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Bancroftian filariasis: patterns of vector abundance and transmission in two East African communities with different levels of endemicity

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Intensive monitoring of *Wuchereria bancrofti* vector abundance and transmission intensity was carried out in two communities, one with high-level endemicity for bancroftian filariasis (Masaika, Tanzania) and the other with low-level (Kingwede, Kenya), on the East African coast. Mosquitoes were collected in light traps, from 50 randomly selected households in each community, once weekly for 1 year. They were identified, dissected and checked for parity and filarial larvae. *Anopheles gambiae* s.l., *An. funestus* and *Culex quinquefasciatus* transmitted *W. bancrofti* in the two communities but the importance of each of these taxa differed between the communities and by season. The overall vector densities and transmission intensities were significantly higher in Masaika than in Kingwede (the annual biting rate by 3.7 times and the annual transmission potential by 14.6 times), primarily because of differences in the available breeding sites for the vectors and in the vectorial capacity of the predominant vector species. A marked seasonal variation in vector abundance and transmission potential contributed to the complex transmission pattern in the communities. Generally, these indices were higher during and shortly after the rainy seasons than at other times of the year. Considerable differences in *W. bancrofti* transmission were thus observed between communities within a relatively small geographical area (mainly because of environmentally-determined differences in vector habitats), and these were reflected in the marked differences in infection level in the human populations. The variation in vector abundance, vector composition and transmission intensity in the two communities is discussed in respect to its cause, its effects, and its significance to those attempting to control bancroftian filariasis.

The East African coast and its nearby islands have long been known to be endemic for bancroftian filariasis. The prevalences of the disease and of human infection with the causative parasite, *Wuchereria bancrofti*, differ considerably, however, from one place to another (White, 1971; Wijers, 1977; McMahon *et al.*, 1981; Meyrowitsch *et al.*, 1995; Simonsen *et al.*, 1995; Wamae *et al.*, 1998; Pedersen *et al.*, 1999), probably primarily because of geographical variation in transmission characteristics. Knowledge

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about the transmission pattern, and about the causes for its variation, is a prerequisite for understanding the geographical distribution of bancroftian filariasis and for effectively controlling this disabling disease.

The vectors transmitting *W. bancrofti* on the coast of East Africa are *Anopheles gambiae* s.l., *An. funestus* and *Culex quinquefasciatus* (White, 1971; Wijers and Kiilu, 1977; McMahon *et al.*, 1981; Mwandawiro *et al.*, 1997; Bøgh *et al.*, 1998; Pedersen *et al.*, 1999). The contribution made by each of these taxa to the overall transmission varies from place to place. Nelson *et al.* (1962) suggested that this variation reflected varying climatic and environmental conditions, such as rainfall, temperature, soil drainage, the occurrence of (and proximity to) permanent or temporal water-bodies, and the presence of wet pit latrines and/or soakage pits. The different environmental requirements of the mosquito taxa involved in transmission also mean that the abundance and involvement in transmission of each taxon may follow seasonal patterns.

The aims of the present study were to determine and compare vector abundance and transmission of *W. bancrofti* in two communities on the East African coastal belt, one of which had high-level endemicity for bancroftian filariasis and the other a much lower level. Overall community microfilarial prevalences (of 24.9% in the community that was highly endemic and 2.7% in the other) were used as indirect indicators of community transmission and the initial criteria for selecting the communities (Simonsen *et al.*, 2002). The overall and seasonal, inter-community variations in vector abundance and transmission were evaluated and analysed, in an attempt to understand the marked differences in endemicity that can be observed between communities located close to each other. The spatial variation of vector abundance and transmission intensity within the same communities will be documented and analysed in subsequent articles.

MATERIALS AND METHODS

Study Area and Study Population

The study was conducted in two villages located 80 km apart: Masaika, in the Pangani district of Tanga region, Tanzania, and Kingwede, in the Kwale district of the Kenyan Coast province. The villages lie 25 km (Masaika) or 3 km (Kingwede) from the Indian Ocean and experience two rainy seasons each year: the ‘long rains’ in March–June and the ‘short rains’ in October–November. The only filarial parasite transmitted to humans in the villages is *W. bancrofti*. The results of cross-sectional surveys, carried out when the present study began, showed that the overall prevalences of microfilaraemia and circulating filarial antigenaemia were 25% and 52% in Masaika and 3% and 17% in Kingwede, respectively (Simonsen *et al.*, 2002).

