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Study of Geographical Distribution of Mosquitoes Vector in Lower Shabelle-Somalia

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ABSTRACT

A STUDY for larvae & adult mosquitoes (Diptera: Culicidae) in sentinel sites , was undertaken during the period of 12/February -27 of April 2021 by using larvae collection , and adult collection for indoor collection and outdoor collection by using aspirators, and the following three different species were collected: Aedes. Anopheles. And culex. Anopheles arabiensis &Anophles funestus are main vectors species of malaria diseases.

Malaria vectors were caught indoor by spray sheet collection and aspirators for outdoor and It's purpose was to collect information on the presence or absence of potential vector of *Anophles Arabiensis* habitats .. The resting of *anopheles Arabiensis &Anophles funestus* and the total catch of adult mosquitoes by pyrethrum space spray was also undertaken.

The results showed that 751 larvae were captured in the survey 1st- 2snd and 3-4th instars.. The former captured 369 and the latter 382,the total captured 511 anopheles and 141 were aedes and 99 culex. 68% were collected as anopheles 18,8% were aedes,13.2%culex and adult both spray sheets and Aspirators 1289 mosquitoes . in which anopheles species were 864 .*Anopheles arabiensise(496) indoor(309) and outdoor(187) and anopheles funestu(368)s*indoor(361) and outdoor 7 were the most abundant species, other species collected such aedes 198 and culex 227

These results proposed that a more urgent, systematic and sustained health education program BCG/IEC to raise public awareness and vector control program that uses both biological and chemical control methods adopted to reduce malaria vector .

INTRUDUCTION

The ultimate objective of malaria surveillance is prevention and control of malaria in the community,surveys of immature mosquitoes are important aspects of an effective mosquito surveillance and control program. They are used to determine the location, species and population densities of pest and vector mosquitoes. They are vital for predicting adult emergence and establishing optimal times for application of larval control measures. They are utilized to forecast the need for adult mosquito control, as well as to assess the effectiveness of both chemical and biological control measure.

These surveys summarize in handling of all or some of Anopheles gambiae complex, concentrated on their efficiency transmission and their role as malaria vector. These surveys was carried out to fill the gaps in the knowledge in malaria vector in the study area on resting behavior according to current strategies in vector control and develop recommendation of new approach and strategies to improve current prevention and control strategies. It purposed to answer these questions, Where are malaria vector rest and normally (endophilic or exophilic) ?,potentiality of transmission by measuring malaria cases trend , any changes in resting behavior of vectors and what is new approaches and strategies should be add to improve the current control measures ?

General objective

To monitor the density of malaria vector (adult & larvae) and compare findings with previous surveillance reports and forecast for epidemics if any.

Specific objective

1. To determine the indoor and outdoor resting of *anopheles arabiensis*

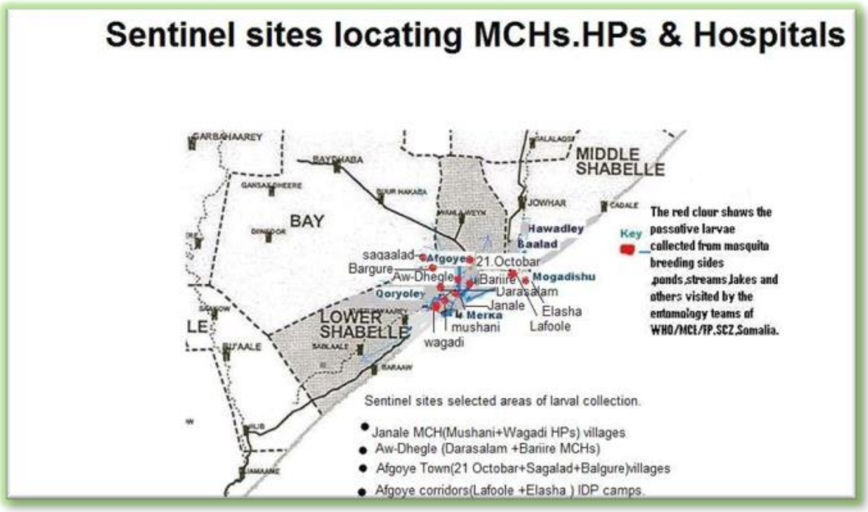
2. To compare the densities of *malaria vector* by geographical areas, to determine protective measures that should be used by the community (scale-up intervention).
3. Monitoring of adult mosquito densities per rooms
4. To describe breeding sites of malaria vector and their habitat types, relative density of larvae, species abundance and calculation breeding index.
5. characterize possible breeding habitats of Anopheles species in the irrigated and non irrigated villages
6. To supervise health facilities which are at Sentinels sites of Entomological surveillance

