Introduction

Sri Lanka has reached the malaria pre-elimination status and currently in the path of elimination of malaria from Sri Lanka.

In the past decade from 2002 to 2012, there has been a dramatic reduction in malaria case load from 41 411 to 93 (99.9% reduction). With the enhancement of surveillance and control activities, number of reported cases has significantly reduced in year 2012 . Out of 93 cases, there were 45 *P. vivax* (83%) infections, 46 *P. falciparum* (17%) and 2 *P. ovalae* infections. The total number of microscopically confirmed indigenous malaria cases reported countrywide was 23. Majority of the cases (78%) were from the Northern Province.

Considering the present favourable malaria situation in the country, the Anti Malaria Campaign aims to achieve malaria elimination from the whole country by end of 2014.

The objectives and strategies of the Anti Malaria Campaign are as follows;

Objectives of the Anti Malaria Campaign

1. To eliminate indigenous *P. falciparum* malaria by 2012.
2. To eliminate indigenous *P. vivax* malaria by 2014.
3. To maintain zero mortality from malaria.
4. To prevent the re-introduction of malaria into the country.

Strategies of the Anti Malaria Campaign

- To provide early diagnosis and prompt treatment of malaria patients and asymptomatic parasite carriers.
- To plan and implement selective and sustainable vector control measures based on the principles of Integrated Vector Management.
- Forecasting, early detection & prevention of outbreaks and the rapid & effective containment of outbreaks.
- To reassess the country's malaria situation regularly, in particular the ecological, social and economic determinants of the disease and evaluation of malaria control activities.
- Enhance community participation and partnership building for effective and sustainable malaria control.
- Promotion of human resource development and capacity building
- Promotion of operational research.

Epidemiology

A total number of 948 250 blood smears were examined during 2012 for the purpose of detection of malaria parasites by the departmental staff attached to the medical institutions and the Anti Malaria Campaign including its regional offices.

Figure 1 shows the blood smears examined during 2011 and 2012 district wise.

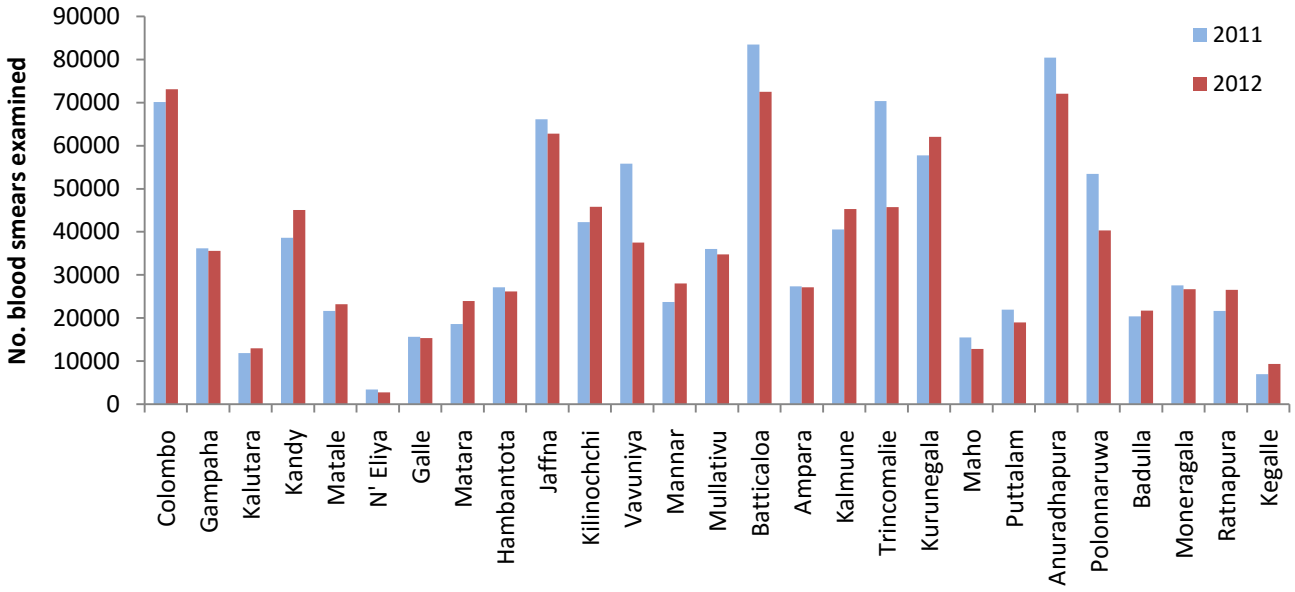

Figure 1: Blood smear examination in Sri Lanka -2011/2012 (district-wise)

Following this screening, 93 confirmed malaria cases were detected. This included 45 *P. vivax* 46 *P. falciparum* and *2 P.ovalae* infections.

The Table 1 shows the Proportion of *P. falciparum* and *P. vivax* for the past 10 years.