Masaika is located in a hilly fertile area. Most of its inhabitants live in mud-walled houses thatched with dried coconut leaves. Domestic water is obtained from shallow wells dug in the lower parts of the village. The main occupation is subsistence farming. Ethnically, the population is very mixed, with more than 20 tribes represented, but the Makonde, Bondei and Zigua predominate, together constituting 54% of the population. The village had approximately 1000 inhabitants at the time of the present study.

Kingwede is located in a flat lowland area and most of its inhabitants live in houses built from coral stone and/or mud, with roofs of dried coconut leaves or iron sheets. Most domestic water comes from deep wells and a seasonal stream that passes close to the village. The main occupation is subsistence farming but many of the males are also employed in jobs outside the village, and some are fishermen in the nearby ocean. The major ethnic group is Digo (>80% of the population). The village had >2000 inhabitants at the time of the present study. To give similar numbers of subjects from the two study communities, only the western half of Kingwede and its village centre were included in the present study.

Mosquito Collection, Identification and Dissection

A census revealed 296 households in Masaika and 180 in the western half and centre of Kingwede. The households recorded in each village were divided into 50 groups of nearly equal size and then one household was randomly selected from each group. If the selected household only had one inhabitant it was de-selected and the nearest household to it that held at least two inhabitants was selected instead. Beginning in July 1998, mosquitoes were collected from each of the 100 selected households once weekly for 12 months, using one CDC light trap/household (Service, 1993). Each individual sleeping in a room with a light trap was given a 2-mm-mesh polyester unimpregnated bednet measuring $1 \times 2.5 \times 2$ m. In each study household, a light trap was placed beside one of the occupied bednets. On a collection night, each light trap was turned on (by a trained member of the household) at 18.00 hours and turned off, after the collecting bag had been bound with string, at 06.00 hours the following morning. Ten houses in each village were sampled each weekday night. Mosquitoes from each light trap were transferred to a labelled paper cup that was covered with netting material and held a cotton pad soaked in 10% glucose. The cups were then placed in a cool box for transportation to the laboratory.

In the laboratory, the mosquitoes were anaesthetized with ethyl acetate, sorted and identified by morphology. All live females were dissected and examined for the first-stage (L_1), second-stage (L_2) and human-infective, third-stage larvae (L_3) of *W. bancrofti* (McMahon *et al.*, 1981) within 24 h of their collection. All the larva-positive slides and 20% of the negative slides were stained in Mayer's acid haemalum at 50°C for 10 min and re-examined, for quality control. The female mosquitoes were scored as parous or nulliparous, after examination of the tracheoles of their ovaries (Detinova, 1962).

To obtain qualitative information about the main breeding sites for the different vector species, water bodies within and around the two study communities were searched for mosquito larvae, using dippers. The larvae collected were identified by morphology. The presence of water and breeding in each pit latrine encountered was checked by dropping a stone into the pit (Maxwell *et al.*, 1990).

Meteorological Data

Rainfall and temperature data for Masaika were obtained from the Mlingano Agricultural Research Institute's weather station, located 15 km from the village. For Kingwede, rainfall data were obtained from Msambweni Hospital, located 3 km from the village.

Data Analysis

Biting rates and transmission potentials were calculated using the formulae given, for onchocerciasis, by Walsh *et al.* (1978). The formulae were adjusted for light-trap catches by assuming that the catch from one light trap was equals to two-thirds of the catch that would be made by one person acting as bait, in human-landing collections (Lines *et al.*, 1991). The monthly biting rate (MBR) was calculated as: (total catch × days in month × 3)/(number of catching nights × number of light traps × 2). The monthly transmission potential (MTP) was calculated as: (MBR × total number of L_3 seen in the dissections)/(number of mosquitoes dissected). The corresponding annual indices, namely the annual biting rate (ABR) and the annual transmission potential (ATP), were calculated by summing up the corresponding monthly indices for the year. In statistical tests, a *P*-value of <0.05 was considered indicative of a statistically significant difference.