ACTIVITIES

1. Larvae survey
2. Adult survey by using spray sheet methods
3. Collection of malaria data through health facilities

3. Material and Methods

3.1. The study area



The Study was conducted in four villages of such **JANNALE, MASHSNI ,JAMBALUULOL ,BARIIRE.** The survey areas are chosen based on the presence of abundance of Anopheline mosquitoes, ecological similarities, houses type , livelihood activities , deficiency of spray operation, suspection of malarogenic potentials and vulnerable to influx of source of infection . However, due to poor construction and lack of maintenance, there were leaking canals, causing leakage pools at unwanted places**.**Prior to the survey , permission was sought from the village elders, following which village meetings were conducted to explain the purpose of the survey , and participation requested. Verbal consent from house owners and theircompound heads for permission to collect mosquitoesfrom their houses

STUDY DESIGN

- Cross-sectional study design was conducted in 4 villages with one session survey on each village;. malaria data and entomological were collected and collated. Some mosquito species enter houses at night to bite and rest indoors. Other species do not enter buildings but bite outside and then rest in the following kinds of outdoor locations;
- On vegetation

On solid surfaces in sheltered places, such as the banks of the streams and ditches; culverts; pits

- cracks in stone walls; caves; animal barrows;
- · On the trunks or stems of larger vegetation

- Outdoor collecting is performed in either the natural resting places described above or in shelter specially constructed for this purpose However, spray sheets collection with sample size of 40 rooms) in villages Jannalle, Mushani , jumbulol and Bariire were conducted as recorded in (WHO, 1975). **Collection of mosquitoes indoor of mud houses with roof thatch and mud with iron by spray sheets (SPC)and aspirators.**
- **One session** of sampled dwellings was conducted 10 houses in each village and randomly 10 rooms were selected in every village for one session..**Selection of rooms for spray sheet collection were based on**
- The poorly constructed and inadequately ventilated housesbecause they usually contain the largest numbers of mosquitoes**.** Houses on the fringe of a village or near known breeding sites will often yield more day-resting mosquitoes**.**
- Rooms selected should be those in which one or more persons slept the previous night
- Collections normally carried out in the morning after the occupants of houses have arisen. Permission was taken from householders to make collection in their houses Spray sheet collection involves using a pyrethrum space spray to knock down mosquitoes resting inside mud houses and collecting them on white sheets spread on floor.In case of indoor resting, mosquitoes were collected first with aspirators followed by PSC ,and each house the following information was recorded such animal presences, bed net, the distance from breeding sites,, numbers of occupants, last spray etc..The PSC involved removing all large pieces of furniture inside the room, covering the floor with white bed sheets with sizes (2mxm, 2mx2m and 2mx3m).

Pyrethrum solution in pif=paf was first sprayed from outside of the house onto the eaves, windows, and door before entering the dwelling and followed spraying the entire inside of the house. All doors and windows remained closed for 10 min to allow for mosquito knockdown. Collectors then re-entered the dwelling and used forceps to collect mosquitoes from the sheets and place them insmall Petri dishes and identified morphologically by using hand Len.