Table 1. Proportion of *P. falciparum* and *P. vivax* 2003- 2012

Year	Total cases	*P. vivax*		*P. falciparum*		Mixed		Other	
		No	%	No	%	No	%	No	%
2003	10510	9237	88	1198	11.4	75(mixed)	0.6		
2004	3720	3171	85	500	13.4	49(mixed)	1.6		
2005	1640	1506	92	94	5.8	39(mixed)	2.2	1(*P.o)*	0.06
2006	591	564	95	18	3.0	9(mixed)	1.9		
2007	198	191	96.4	6	3	1(mixed)	0.6		
2008	670	623	93	29	4.3	17(mixed)	2.5	1(*P.m)*	0.1
2009	558	529	95	21	3.8	8(mixed)	1.2		
2010	736	704	95.3	17	2.3	14(mixed)	2.2	1(*P.m)*	0.1
2011	175	158	90.3	12	6.8	5(mixed)	2.6		
2012	93	45	48.3	42	45.2	4(mixed)	4.3	2(*P.o)*	2.2

Figure 2 shows the district-wise comparison between the number of positive cases reported in the country in year 2011 and 2012 (indigenous cases).

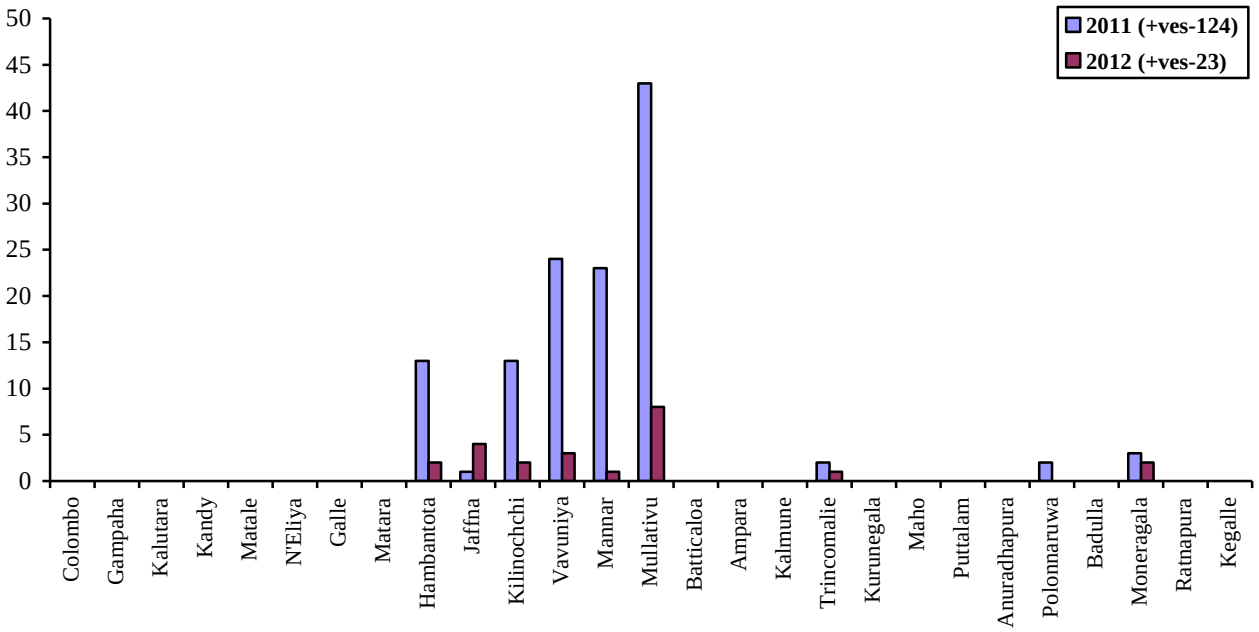

Figure 2: Microscopically confirmed malaria cases in Sri Lanka- 2011/2012 (district-wise)

There was a marked reduction of relapses due to the DOTS strategy adopted by the Anti Malaria Campaign in late 2010.

The Figure 3 shows the intensity of malaria transmission in the year 2012 in Sri Lanka based on Annual Parasite Index/Incidence (API). API is the number of confirmed malaria cases per thousand persons at risk per year.

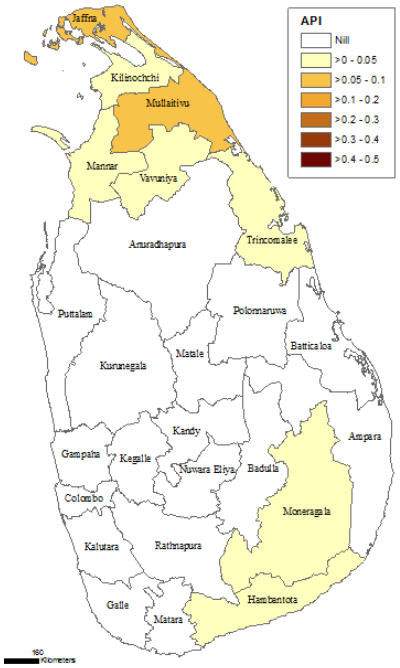

Figure 3: Intensity of malaria transmission in Sri Lanka (district-wise) 2012

Imported malaria

In addition to the indigenous cases, 70 imported malaria cases from other countries were reported (26 *P. vivax* infections, 37 *P. falciparum,* 2 *P.ovale* and 5 mixed infections) (Figure 4). There had been a rise in imported malaria cases in 2012; while 75% of total cases were imported cases in 2012, only 29% were imported cases in 2011. Majority of cases were imported from India and Benin.