RESULTS

Overall Vector Abundance

Between July 1998 and June 1999, 26,264 and 7372 female mosquitoes were collected in 2359 and 2497 catches in Masaika and Kingwede villages, respectively (Table 1). The mean number of mosquitoes/catch was thus 11.13 in Masaika and 2.95 in Kingwede. *Anopheles gambiae* s.l. was the most abundant potential vector in Masaika followed by *Cx. quinquefasciatus* and *An. funestus*. In Kingwede, *Cx. quinquefasciatus* was most abundant, followed by *An. funestus* and *An. gambiae* s.l. The mean number of potential mosquito vectors caught/collection-night was significantly higher in Masaika than in Kingwede (Table 2). The mean numbers of *An. gambiae* s.l. and *An. funestus* caught/night were also significantly higher in Masaika than in Kingwede, whereas this was not the case for *Cx. quinquefasciatus*.

Overall Vector Infection and Infectivity

Overall, 17,608 mosquitoes from Masaika and 6328 from Kingwede were dissected and examined for filarial larvae. In Masaika, 398 (2.26%) were found infected with the L_1, L_2 and/or L_3 of *W. bancrofti*, and 128 (0.73%) were found to be harbouring (a total of 260) L_3 (Table 1). In Kingwede, 33 (0.52%) of the dissected mosquitoes were found infected and 12 (0.19%) were found infective (with a total of 25 L_3). As seen in Table 2, the prevalences of infection and infectivity, for all the potential vectors combined, were significantly higher in Masaika than in Kingwede. The prevalences of infection and infectivity in the *Cx. quinquefasciatus* and *An. funestus* and the prevalence of infection (but not that of infectivity) in the *An. gambiae* s.l. were also each significantly higher in Masaika than in Kingwede.

Overall Vector Parity

Of the mosquitoes dissected and checked for larvae, 13,811 of those from Masaika and 5949 of those from Kingwede were also examined for parity (Table 1). In Masaika, the parity 'rate' for the potential vectors combined was 72.4%, with *An. gambiae* s.l. (81.5%) and *An. funestus* (80.6%) having much higher 'rates' than *Cx. quinquefasciatus* (46.0%). In Kingwede, the overall parity 'rate' for the potential vectors was 77.1%, with *An. funestus* having a slightly higher 'rate' (85.6%) than *An. gambiae* s.l. (80.0%) or *Cx. quinquefasciatus* (71.8%). Parity 'rates' for all the potential vectors combined, for *An. funestus* and for *Cx. quinquefasciatus* (but not for *An. gambiae* s.l.) were significantly higher in Kingwede than in Masaika ($P<0.05$; Table 2).

Overall Entomological Indices of Abundance and Transmission

The overall ABR, for the three taxa of potential vectors combined, were 6166 and 1659 bites/person-year in Masaika and Kingwede, respectively (Table 1). In Masaika, the majority of bites were from *An. gambiae* s.l. (49.7%) followed by *Cx. quinquefasciatus* (30.5%) and *An. funestus* (19.8%). In Kingwede, however, *Cx. quinquefasciatus* provided most of the bites (55.6%), followed by *An. funestus* (32.8%) and *An. gambiae* s.l. (11.7%).

The overall ATP, for the three taxa of potential vectors combined, were 92.91 and 6.38 infective larvae/person-year in Masaika and Kingwede, respectively. *Anopheles gambiae* s.l. contributed more than half (59.4%) of the ATP in Masaika, followed by *An. funestus* (23.2%) and *Cx. quinquefasciatus* (17.4%). In Kingwede, however, *An. funestus* contributed 46.7% of the ATP, *Cx. quinquefasciatus* 41.2%, and *An. gambiae* s.l. just 12.1%. The proportional distributions of the ABR and ATP among the three taxa and two study villages are shown in Figure 1.

Seasonal Variation in Rainfall and Temperature

The Masaika area had two major periods of rainfall between January 1998 and June

TABLE 1. *The numbers of potential vectors (*Anopheles gambiae *s.l.,* An. funestus *and* Culex quinquefasciatus*) caught, the numbers dissected, and the transmission indices for* Wuchereria bancrofti *in Masaika and Kingwede, between July 1998 and June 1999*