The combined number of mosquitoes collected from the PSC and hand collection was calculated to provide a total catch for each dwelling.Despite that there are many factors influencing our methods PSC such number of mosquitoes resting inside of houses are different ,for instance, unfed mosquitoes to be attracted to house in high occupant (haddow, 1942).but, no general arithmetic relationship has been established between catch size and number of occupied

Plate 1. Mud with iron roof

Iron roof mud houses

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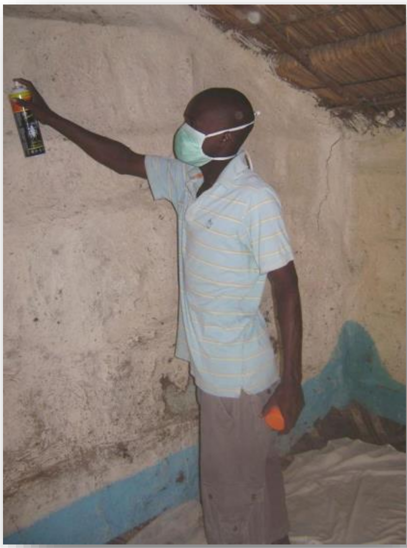

Plate2 Spray sheet processing in jumbulul

Collection of mosquitoes outdoors by using aspirators:

- The common method used to collect mosquitoes resting outside was a sucking tube (Aspirators).Anophline species that normally rest on solid surfaces were collected with the aid of sucking tube and torch, from artificial and natural's shelters .Artificial shelters were pits, barrels or any large container, granaries of stalk, clay pots, and chicken sheds. While, natural resting tackled cracks on walls and tree bases, etc.Data collected from outdoor, artificial and natural shelters, were compiled before being analysed

Plate 3.Collection of mosquitoes in banana trees in BARIIRE outdoors

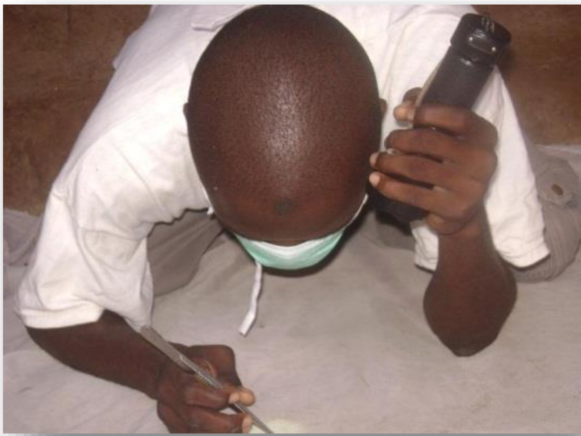

Plate5. Mosquitoes identification

Plate 4. Animal Sheds Collection Outdoors

Mosquitoes processing and morphological identification

The total number of mosquitoes collected were identified according to morphology keyof Gillies and De million (1968), Gillies and coetzee (1987) and separated by examining their gonodotrophic cycle (fed, unfed, gravid, half gravid) based on(WHO protocol 1975)

- Mean values; Fed Anopheles had their abdomen filled with blood meal and appeared reddish; †Half-gravid Anopheles had their abdomen half full of blood meal/eggs, and appeared reddish/whitish; ‡Gravid Anopheles had whitish

Larval survey

larvae survey were conducted in villages of Mushani, Darsalam, Jambulul, jannalle with four surveys . The main microhabitats of larvae were **Barkits, ,wells, canals, pots, water tanks, greganies, ponds and others.**

Mosquito larvae were found in a great variety of habitats. This fact has created a need to develop a number of different sampling techniques to ascertain the presence or absence of immature mosquitoes, and to estimate their numbers (Hatfield et al., 1985). Mosquito larvae were usually found where surface vegetation or debris are present. Dipping was done around floating debris, aquatic and emergent vegetation, logs and tree stumps in the water, and grasses around the margins..

Larval habitats were mapped and larvae sampled longitudinally using standard d**ipping techniques. Larvae were identified to species level morphologically using taxonomic keys**. Physical characteristics of larval habitats, including water depth, turbidity, and presence of floating and emergent vegetation , algae were recorded.

Ten dips were taken from each habitat, especially edges of habitat around vegetation shallow area , water channels and drains or large water storage were taken 60dips /habitat. The presence of larvae at high or low densities was determined by dipping. From every potential breeding site up to 10 dips were taken with a standard 350 ml dipper.