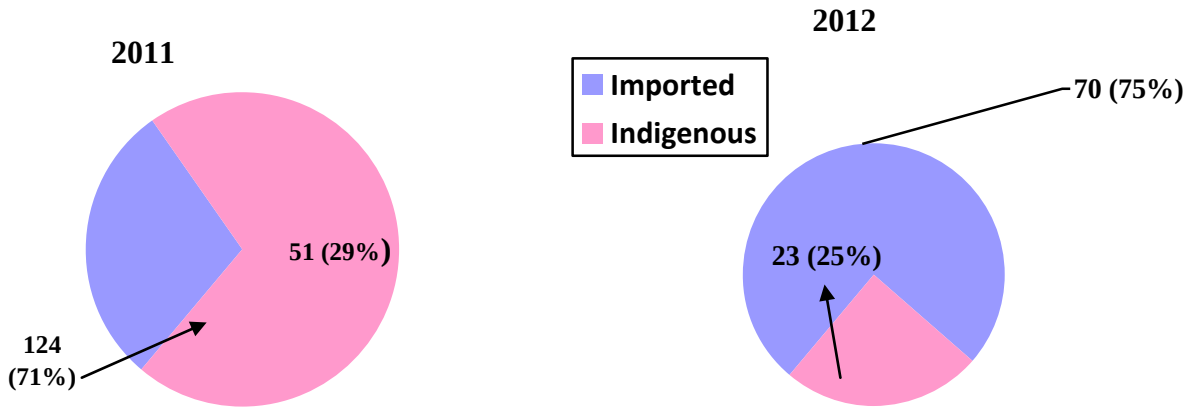

Figure 4 : Imported malaria cases – 2011/2012

Table 2: Imported malaria cases by country of origin 2011/2012

Country	2011	2012
South East Asia	**42 (82.4)**	**29 (41.4)**
India	37 (72.6)	27 (38.6)
Pakistan	4 (7.8)	2 (2.9)
PNG	1 (2.0)	(0.0)
Africa	**9 (17.6)**	**38 (54.3)**
Angola	1 (2.0)	(0.0)
Benin	(0.0)	20 (28.6)
Ghana	1 (2.0)	1 (1.4)
Guinea	(0.0)	5 (7.1)
Kenya	1 (2.0)	(0.0)
Liberia	1 (2.0)	4 (5.7)
Nigeria	(0.0)	3 (4.3)
Sierra Leone	(0.0)	2 (2.9)
South Africa	1 (2.0)	(0.0)
Togo	(0.0)	2 (2.9)
Uganda	3 (5.9)	(0.0)
West Africa	1 (2.0)	1 (1.4)
Other	**0 (0.0)**	**2 (2.9)**
Haiti	(0.0)	2 (2.9)
Saudi Arabia	(0.0)	1 (1.4)
Total	51 (100.0)	70 (100.0)

Chemoprophylaxis

The Anti Malaria Campaign provided chemoprophylaxis to travellers to malaria endemic countries based on WHO guidelines. AMC headquarters has provided chemoprophylaxis for 951 persons during the year 2012. Mefloquine (3677 tablets) and Chloroquine (672 tablets) were issued to them depending on the country they visited. Majority of these travelers were males (88%) and above 18 years old (96%).

Mortality

When compared with other South-East Asian countries, mortality due to malaria in Sri Lanka is extremely low. No deaths due to malaria were reported in the year 2012.

Information Management

Network facilities were already established between the Anti Malaria Campaign Headquarters and the Regional Malaria Offices with the assistance of the Global Fund. Information regarding positive cases was transmitted to AMC Headquarters through a web based system established at AMC Headquarters. Furthermore, all malaria cases and potential vector breeding sites were mapped with the GIS.

To enhance the case surveillance from the private sector, communication cell at the AMC Headquarters was maintained with the assistance of Global Fund.

Prevention and control of epidemics/outbreaks

The following strategies are used to forecast epidemics.

(a) Regular observation of fever incidence/ and malaria morbidity in Medical Institutions.
(b) Monitoring of vector densities (larval and adult) in sentinel stations and by random spot checks.

There were no epidemics reported in the year 2012.

Status of drug resistance and drug policy

All the *P. falciparum* and *P. vivax* positive patients were followed-up for one month to detect resistant strains of the parasite to artemether-lumefantrin and chloroquine respectively. There were no resistant *P. falciparum* and *P. vivax* cases detected during year 2012.

Programme priorities

Elimination of indigenous malaria transmission and control of imported malaria cases have been identified as priorities. Malaria control among security forces, internally displaced populations in the Northern Province, and in the bordering provinces was also considered as a programme priority during the year 2012.

Parasitological Surveillance

The Parasitological Surveillance in the country is implemented mainly through screening of individuals attending to medical institutions and village level screening done in malarious localities. Screening done at medical institutions is categorized as Passive Case Detection (PCD) which included medical institutions where there is no Public Health Laboratory Technician (PHLT)/ Public Health Field Officer (PHFO) or Activated Passive Case Detection (APCD) which includes medical institution where there is either a PHLT and/or a PHFO. Village level screening is done by Active Case Detection (ACD) and Mobile Malaria Clinics. Microscopy is the main diagnostic method while Rapid Diagnostic tests (RDTs) are also being used as a supplementary tool.

The Anti Malaria Campaign recommends screening all fever patients that come to an APCD institution for malaria. However, the number of blood smears taken in such institutions has decreased over the years, as the malaria disease burden has fallen down drastically. Active case detection (ACD) and Mobile Clinics are done as a measure to detect malaria cases early (including asymptomatic parasite carriers) thereby preventing transmission.