	Masaika				Kingwede			
	Total	*An. gambiae* s.l.	*An. funestus*	*Cx. quinquefasciatus*	Total	*An. gambiae* s.l.	*An. funestus*	*Cx. quinquefasciatus*
NO. OF MOSQUITOES								
Caught								
Total	26,264	12,859	5376	8029	7372	884	2371	4117
Mean/catch	11.13	5.45	2.28	3.4	2.95	0.35	0.95	1.65
Dissected	17,608	9329	2701	5578	6328	781	1981	3566
For which parity was determined	13,811	8156	2154	3501	5949	771	1801	3377
Found parous	9993(72.4%)	6645(81.5%)	1737 (80.6%)	1611 (46.0%)	4585 (77.1%)	617 (80.0%)	1542 (85.6%)	2426 (71.8%)
Found infected	398(2.26%)	230(2.47%)	81 (3.00%)	87 (1.56%)	33 (0.52%)	6 (0.77%)	11 (0.56%)	16 (0.45%)
Found infective	128(0.73%)	77(0.83%)	33 (1.22%)	18 (0.32%)	12 (0.19%)	2 (0.26%)	8 (0.40%)	2 (0.06%)
No. of third-stage larvae (L_3) of *W. bancrofti* detected	260	163	48	49	25	3	10	12
Annual biting rate (bites/person-year)	6166.2	3062.7	1223.3	1880.2	1658.5	193.4	543.7	921.4
Annual transmission potential (no. of L_3/person-year)	92.91	55.22	21.56	16.13	6.38	0.77	2.98	2.63

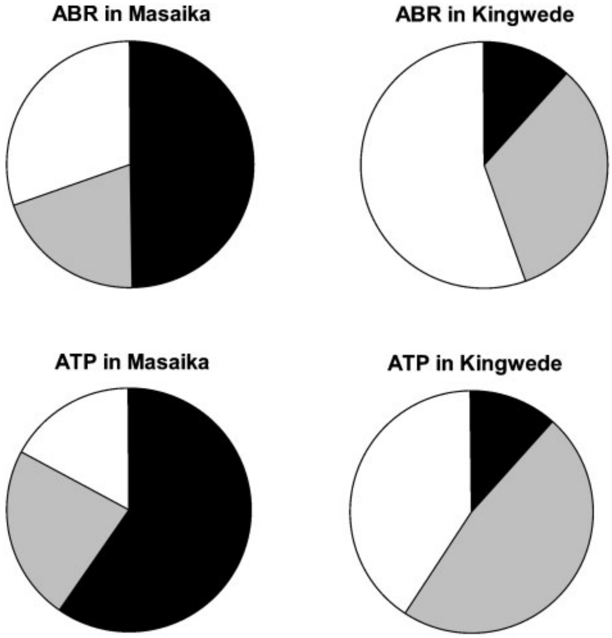

FIG. 1. The proportional distributions of annual biting rates (ABR) and annual transmission potentials (ATP) for the potential vectors — *Anopheles gambiae* s.l. (■), *An. funestus* (■) and *Culex quinquefasciatus* (□) — in Masaika and Kingwede.

TABLE 2. *Inter-community comparisons of the populations of potential vector mosquitoes and their infections with* Wuchereria bancrofti *between July 1998 and June 1999*

	Masaika	Kingwede	*P*
MEAN NO. MOSQUITOES/CATCH			
All potential vectors	11.13	2.95	<0.001*
Anopheles gambiae s.l.	5.45	0.35	<0.001*
An. funestus	2.28	0.95	<0.001*
Culex quinquefasciatus	3.40	1.65	0.911*
PREVALENCE OF INFECTION (%)			
All potential vectors	2.26	0.52	<0.001
An. gambiae s.l.	2.47	0.77	0.003
An. funestus	3.00	0.56	<0.001
Cx. quinquefasciatus	1.56	0.45	<0.001
PREVALENCE OF INFECTIVITY (%)			
All potential vectors	0.73	0.19	<0.001
An. gambiae s.l.	0.83	0.26	0.083
An. funestus	1.22	0.40	0.003
Cx. quinquefasciatus	0.32	0.06	0.008
PARITY (% of those investigated found parous)			
All potential vectors	72.4	77.1	<0.001
An. gambiae s.l.	81.5	80.0	0.324
An. funestus	80.6	85.6	<0.001
Cx. quinquefasciatus	46.0	71.8	<0.001

*From Mann–Whitney tests (the other *P*-values shown are from χ^2 tests).