If *Anopheles sp*. could be seen without dipping or nearly every dip contained *Anopheles sp*. larvae, the site was defined as having a high *Anopheles sp*. density. Sites where only one or two dips out of 10 contained *Anopheles sp.* larvae were defined as having a low *Anopheles sp*. density. Sites where no *Anopheles sp*. larvae could be found in ten dips were recorded as empty. Pupae were not recorded as they cannot be differentiated from non-*Anopheles* species in the field.

Plate 6. collection of larvae

p.7 Larvae collection through cements

p.8 Water storage in Jannalle sites

In small habitats where this was not practical, larvae were collected individually using plastic pipettes on a daily basis. Larvae were then transferred from the dipper by pipetting into a white collecting tray with clear water for categorization into different instar stages, followed by counting, morphological identification and recording .The 3rd and 4th instar anophelines were identified morphologically using taxonomic keys of Gillies and De Meillon and Gillies and Coetzee.

Data collection:

The data collected from the four fixed stations using different methods of mosquito collection include pyrethrum spray sheet method to collect adult mosquitoes from inside houses. The outdoors collection was carried out by a surveys to collect mosquitoes that resting out doors (aspirators) . All potentials resting places were inspected by high skill trainees personnel. and pyrethrum spray sheet collection methods and mosquitoes nets were adopted where they were practicable and larvae methods.

Data analysis

Statistical analyses were done using SPSS software (Version 15.0 for windows, SPSS Inc., Chicago, IL). One-way Analysis of Variance (ANOVA) was used to compare the differences in larval abundance between sites. Where significant differences were observed, the means were separated by Tukey test. Pearson correlation was used to determine the association between Anopheles larval density and adult densities. The relative abundance of Anopheles was calculated as the number of larvae divided by the number of dips taken from each larval habitat, and then expressed as density per 10 dips. The dependent variable (relative abundance of Anopheles larvae) was square roots x+0.5 to stabilize the variance and improve normality of distribution.. Analysis of variance (ANOVA) was used to test difference between means of different four villages followed by Tukey, Post Hoc to separate between means.

Result:

Larval Abundance; Overall, **751 larvae** were captured in four survey 1^{st} - 2nd and 3-4^{th} instars.. The former captured **369** and the latter **382**.the total captured **511 anopheles** and **141** were aedes and 99 **culex. 68%** were collected as anopheles **18,8%** were aedes,**13.2%culex**

Tab 1. Relative abundance of anopheles larvae(3^{rd} and 4^{th} instars) in the four villages data transformed by square root of x+0.5

JANNALLE	MUSHANI	BARIIRE	JUMBALUUL
5.5	**3.9**	**7.6**	**5.9**
3.7	**2.7**	**2,9**	**5.7**
6	**4.4**	**3.7**	**4.7**
5.5	**4.9**	**5.8**	**4.4**
2.5	2.7	4	4.9

Analyzed by **ANOVA**-one way **f=1.004 df=3 p= 0.4**16 no different larvae distribution among villages.

Breeding habitat	Number of breeding habitats	No. of Anopheles larvae	Density (no./10 dips)
Barkites	45	176	17,6
well	14	47	4.7
Ponds	14	51	5,1
W./tanks	56	123	12.3
Others	74	114	11.4
Total	203	511	10.22/dip

Tab 2. Density of Anopheline Larvae Collected from Different Types of Breeding Sites such jannale ,Bariire ,jambaluul and mushani

The total anopheline larvae collected were identified to species by morphological criteria. the main vector species, *An. Arabiensis* , *An.funestus* were found to breed in at least five habitat types (tab 2) illustrate the relative importance of BARKITS 176 , water tanks 123 larvae (**greganies,cements , pots etc),ponds,, Barkits**as important breeding sites for malaria vectors in the sentinel sites the total number of breeding sites were 203 breeding sites ,. In all villages, larval breeding were found in at least five different habitats :**Barkites, wells, ponds water tanks , and others**And larvae productivity highest in Bariire,Jannale , Jumbaluul**.** Shows the distribution of the various species identified among the different breeding sites. These data show the diversity and significance of different breeding habitats for malaria vectors, which is an important step in planning larval control interventions. Further analysis to determine the factors responsible for the variation in larval densities will be necessary future study

2.Anopheles species composition and distribution among the habitats types

Species composition of larvae among villages . overall number of *an. Arabiensis* larvae (311 and AN. funestus larvae 200 .the former 60.9% and latter 39.1% . Data were collected on a range of factors that would affect the production of larvae and therefore explain variability in densities of larvae.