Screening of suspected malaria patients

For the year 2012 there were 93 confirmed malaria cases (23 indigenous and 70 imported) in the country. In addition to the cases reported by Public Health Laboratory Technicians (PHLTT) attached to the Anti Malaria Campaign, these include the cases reported from the armed forces, other government medical institutions and the private sector. Majority of malaria cases (45 out of 93) detected were among the suspected malaria patients screened by the PHLTT attached to the central laboratory. Out of them, 20 were detected at the Bandaranaike International Airport, 10 were detected at private hospitals in the Colombo district, 5 from government medical institutions while the balance 10 were from the patients who came to AMC Headquarters for diagnosis of malaria.

The total number of blood smears examined by PHLTT attached to the Anti Malaria Campaign in each district/RMO region is given in Table 2, while the percentage wise data are shown in Figures 5 and 6 respectively.

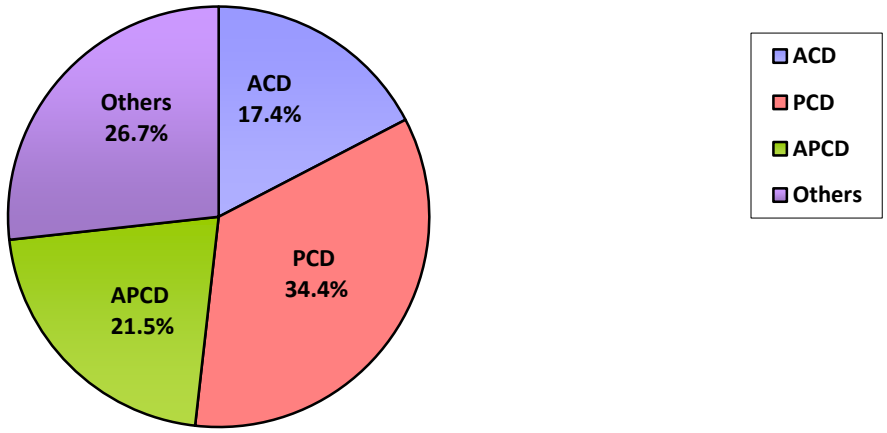

Figure 5: Category wise percentages of individuals screened by the Anti Malaria Campaign in the country - 2012.

Table 2. Total number of blood smears screened by the Anti malaria Campaign during the year 2012

District	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Colombo	6169	5438	7589	4513	7065	7676	6866	5640	4752	6285	6714	4378	73085
Gampaha	2288	5007	3794	2807	2145	2203	1901	3320	2176	4138	2962	2846	35587
Kalutara	645	1799	1216	505	1276	573	1694	906	776	1708	368	1481	12947
Kandy	3898	3487	3864	3489	4053	3703	4077	3496	3666	3701	3852	3797	45083
Matale	1633	1960	2106	1986	2152	2067	2068	1987	1867	2037	2043	1270	23176
N' Eliya	470	282	342	103	132	225	81	305	192	225	423	0	2780
Galle	981	1456	1347	1119	1388	1207	1330	1542	1167	1176	1168	1432	15313
Matara	1446	2275	2136	1614	1445	2008	1896	2447	2409	2512	2158	1597	23943
Hambantota	2564	1735	2069	1733	2261	2144	3110	2529	2392	1870	2056	1723	26186
Jaffna	5646	6437	5526	4138	5555	5639	4589	4418	4287	5045	5609	5901	62790
Kilinochchi	5493	5919	3961	2727	3359	4260	3040	3825	3411	3166	3361	3330	45852
Vavuniya	2943	2984	3578	2957	3303	2582	3391	3574	2465	3287	3466	2984	37514
Mannar	1993	1821	3130	2402	2813	2308	2724	2450	3022	3032	1542	755	27992
Mullativu	7213	4293	2803	1935	2965	1281	2391	2221	2637	3031	2687	1285	34742
Batticaloa	5236	6899	9531	5943	6166	7159	976	6509	5224	5746	6986	6123	72498
Ampara	2848	2259	2296	1993	2081	2299	2308	2187	1982	2418	2218	2271	27160
Kalmune	3845	3441	4038	3529	3774	3900	3602	3583	3503	3766	4264	4035	45280
Trincomalie	5121	3492	4358	3330	4129	4096	3456	3590	3521	2819	4355	3508	45775
Kurunegala	5019	5066	4899	4471	5701	5192	5323	4573	5429	5275	5472	5614	62034
Maho	1133	1050	1021	811	944	1092	1267	1129	1107	1073	1056	1110	12793
Puttalam	1392	1496	1272	1336	1763	1669	1783	1997	1580	1853	1529	1325	18995
Anuradhapura	7101	5835	5249	5491	6619	6307	5986	5774	5911	5735	5919	6164	72091
Polonnaruwa	3766	4147	3572	2648	3492	3204	3861	2944	2503	3557	3234	3388	40316
Badulla	1584	1436	1648	1576	2111	1994	2157	2014	1797	1604	1725	2077	21723
Moneragala	2244	1920	1912	1891	2382	2224	3879	2051	1751	2338	2709	1396	26697
Ratnapura	2120	1733	2001	2258	2178	2230	2413	2130	2151	2475	2406	2440	26535
Kegalle	698	957	653	579	747	782	613	801	857	956	843	877	9363
Total	85489	84624	85911	67884	81999	80024	76782	77942	72535	80828	81125	73107	948250

