattle water troughs in 173 randomly selected domestic premises. Of the surveyed troughs, 30.1% were infested with pre-imaginal stages of culicine mosquitoes. *Culex quinquefasciatus* formed the highest proportion (76.5%). Other mosquito species included *Aedes aegypti* (15.6%), *Cx cinereus* (7.0%), *Cx decens* (0.8%) and *Cx annulioris* (0.1%). The mean density of mosquito larvae found in the study area was 1001 per water trough. Although most of the farmers claimed to clean and replace water in the troughs frequently, 14.8%, 22.8% and 46.3% of those replacing water everyday, after every two days and after every three days respectively, had their troughs containing immature stages of mosquito. Mosquito larvae or pupae were absent in all troughs that were harbouring tadpoles.

INTRODUCTION

Urban agriculture is becoming an important economic activity in most of the towns and cities in Africa. The expansion of urban agriculture in Africa has been stimulated by economic structural adjustment programmes and the collapse of much of the formal economy (Annon, 1999). In Dar es Salaam, Tanzania, more than two-thirds of all families were engaged in some form of urban farming in the early 1990s, compared to only one-fifth in the late 1960s (Annon, 1999). Most urban agriculture is small-scale and in many countries it is dominated by women (Annon, 1999). Of the types of urban agriculture, dairy cattle farming is becoming an important economic activity in most of the major towns of Tanzania. Dairy cattle farming has increased markedly over the last two decades (see Mboera *et al.*, 1997).

Before 1980s there were no cattle in Tanga Municipality except few that were brought for slaughter. Pets and poultry were among the few domestic animals present (White, 1968). In Tanga, small-scale dairy farming has increased over the past fifteen years. To date there are over 590 dairy cattle farmers keeping over 1,500 head of cattle. The animals are kept in cow-sheds near homes for various reasons including security and easy of feeding and watering. Water is provided most always in concrete built troughs. Water in this kind of containers may provide optimal

conditions for mosquito breeding to take place. Recently a survey conducted in a small town of Muheza showed that over 57.2% of all cattle water troughs support the breeding of culicine mosquitoes (Mboera *et al.*, 1987). The mosquito productivity of such containers in larger towns and cities of Tanzania is however, not known. In view of the above it was important therefore, to determine the potentiality of cattle water troughs in supporting the breeding of mosquitoes in Tanga. Specifically, the purpose of this study were (i) to investigate the extent of mosquito breeding in cattle water troughs in Tanga Municipality; (ii) to determine the species of mosquito breeding in the troughs; (iii) to estimate the mosquito larvae productivity of the troughs; and (iv) to determine the frequency of trough cleaning habits in relation to breeding of mosquitoes in the troughs.

MATERIALS AND METHODS

The study was carried out in Tanga Municipality from March to May 1998. Tanga is one of the largest urban centres of Tanzania and lies on the coastal belt of the Indian ocean between 5°7'S and 39°05'E. Most parts of the town lie at less than 40 m above sea level. The rainfall pattern in the area is characterised by two peaks, the main one in April-June and another less pronounced peak in October-November. The annual rainfall averages 1,340 mm with a perennial high humidity. The mean annual temperature is 26°C, with cooler months in June-September and warmer months in October-May. Few people are employed as civil servants, while the majority are engaged in small scale farming, fishing and petty businesses.

The study area was divided into six zones namely: Raskazone, Mikanjuni, Sahare, Pongwe, Kange, and Nguvumali. Randomly selected farmers with concrete water troughs within each zone were enrolled. In each zone, each enrolled cattle farmer was informed of the aims of the study so as to have his/her consent and co-operation during the survey. Each cattle water trough was thoroughly searched for the presence of mosquito eggs, larvae or pupae. A dipping method as the main larval sampling technique was used. Where water level in the trough was extremely low, a known volume of water was added before sampling. Collected mosquito eggs, larvae and pupae were transferred into a labelled collecting bottle and taken to a laboratory and reared to the adult stage for identification (Edwards, 1942; Gillett, 1972).