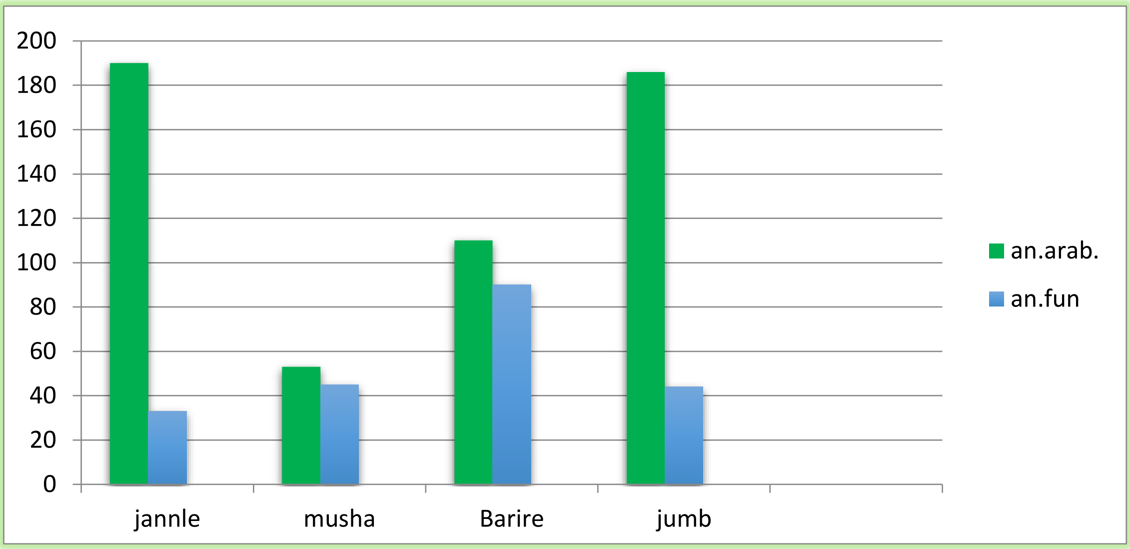

Fig1. Distribution of anopheles larvae among villages

The density of Anopheles species larvae was higher in the irrigated villages than the non-irrigated village throughout the period of the survey.

B.Abundance of adult anophelines;

The survey was collected a total 1289 mosquitoes . in which anopheles species were 864 .*Anopheles arabiensise(496) indoor(309) and outdoor(187) and anopheles funestu(368)*sindoor(361) and outdoor 7were the most abundant species, other species collected such aedes 198 and culex 227. *Anopheles arabiensis* were more predominant species in all four villages .indoor of mud houses with roof thatch (208) outdoor (89)were more collected in respect of mud with iron roof(101).and outdoor(98)while *Anopheles funestus* mud with thatch indoor(241) outdoor(0)and mud with iron indoor(120) ,outdoor(0)

Tendency of exophly and endophyl

Anopheles arabiensis and Anophles funestus in villages have been calculated by indoor and outdoor,thus, the result have shown that *Anopheles arabiensis* have higher endophly tendency(**62%**) and **37,7%** exophylic tendency,. meanwhile, .*Anophles funestus* **98%** endophylic ,higher than *Anopheles arabiensis*, but , very low exophylic tendency.**0.02%.**

Comparison of the indoor and outdoor resting behaviour of Anopheles arabiensis and *anopheles funestus*in mud with thatch and mud with iron roof:

The four sentil sites of entomological study areas were denoted that indoor of mud houses with thatch roofs have a high density of *Anopheles arabiensis* and anopheles funestus population resting inside, in contrast to indoor mud with iron roof houses observed lower densities of *Anopheles arabiensis **and anopheles funestus***

The difference was statistically significant within villages; such mud with thatch roof and mud with iron houses within four villages **f=4 df-7 p=0.000**