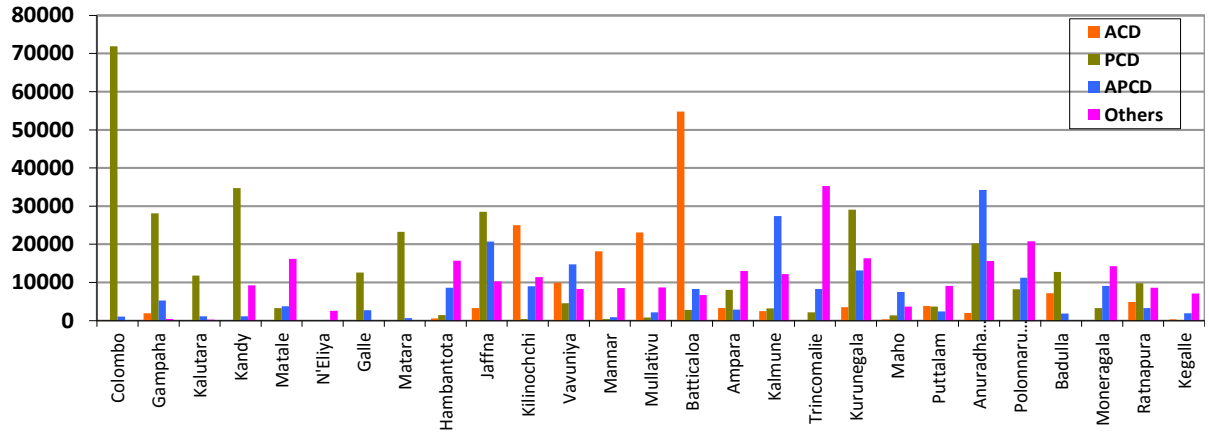

Figure 6: Category wise distribution of individuals screened by the Anti Malaria Campaign in each district/RMO region

Provision of laboratory items

The Central laboratory distributes laboratory items required for malaria microscopy to regional malaria offices. Some laboratory items issued during the year 2012 are given in Table 3.

Table 3. Laboratory items distributed

District	Glass Slides	Lancets	Methanol (L)	Giemsa (L)	Ethanol (L)	RDT Kits
Ampara	11100	13000		4		1200
Anuradhapura	10000	15000	2.5	4		1200
Badulla		10000				60
Batticaloa	94001	45000				
Colombo						70
Gampaha	864	1200		1	1	220
Hambantota	22200	14600	2.5	3		1440
Jaffna	5000	60000		3		1860
Kalmune	12200	15000	1	3		
Kalutara						25
Kandy	2500	5000		4		600
Kegalle	6820	5000				600
Kilinochchi	14400	30000		2	2	1200
Kurunegala		5000	2.5	3		
Maho	10800	15000				780
Mannar	6100	30000			2.5	300
Matale	12200	20000				300
Monaragala	10000	5000				240
Mullathive	7200				2.5	300
Polonnaruwa	5000	10000		3		300
Puttalam	10000	5000	2.5			660
Ratnapura				2		1080
Trincomalie	15800	30000		6		180
Vavunia	18800	25000			2.5	600
Total	274985	358800	11	38	10.5	13215

Screening programmes conducted at ports of entry

During the year 2012, the Anti Malaria Campaign conducted special screening programmes at the Bandaranaike International Airport to screen military personnel and special groups returning from malaria endemic countries. Among the 2226 individuals screened, 20 P. falciparum malaria cases have been detected.

Establishment of the PCR laboratory

Measures were taken to establish a PCR diagnostic laboratory at the AMC Headquarters with GFATM funding.

In-service training programmes conducted by the AMC Directorate for Laboratory Technicians

The Anti Malaria Campaign annually conduct in-service training programmes for Laboratory Technicians doing malaria microscopy. During the year 2012, twelve in-service training programmes were conducted for Public Health Laboratory Technicians. Six programmes were conducted at AMC HQ for the PHLTT in Western, Northern, Eastern, Sabaragamuwa and North Central provinces while the other six programmes were conducted in the periphery for PHLTT in the Southern, North Western and Central Provinces. In addition six one day training programmes on malaria microscopy were conducted for laboratory technicians working in the private hospitals. Hundred and eighty three participants from Western, Northern, Central and North Western provinces were trained. Activities related to the quality assurance were also covered during these training programmes.

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Cross Checking results

Cross checking of initial PHLT results is done by the well experienced PHLTT in the cross checking lab of AMC.

Table 4. Cross-checking results

RMO Region	Initial PHLT results				Cross-check Results			
	Negative	P. vivax	P. falciparum	Mixed	Negative	P. vivax	P. falciparum	Mixed
Anuradhapura	13571	1	0	0	13571	1	0	0
Ampara	2493	0	0	0	2493	0	0	0
Badulla	506	1	0	0	506	1	0	0
Batticoloa	3416	0	1	0	3416	0	1	0
Hambantota	1118	0	0	0	1118	0	0	0
Jaffna	3314	0	6	0	3314	0	6	0
Kandy	660	0	1	1	661	0	1	1
Kurunegala	416	1	0	0	416	1	0	0
Maho	487	0	0	0	487	0	0	0
Kegalle	724	0	0	0	724	0	0	0
Killinochchi	2921	2	0	0	2921	2	0	0
Kalmune	1336	1	0	1	1336	1	1	0
Moneragala	1439	1	0	0	1439	1	0	0
Mannar	2459	0	0	0	2459	0	0	0
Puttalam	1446	1	0	0	1446	1	0	0
Polonnaruwa	916	0	0	0	916	0	0	0
Ratnapura	565	0	0	0	565	0	0	0
Trincomalie	3120	0	0	0	3120	0	0	0
Mullaitivu	1764	0	0	0	1764	0	0	0
Matale	1100	0	0	0	1100	0	0	0
Vavuniya	1483	0	0	0	1483	0	0	0
Total	45254	8	8	2	45255	8	9	1

Vector Surveillance

Malaria entomological investigations were carried out by central and regional entomological teams of the Anti Malaria Campaign in 57 sentinel sites in the country during 2012. In addition to that 80 sites were covered in the form of spot checks.