1999 [Fig. 2(a)]. The amount of rain in these two 'rainy seasons' differed markedly, with 1248 mm falling in the first (over a period of 6 months) and 591 mm in the second (over a period of 4 months). The Kingwede area also had two 'rainy seasons' during the same period [Fig. 3(a)] but there the rains had not ceased by June 1999, and the rainfall in the second rains was not markedly lower than that in the first. Temperatures vary only a little from place to place in this East African coastal area, and the temperatures recorded at Mlingano can be taken as representative for both Masaika and Kingwede. As seen in Figure 2(a), the variation in mean monthly temperature was minor during the study period.

Seasonal Variation in Monthly Biting Rate

The overall MBR, for the three taxa of potential vectors and two study villages combined, showed a seasonal pattern closely associated with the rainfall. In Masaika [Fig. 2(b)], the highest MBR for *An. gambiae* s.l. occurred during the long rains of March–June 1999, whereas the higher MBR for *Cx. quinquefasciatus* occurred during July–September 1998 and May–June 1999, coinciding with the late part of each rainy season and the few weeks following. Although *An. funestus* had rather uniform MBR throughout most of the study period, there was a small peak in the rate for this species in July–August 1998, after the long rains. In Kingwede [Fig. 3(b)], the MBR for *Cx. quinquefasciatus* were slightly higher than average in July–August 1998 (late rainy season) and in December 1998 (dry season). The *An. funestus* of Kingwede also had higher-than-average MBR in July–August 1998 whereas the MBR for *An. gambiae* s.l. were lowest during the dry season and slightly elevated during the rainy season in 1999.

Seasonal Variation in Monthly Transmission Potential

Like the MBR, the MTP (for the three taxa of potential vectors combined) also varied seasonally within each village, and were higher in Masaika than in Kingwede.

In Masaika [Fig. 2(c)], transmission took place throughout the year. An initially high level of transmission, to which all three taxa of potential vectors contributed, was seen from July–September 1998 (shortly after a rainy season). Low-level transmission was maintained, mainly by *An. funestus*, from October 1998 to January 1999 (dry season) but transmission was intense from February–June 1999 (rainy season), with *An. gambiae* s.l. then being by far the most important vector. At the end of the study period, in June 1999 (end of rainy season), all three taxa of potential vectors were again contributing to transmission.

In Kingwede [Fig. 3(c)], transmission was concentrated between the July and September of 1998 (end of rainy season) and between the April and June of 1999 (rainy season). Although only *An. funestus* contributed to the transmission in the first of these periods, only *An. gambiae* s.l. and *Cx. quinquefasciatus* transmitted in the second period. Between October 1998 and March 1999 (dry season) there was virtually no transmission in Kingwede.

Mosquito Breeding

The domination of *An. gambiae* s.l. in Masaika appeared to have its basis in the small and wide-spread temporal puddles created during the rainy season, especially in the valleys and lower parts of the hilly environment. *Anopheles funestus* favoured more shaded and permanent breeding sites, such as shallow dug-out wells shaded by banana plants, rice fields, and puddles created by the seasonal stream. Most *Cx. quinquefasciatus* in Masaika bred in pit latrines, especially in the lower parts of the village, where many latrines were wet during the rainy season. In Kingwede, the flat landscape and sandy soil with coral outcrops limited the breeding of *An. gambiae* s.l., as the puddles that did form were shallow and drained or evaporated away too quickly to