Fig 2. Distribution of anopheles arabiensis in mud thatch and mud with roof iron

Tab 3. Density of adult Anopheles in defferent villages

villages	Mud with thatch in roof density/room	Mud with iron roof Density/room	
jannalle	30.8	21.6	
Mushani	24.6	13.2	
Bariire	26.8	11.4	
jambulul	27.8	21	
	27.5	13.9	Density=22.15/room

Effects of animal's distribution on mosquito's collection compared to indoor and outdoor collection

The result of animal distribution in four areas has shown strong association in distribution of *Anopheles arabiensis resting behaviour of* outdoor and indoor. For instance, in jannalle 101 animals distribution of outdoor 66 anophles arabiensis both houses

In **Bariire** NO animals were 24 in which outdoor collection 18 in village Mushani the distribution of animals were 74 in which and *Anopheles arabiensis* 51 while jumbulul the distribution of animal were 80 with collection of *Anopheles arabiensis* is 56 ,

These result show that the distribution of *Anopheles arabiensis* in outdoor is highly influence the distribution of animal.

Tab 4. Sentinel and Vector Density in Malaria Cases

Sentinel sites	Date	Larval density	Adult density	Malaria cases	Interpretation/remark
jannale		**13.7**	**26.2**	**95**	**High vector density and malaria cases**
Jumbulul		**14.2**	**24.4**	**443**	**More high malaria cases as well as vector density**
BARIIRE		**16.7**	**19.1**	**506**	**The highest malaria cases as well vector density**
MUSHANI		**6.5**	**18.9**	**635**	**The highest malaria cases than four villages**

Malaria cases in sentinel sites`

Data from health facilities are potentially useful for monitoring time trends in the number of malaria cases and deaths but have severe limitations most cases of malaria are diagnosed on the basis of clinical symptoms or RDT, rather than based on laboratory confirmation. Despite most villages with high density of larvae and adult mosquitoes are high .

Tab.5 Malaria cases in months of October, November, DEC 2011

villages	October 2011		NOV.		DEC	
	malaria cases		Malaria cases		malaria cases	
	.<5	>5	<5	>5	<5	>5
Jambaluul	33	28	86	102	62	132
Mushani	32	15	34	102	182	270
Bariire	7	26	69	198	53	153
jannalle	3	13	3	22	10	69
total	75	82	192	424	307	624