Vector density based on cattle baited hut collections

The 57 sentinel sites (represented by location of the cattle baited cadjan huts) were mapped and the annual mean adult density of main malaria vector *Anopheles culicifacies* in each site was determined (Figure 7). When compared with the year 2011 (Figure 8) the densities of the main vector showed an increase in 2012. For example, only 13.6% (6 out of 44) of sites had more than 5 female *An. culicifacies* mosquitoes detected per hut during 2011 whereas this has increased up to 22.8% (13 out of 57 sites) in 2012. Further, among these 13 sites there were 3 sites (Horowpothana, Nikaweratiya, Kotawehera) with the density of 25 - 45 female *An. culicifacies* mosquitoes per hut.

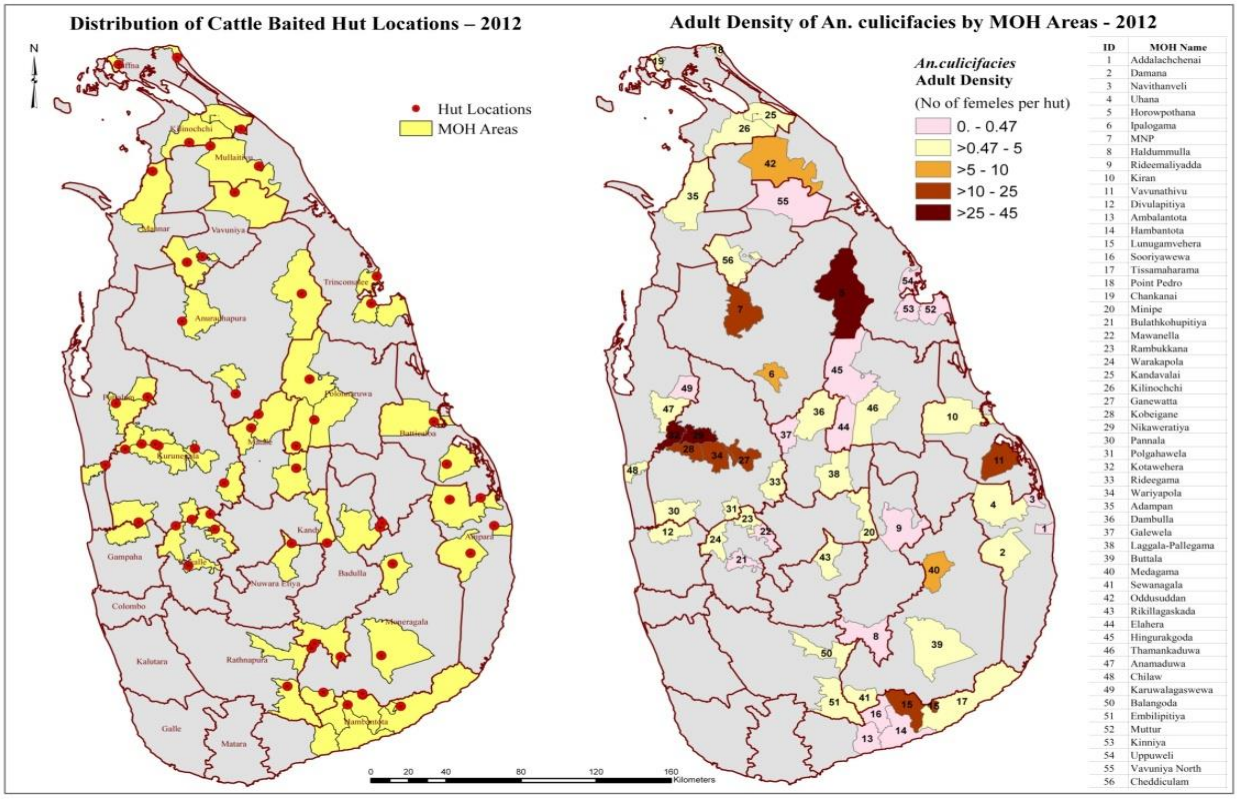


Figure 7: Adult female density of *An. culicifacies* by MOH areas in 2012

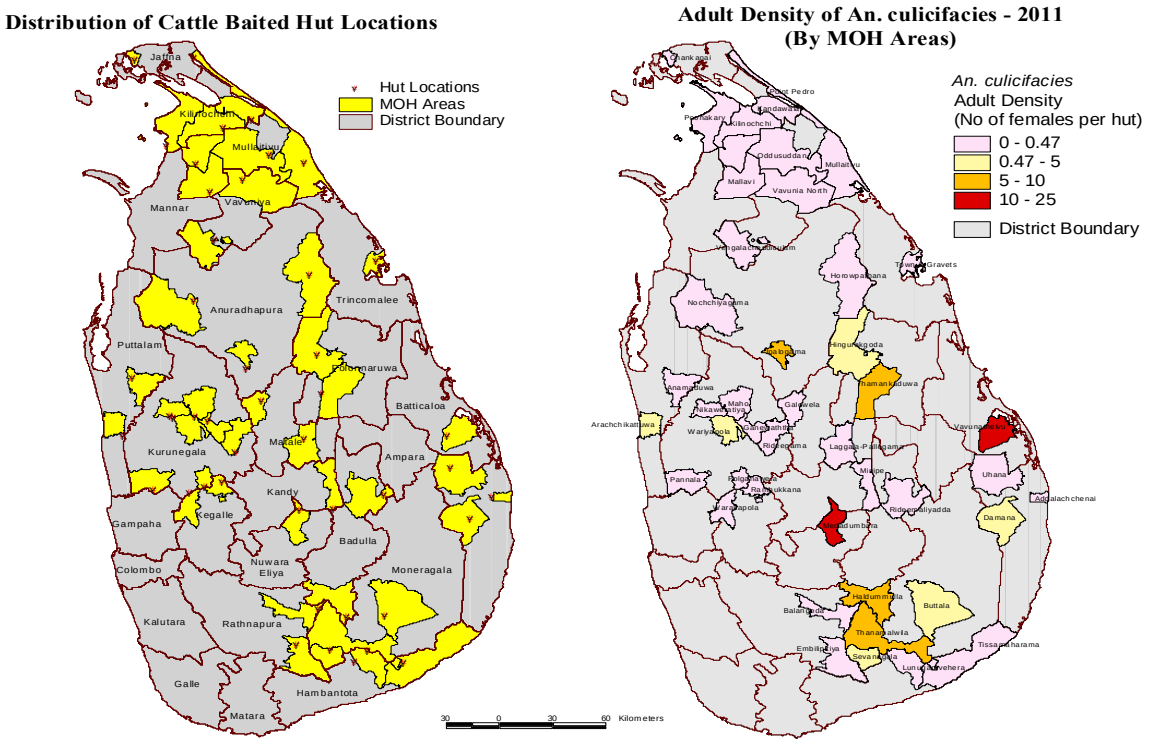