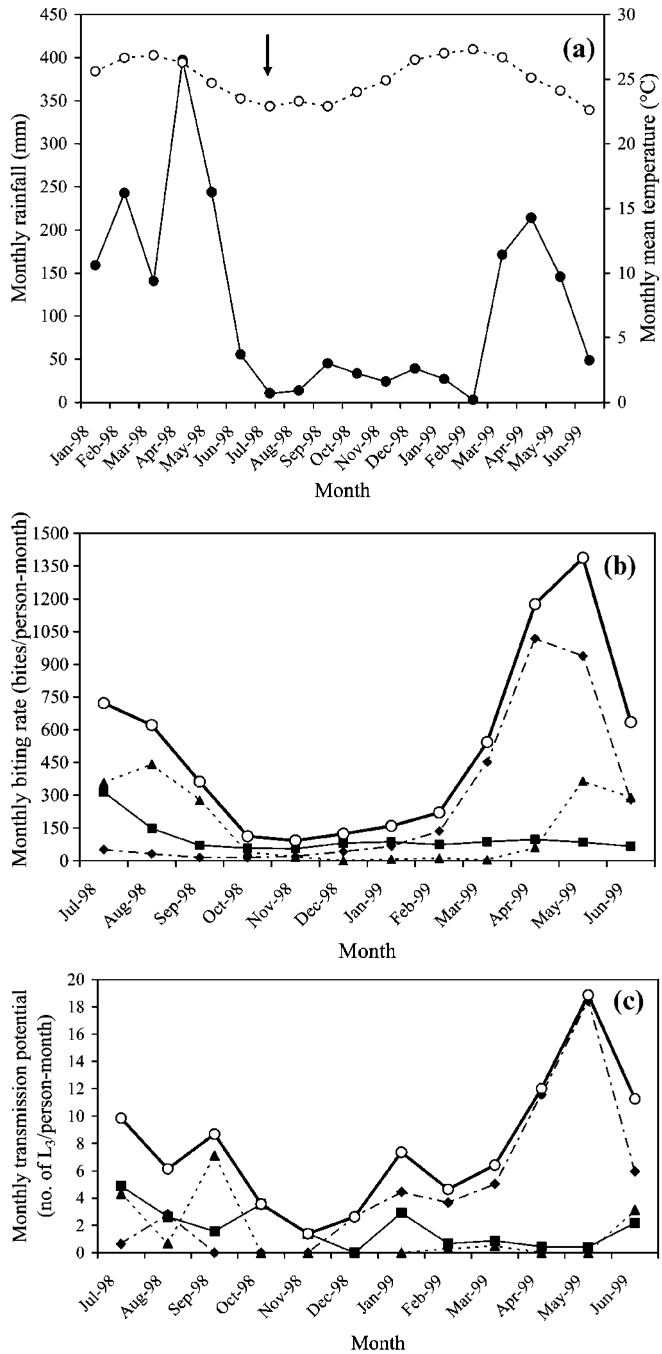

FIG. 2. The seasonal variation seen in climate, the numbers of potential vectors biting, and transmission of *Wuchereria bancrofti*, in Masaika. On the plot (a) of monthly rainfall (●) and mean temperature (○), as measured at Mlingano weather station near Masaika, the arrow indicates the time mosquito sampling began. Monthly biting rates (b) and monthly transmission potentials (c) are shown separately for *Anopheles gambiae* s.l. (◆), *An. funestus* (■), and *Culex quinquefasciatus* (▲), and also for all three of these taxa combined (○). L_3, Human-infective, third-stage larvae of *W. bancrofti*.