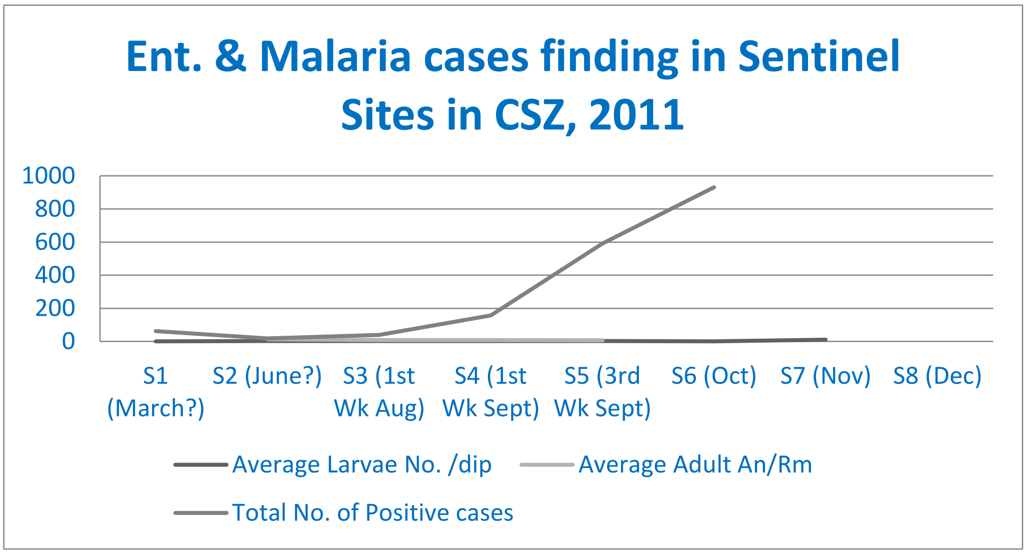

Fig 3, Malaria cases Trend

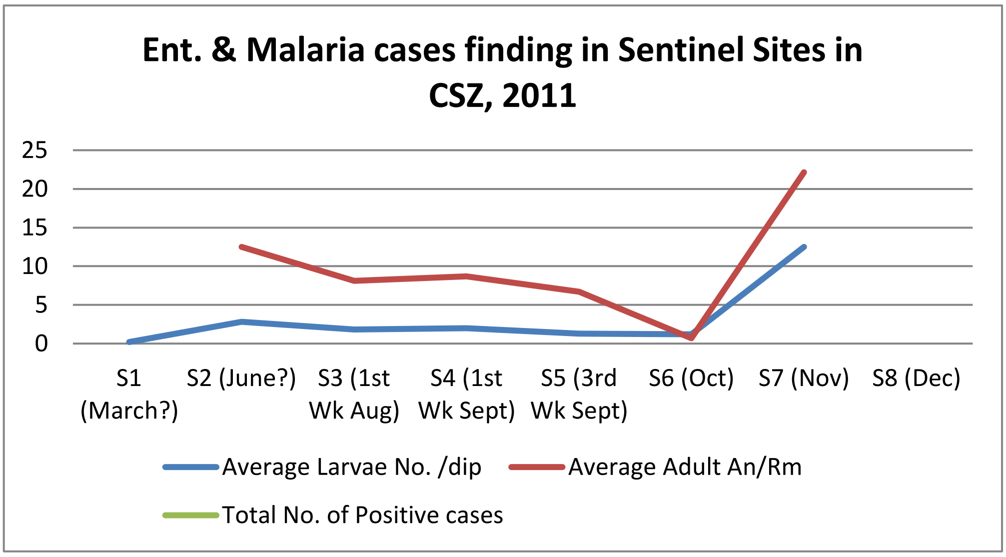

Fig4. Larvae and adult density trend in surveys

Discussion

The adult *An. arabiensis* and *ano. Funstus* were collected from indoor and outdoor, Population density per room accounted during the period throughout the survey in the entomological four sentinel sites showed seasonal variations and fluctuation..Thus, the persistence of rainful in the last three months result tremendously increase both larvae and adult density Producing many potentials breeding sites. Both males and females were more abundant incollections towards the end of the season., concurrent with a humidity increase Our study showed that *An. Arabiensis* and *Anoph. funestus* clearly preferred thatched to mud walls as a resting surface in respect of mud with iron roof these finding suggest that suitability of temperature, and relative humidity. A similar finding was observed from central Ethiopia(**Ameneshewa,B;, Service, M.W.(1996)**. ; This may explain why more mosquitoes were caught in mud houses with thatched roof than mud with iron roof ,overall housing construction is strongly connected to socioeconomic status, and fewer anopheline mosquitoes could be expected to be found indoors when poverty is reduced and houses improved, but this, of course, is a long-term strategy.

The findings here may be influenced by a bias in the spray sheet collections: Anopheline species that bite indoors but rest outdoors would not have been captured with the methods that were used. This could especially have influenced the collections of *An. arabiensis* and *An. funestus* but would still be of limited importance when compared with the overall collection of . *Malaria vectors.* Both the entomologic and epidemiologic studies in the area support a malaria control strategy for the malarious arid zone of SCZ focusing on residential areas with special attention given to areas with the poorest type of house construction, such as refugee settlements, poor rural communities, and seasonal migrant settlements.. The findings of this study indicate that families living in houses with the poorest construction and close to the vector breeding sites should be the primary target for the provision of bed nets. The effect of animal distribution among sentinel villages shows a great assosicaition between animal distribution and exophlicity of *anopheles arabiensis* which has behavior of zoophilic.

The coverage of Bed net distributions were shown below the requirement but a close association has been observed between people´s perception of the cause of malaria and the type of protective measure used. The level of household income has been found to directly influence the purchase and prolonged use of bednets.