Water in some randomly selected water troughs was gently stirred prior sampling. Using a dipper (1.75 l capacity) five samples from the troughs were taken. By calculating the volume of water in the container, the number of larvae caught with the dipper was related to the capacity of the containers and larvae population estimates was determined using Croset *et al.* (1976) technique: $P = vn/c$, where: P is the absolute population estimates of larvae; c is the capacity of the dipper; n is the number of dips taken and, v is the volume of water in the larval habitat.

A check list was used to collect information concerning general features of the water troughs, the volume of troughs, condition of troughs, condition of water in the troughs, and general information on the management and maintenance of the water troughs.

RESULTS

It was found that the proportion of cattle water troughs infested with mosquito pre-imaginal stages ranged from 17.6% in Mikanjuni to 40.7% in Nguvumali (Table 1), with a mean infestation rate of 30.1%. Five species of culicine mosquitoes were identified. These included: *Culex quinquefasciatus, Aedes aegypti, Cx cinereus, Cx decens,* and *Cx annulioris* (Table 2). *Cx quinquefasciatus* was the dominant species forming 76.5 % of the total mosquitoes identified. This was followed by *Ae. aegypti* (15.6%), *Cx cinereus* (7.0%), *Cx decens* (0.8%) and *Cx annulioris* (0.1%). The mosquito species composition differed from one zone to another. All the five mosquito species were found in the water troughs in Pongwe area only. *Cx quinquefasciatus* and *Ae. aegypti* were observed to breed in equal proportions in Raskazone. In Mikanjuni, Nguvumali, and Sahare, the troughs were observed to harbour *Cx quinquefasciatus, Cx cinereus,* and *Ae. aegypti.* In Kange, the water troughs harboured the pre-imaginal stages of *Cx quinquefasciatus, Cx cinereus,* and *Cx decens.* Infested water troughs contained between 22 and

6,063 mosquito larvae per trough, giving a mean larval density of 1,001 per trough.

During the study period 95% of all troughs surveyed contained water. On average the capacity of water troughs ranged between 32.6 and 277.2 litres. Of the troughs with water, 48.9% were dirty and contained either fodder or other plant debris. Six percent of the troughs were found to harbour frog eggs and tadpoles, and no mosquito stages could be found in these troughs.

A total of 149 farmers or cattle keepers were available for a brief interview during the survey. Of these, 94% showed preference for concrete (permanent) water troughs. The rest (6%) had permanent concrete-build troughs, though they preferred to water their animals using buckets. Information on watering habits of the farmers revealed that 14.8%, 22.8% and 46.3% of the farmers replace water in their troughs every day, after two days and after three or more days respectively. However, 24.6%, 44.1% and 43.5% of those who claimed to replace water everyday, after every two days, and after every three days respectively, had their troughs with various pre-imaginal stages of culicine mosquitoes.

Table 1. Number and proportion of mosquito infested troughs in Tanga Municipality

Area	No. of troughs	No. infested	Per cent infested
Mikanjuni	17	3	17.6
Kange	41	8	19.2
Raskazone	29	7	24.1
Sahare	8	3	37.5
Pongwe	51	20	39.2
Nguvumali	27	11	40.7
Total	173	52	30.1

Table 2. Percentage of female mosquitoes as emerged from larvae and pupae in Tanga Municipality

Area	*Cx quinquefasciatus*	*Cx cinereus*	*Cx decens*	*Cx annulioris*	*Ae. aegypti*
Raskazone	51.0	0	0	0	49.0
Mikanjuni	87.6	3.6	0	0	8.8
Sahare	85.1	2.7	0	0	12.2
Pongwe	82.5	13.5	2.9	0.4	0.7
Kange	87.6	10.8	1.6	0	0
Nguvumali	65.2	11.6	0	0	23.2
Total	79.7	9.7	1.2	0.1	9.3

DISCUSSION

The results of our study showed that mosquito breeding differ from one part of the town to another, both in terms of the number of troughs infested and the species composition. It was further found that *Cx quinquefasciatus* was the dominant species in all areas of the Municipality. The overall water trough infestation rate of 30.1% is significant when considering that 95% of the farmers in Tanga have permanent watering troughs. This rate was however, lower than that observed in a nearby town of Muheza (Mboera *et al.*, 1997).