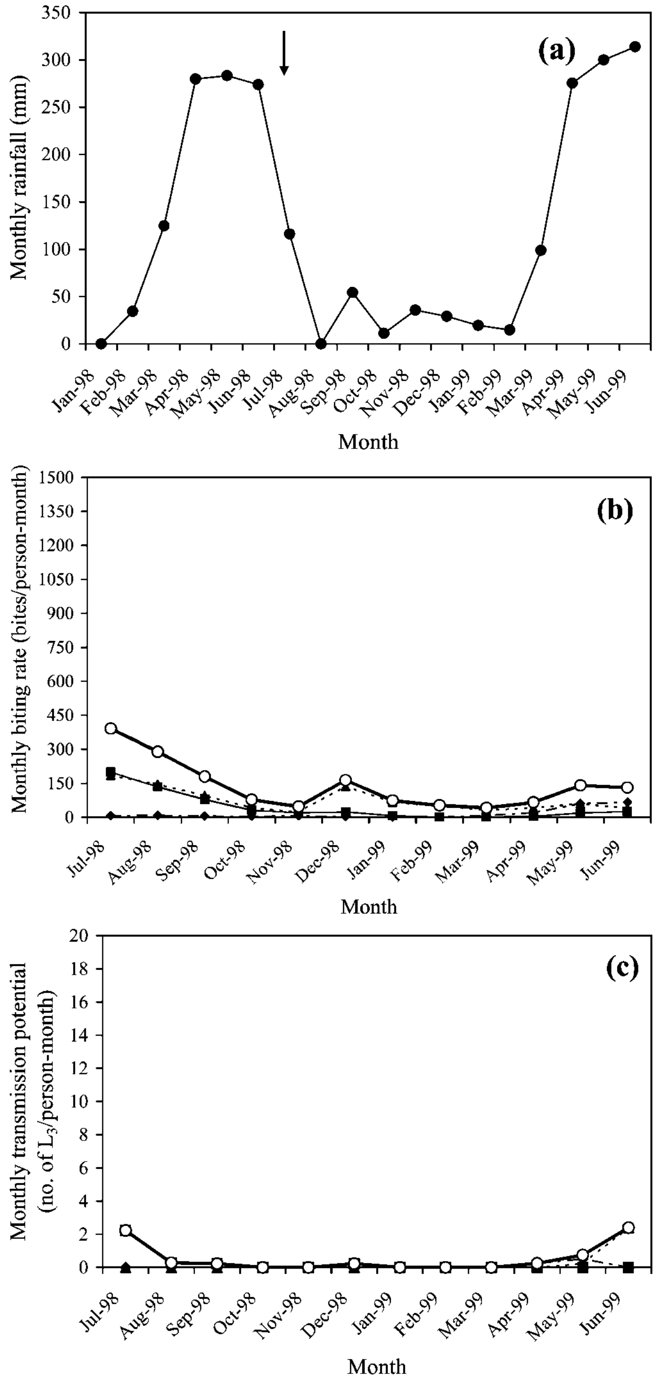

FIG. 3. The seasonal variation seen in rainfall, the numbers of potential vectors biting, and transmission of *Wuchereria bancrofti*, in Kingwede. On the plot (a) of monthly rainfall (●), as measured at Msambweni Hospital near Kingwede, the arrow indicates the time mosquito sampling began. Monthly biting rates (b) and monthly transmission potentials (c) are shown separately for *Anopheles gambiae* s.l. (◆), *An. funestus* (■), and *Culex quinquefasciatus* (▲), and also for all three of these taxa combined (○). L_3, Human-infective, third-stage larvae of *W. bancrofti*.

permit mosquito breeding in them. The dense vegetation, with many coconut and mango trees, also limited the availability of the open sites favoured for breeding by *An. gambiae* s.l. In contrast, *An. funestus* bred in Masaika in the shaded puddles along the seasonal stream, and the prolonged availability of these habitats enabled this species to maintain low numbers throughout the study period. The lower number of *Cx. quinquefasciatus* in Kingwede than in Masaika was presumably a reflection of the relative rarity of pit latrines and the better drainage of the soil in Kingwede. Of the 50 study households in each community, only 13 of those in Kingwede but 30 of those in Masaika had pit latrines, and two and 11 of these, respectively, were found to be wet, with mosquitoes emerging.

DISCUSSION

As similarly observed in other endemic communities on the East African coast (White, 1971; Wijers, 1977; McMahon *et al.*, 1981; Mwandawiro *et al.*, 1997; Bøgh *et al.*, 1998; Pedersen *et al.*, 1999), *An. gambiae* s.l., *An. funestus* and *Cx. quinquefasciatus* were found to be the vectors of *W. bancrofti* in the two study communities. Although *An. gambiae* s.l. was predominant in the highly endemic community of Masaika (followed by *An. funestus* and *Cx. quinquefasciatus*), *Cx. quinquefasciatus* was predominant in Kingwede (followed by *An. funestus* and *An. gambiae* s.l.). Overall vector densities were significantly higher in Masaika than in Kingwede, and the ABR in Masaika, which was 3.7-fold higher than that in Kingwede, indicated that the villagers of Masaika were considerably more exposed to vector biting than those of Kingwede.