Figure 8: Adult female density of *An. culicifacies* by MOH areas in 2011

The density of secondary malaria vectors *An. subpictus* and *An. annularis* were compared with that of *An. culicifacies*, based on the cattle baited hut collections in RMO regions in *Figure* 9. The most abundant species detected was *An. subpictus* except in Batticaloa, Anuradhapura, Kegalle and Kandy.

An. culicifacies density was highest in Maho (25 females per hut) and Kurunegala followed by Batticaloa, Anuradhapura, Mullaithivu and Hambanthota. By this technique, *An. annularis* was recorded only from 8 RMO regions.

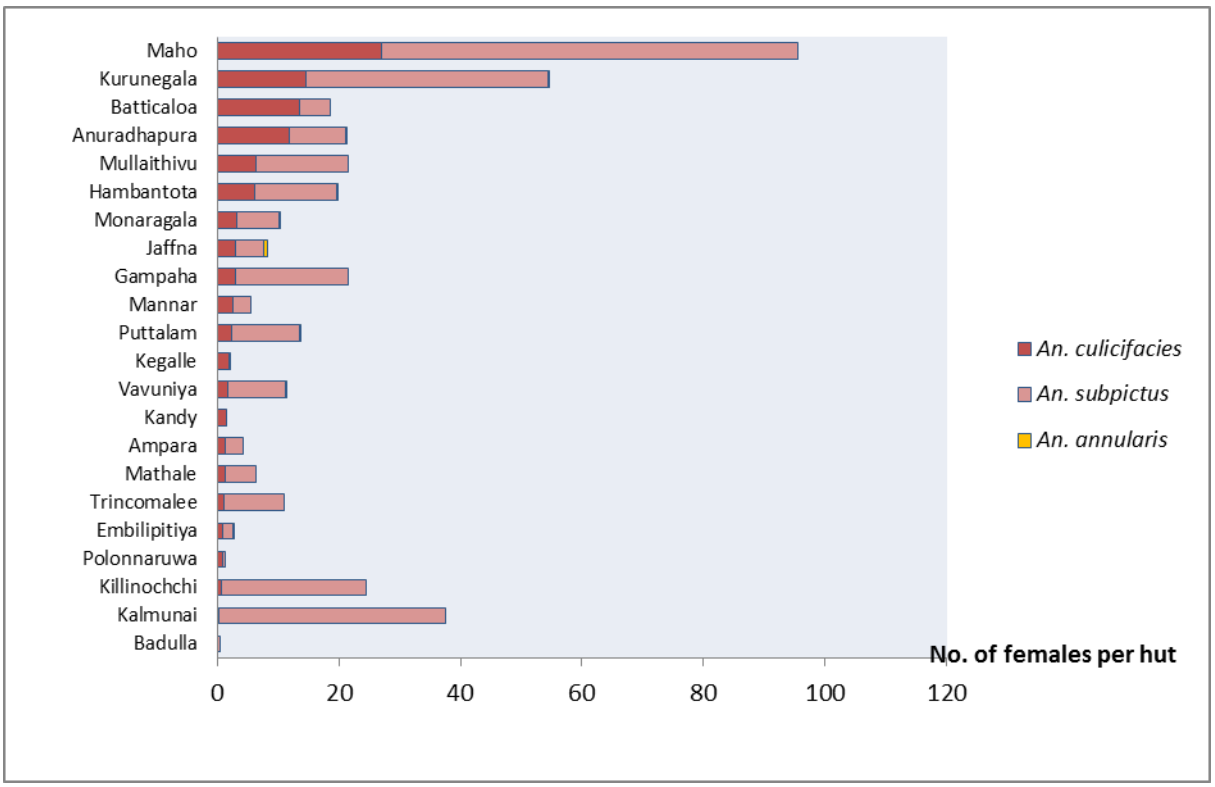


Figure 9: Mean density of malaria vectors in 2012 in RMO regions (Cattle baited hut collections)

Larval surveys

Based on the larval survey results from 138 sites (sentinel and spot surveys) the mean larval density of *Anopheles culicifacies* was calculated and MOH areas were stratified based on the density (Figure 10).