The density of Anopheles spp show that there are a great diversity in villages. However a much greater diversity in anophline species are present in Jannale ,Mushani . And Jumbalulu ,Bariire ,these can attributed to the diversity of ecological factors. These arise from suitable breeding habitats of the anopheline species that contribute to the transmission of malaria. In sentinel sites , *Anopheles arabiensis* is considered to be the major malaria vector. Knowledge of the influence of habitat factors on larval production would be critical for understanding the spatial and temporal distribution patterns of the anopheline species. The present survey was conducted to determine the spatial and temporal distribution of anopheline species in relation to habitat diversity.The presence of different environmental factors are typically associated with the presence of different *Anopheles* species (Bogh et al. 2003; Fillinger et al. 2004;Minakawa et al. 2004). However, these phenomena may also occur due to the effects of different vegetation types on local water temperatures (Haddow 1943).The most important malaria vector in SCZ are arabiensis, will readily rest in the dwellings of rural villages (Service and Townson 2002). A common method for sampling populations of these resting mosquitoes is a search of a dwelling by a trained technician using SPC (Service 1993, WHO 1992)..

An. Arabiensis and anopheles funestus were prevailed in some localities in irrigated, as expected (White 1974, Lindsay et al. 1998, Coetzee et al. 2000.The observations above are in agreement with those of Coluzzi et al. (1979), who collected indoor-resting females..

epidemiological studies of mild morbidity frequently use fever ,

. These events are either detected through cross-sectional surveys (Gazin *et al.* 1988), Active surveillance relies on the attribution of a febrile event to the associated parasitaemia (Snow *et al*., 1999). Health Facilities for investigation of suspected cases by microscopy are rarely, mostly use RDT method, others they lack; both microscopy and RDT. The malaria cases increases with increase of vector density of (larvae ,adult)and malaria cases in survey done **24-27/12/2011.** show extremely high as shown tab5, due to an abrupt rise in *Anopheles* density due to abnormally heavy rains, and/or increased survival of the mosquitos due to prolonged warm and humid weather; Increased rainfall specially rainy days result in mosquitogenic conditions. Pre-monsoon rains, which maintain temperatures between 25-30 C and relative humidity around 80% for longer duration, lead to increase vector density and longevity to initiate malaria transmission, if parasite load exists in the community. . The incidence of malaria in sentinel sites has risen steadily and steeply over the past three months. The total number of cases reported during the three months of 2011 was over 1704 cases in which under five , 888 cases and 816 cases were over five representing an increase of tremendously compared with the previous surveillance. The sharp increase in malaria incidence could have potentially severe consequences not only for public health but also economic development in SomalI. (see tab 5) cases ,

Conclusion and recommendation

1.The vector density indices suggest that human populations in mushani ,jannalle,Bariire, janbaluul are more predisposed to malaria vector bites; hence there is a greater risk of malaria in these zones. This finding accentuates the need for greater focus in terms of vector control efforts in these villages .

2._Regular monitoring of species densities and composition is needed to continually assess any surges in the size of adult populations of the main vectorial system.

3.. Strengthening of vector surveillance mechanisms through sentinel sites would address the prediction of epidemic. The choice of sentinel sites should be based representative ecological strata.

4._ Vector control measures should focus where the large number of captured females of *A. arabiensis and An.funestus* from bedroomsindicates their anthropophagic behavior. are of epidemiological importance in thedynamics of mosquito-borne pathogens responsible for the continuedtransmission of malaria in the sentinel malaria .

5.Further investigation is needed to study Impact of irrigation schemes on abundance of breeding sites, mosquito densities and malaria transmission.

6.awareness raising to community participation in environmental

management and encourage the use of local larvious fish especially breeding of Barkits and big water tanks in many areas of urban.

7. The present survey demonstrates the diversity of breeding habitats and their relative significance for Anopheles larval production. The breeding sites could be ranked according to larval presence and abundance. This provides a basis for consistent monitoring and targeting of specific breeding sites by use of appropriate larval control strategies on a temporal basis .

8.Prompt and accurate parasitological confirmation of malaria is essential for effective disease management and malaria surveillance with diagnostic tools - microscopy and rapid diagnostic tests unfortunately some sentinel sites they luck both diagnostic tool and focus only clinical features I recommend if possible the supply RDT TESTs.

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