In both communities, the overall parity ‘rates’ for the 1-year study period were markedly higher for *An. gambiae* s.l. and *An. funestus* than for *Cx. quinquefasciatus*, indicating that the two anopheline taxa live longer than the culicine. This difference in life-span is probably a major reason for the observation, made in the present study and many others on the coast of East Africa (White, 1971; Bushrod, 1979; McMahon *et al.*, 1981; Mboera *et al.*, 1997; Mwandawiro *et al.*, 1997), of higher prevalences of infection and infectivity in the anophelines than in *Cx. quinquefasciatus*. That the percentage of infected mosquitoes found to be infective was always lower for *Cx. quinquefasciatus* than for the anophelines (33%, 40% and 20% in Masaika and 33%, 72% and 13% in Kingwede for *An. gambiae* s.l., *An. funestus* and *Cx. quinquefasciatus*, respectively) further supports a positive correlation between the mean lifespan of a mosquito species than can act as a vector and that species’ actual importance as a vector. It appears that, in Masaika and Kingwede during the period of the present study, relatively few *Cx. quinquefasciatus* survived long enough to support the development of the microfilariae that they had ingested into the human-infective L_3. Thus, despite the predominance of this species in Kingwede, it was less likely to be found infective than the local *An. gambiae* s.l. or *An. funestus*. It is interesting to note, however, that the *Cx. quinquefasciatus* from Kingwede were also less likely to be found infected than the anophelines. *Culex quinquefasciatus*, unlike *An. gambiae* s.l. and *An. funestus*, is known to feed on birds as an alternative to humans (Subra, 1981; Bøgh *et al.*, 1998), and this behaviour is also likely to reduce its importance as a vector of *W. bancrofti*. All in all, the two anophelines contributed more to the overall ATP, in both communities, than *Cx. quinquefasciatus*. During the present study period, the predominance of anophelines in Masaika, combined with the higher number of biting mosquitoes, resulted in an overall ATP in Masaika that was 14.6 times higher than that in Kingwede.

The dependency of the vectors of *W. bancrofti* on seasonal rainfall has been a common observation in East Africa (White, 1971; Wijers and Kiilu, 1977; McMahon *et al.*, 1981; Mboera *et al.*, 1997; Mwandawiro *et al.*, 1997). The increased abundance of potential vectors during and shortly after the rainy months is reflected in the increased biting rates and transmission potentials. In Masaika, for example, the MTP (for the three taxa of potential vectors combined) was 13.5 times higher in May 1999 than in November 1998. Within each of the two study communities, the role of individual mosquito taxa also differed by season. In Masaika, *An. gambiae* s.l. and *Cx. quinquefasciatus* were the main vectors during and shortly after the rainy months. *Anopheles funestus*, on the other hand, contributed to transmission throughout most of the year but at highest intensity shortly after the rainy seasons. In Kingwede, transmission was generally low, but *An. gambiae* s.l. and *Cx. quinquefasciatus* supported a minor increase during the rainy season.

Significant inter-community variation in the intensity of *W. bancrofti* transmission may occur within a relatively small geographical area, primarily because of differences in the habitats available for vector breeding. The much higher level of *W. bancrofti* endemicity in the human population in Masaika (compared with that in Kingwede) clearly corresponded with the higher intensity of transmission maintained by larger numbers of vectors (especially the highly efficient anophelines). The involvement of *An. gambiae* s.l. , *Cx. quinquefasciatus* and *An. funestus* — three taxa with different habitat requirements and vectorial capacities and therefore different roles in transmission at different seasons — makes transmission of *W. bancrofti* on the East African coast rather complex. The fact that several sibling species of *An. gambiae* s.l. are potential vectors in the study area (Bushrod, 1981) complicates the transmission picture even further. Considerable year-on-year variation in the transmission pattern can also be expected, especially if the rainfall pattern varies between years. Assessment of the overall transmission to which a community in this region is exposed is thus a comprehensive task that may require detailed observation over several years.

The primary intervention measure recommended by the Global Programme to Eliminate Lymphatic Filariasis is repeated, community-wide, mass drug administrations, to eliminate the microfilariae and thereby reduce transmission (Ottesen, 2000). Vector control may be a useful additional measure, helping to reduce the number of years required to meet the threshold for transmission interruption (Michael *et al.*, 2004). On the East African coast, the involvement of at least three different vector species, with different behaviours and presumably different responses to mosquito-control interventions, appears challenging. The observation that anophelines generally have a predominant role as vectors of *W. bancrofti* in rural East Africa indicates, however, that insecticide-treated nets might have a significant impact on the transmission of this nematode, in addition to their already recognized effect on the transmission of malarial parasites (Magesa *et al.*, 1991). In one area of coastal Kenya, the introduction of permethrin-impregnated bednets recently led to a dramatic reduction in the transmission of *W. bancrofti*, as indicated by a 92% reduction in ATP (Pedersen and Mukoko, 2002). The fact that insecticide-treated nets divert the feeding preference of *Cx. quinquefasciatus* from humans to birds (Bøgh *et al.*, 1998) reinforces their potential effect on the transmission of *W. bancrofti* and their value for the control of bancroftian filariasis in the East African coastal environment.

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