The mosquito species composition observed in cattle troughs in Tanga is similar to that found by Mboera *et al.* (1997) in Muheza. However, *Cx annulioris* observed in Pongwe area has not been reported to breed in cattle water troughs in other areas of north-east Tanzania before. This is the first record of *Cx annulioris* breeding in man-made peridomestic containers in Tanzania. This species has been reported to occur in Dar es Salaam, Tanga, Mombo and Amani where it breeds in pools and slow moving streams with vegetation (Harris, 1942). The presence of *Cx quinquefasciatus, Cx cinereus, Cx decens* and *Ae. aegypti* in the same ecological habitats has also been observed in man-made containers in north-east Tanzania by Mboera (1999).

The interviewed farmers indicated that they were cleaning and replacing water in their cattle troughs every day. However, about quarter of their troughs were found to support breeding of mosquitoes. It is likely that either the farmers were not telling the truth or they were adding water to dirty troughs. It was not surprising to observe mosquito immatures in troughs in which water was replaced every second or third day. It is known that in culicine mosquitoes, particularly *Cx quinquefasciatus,* hatching usually occurs one day after egg-laying. The presence of dirty and grass debris in about half of the surveyed troughs indicates that most of these containers were not frequently cleaned and if at all cleaned, then cleaning was not thorough. Grass fermentation that was observed in some of the troughs is likely to results into grass infusion containing compounds such as 3-methyl indole, that are known to be oviposition attractants for culicine mosquitoes (Mboera, 1999). Fermented grass infusions, for instance, *Cynodon dactylon* (Millar *et al.*, 1992) and *Digitaria* species (Mboera *et al.*, 1999) contain compounds which are known semiochemicals that influence oviposition site selection by *Cx quinquefasciatus* and *Cx cinereus.*

The absence of mosquito immature stages in troughs harbouring frog eggs and tadpoles was remarkable. It is likely that the tadpoles were preying on mosquito larvae and thus preventing their further

development. Further studies on this is important as it might provide future prospects of using frogs as biological control agent for mosquitoes breeding in enclosed structures.

The impact of dairy cattle husbandry on the transmission of mosquito-borne diseases in Tanzania has not been established, but the results of this study have shown that urban cattle farming contribute highly to the overall mosquito density in an area. Already some studies elsewhere have shown that close proximity of humans to livestock, particularly cattle and goats, increases the subject's chances of being bitten by mosquitoes. In Pakistan, for instance, man-biting by *Anopheles stephensi* was observed to rise by 38% in the presence of a cow, and by 50% in the presence of two goats (Hewitt *et al.*, 1994).

Cx quinquefasciatus is the major vector of urban bancroftian filariasis in the world. It is likely that the practice of keeping cattle within family compounds, not only provide extra breeding sites for mosquitoes, but also considerably increases the occupant's chances of being bitten by a range of culicine mosquitoes. In addition, the rearing of many domestic animals may change the environmental conditions and produce habitats suitable for mosquito larvae. It is probably that recommendations that animals be kept outside compounds would be unacceptable by many farmers as security to their livestock is of primary concern. Alternative strategies such as watering cattle using buckets, or frequent cleaning of the troughs may offer a solution to the mosquito breeding problem.

It can be concluded that a high proportion of cattle water troughs in Tanga harbour mosquito pre-imaginal stages and allow mosquito breeding to take place. The breeding of *Cx quinquefasciatus* in these containers add to the already existing man-made structures such as cesspits, soakage pits and pit latrines, which are known breeding sites for this important vector. The presence of *Cx quinquefasciatus* in the peridomestic areas may pose danger of transmitting bancroftian filariasis which is endemic in the study area. *Ae. aegypti* is another mosquito of medical importance. The species transmits yellow fever. An outbreak of the disease has been reported in the neighbouring Kenya recently (Sanders *et al.*, 1998; Reiter *et al.*, 1998). It is important therefore, to consider mosquito production potential of cattle water troughs during planning and implementation of mosquito control programmes in urban areas. The success of any healthy urban farming will depend on close partnership between local authorities, extension workers, urban farmers and health authorities.

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