Five MOH areas namely Kegalle, Warakapola, Kotawehera, Nikaweratiya and Thambuththegama had mean annual *An. culicifacies* density above 25 larvae per 100 dips and ten MOH areas (Chilaw, Kobeigane, Maho, Kanthale, Muthur, Kuchchaweli, Mawanella, Medagama, Siyambalanduwa and Lunugamwehera) had 10-25 larvae per 100 dips indicating the high receptivity of these areas to malaria.

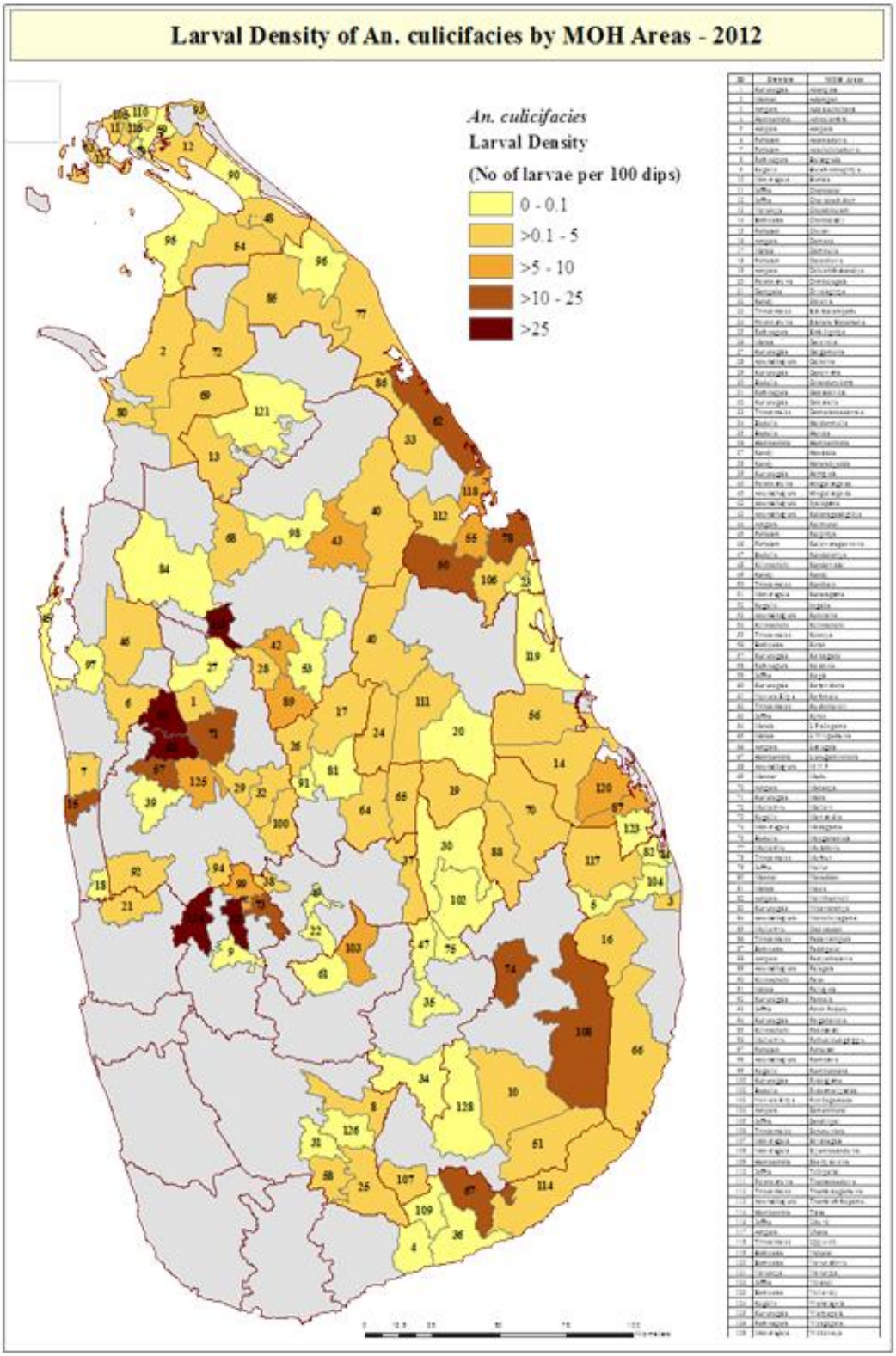


Figure 10: Larval density of *An. culicifacies* in MOH areas -2012

Larval density of major vector and secondary vectors were compared in Figure 11. Maho RMO region showed the highest larval density for the year (Figure 11) followed by Kegalle and Trincomalee. In nine RMO regions the density of secondary vector *An. subpictus* was higher than that of the major vector. However, *An. annularis* was present in very low density.

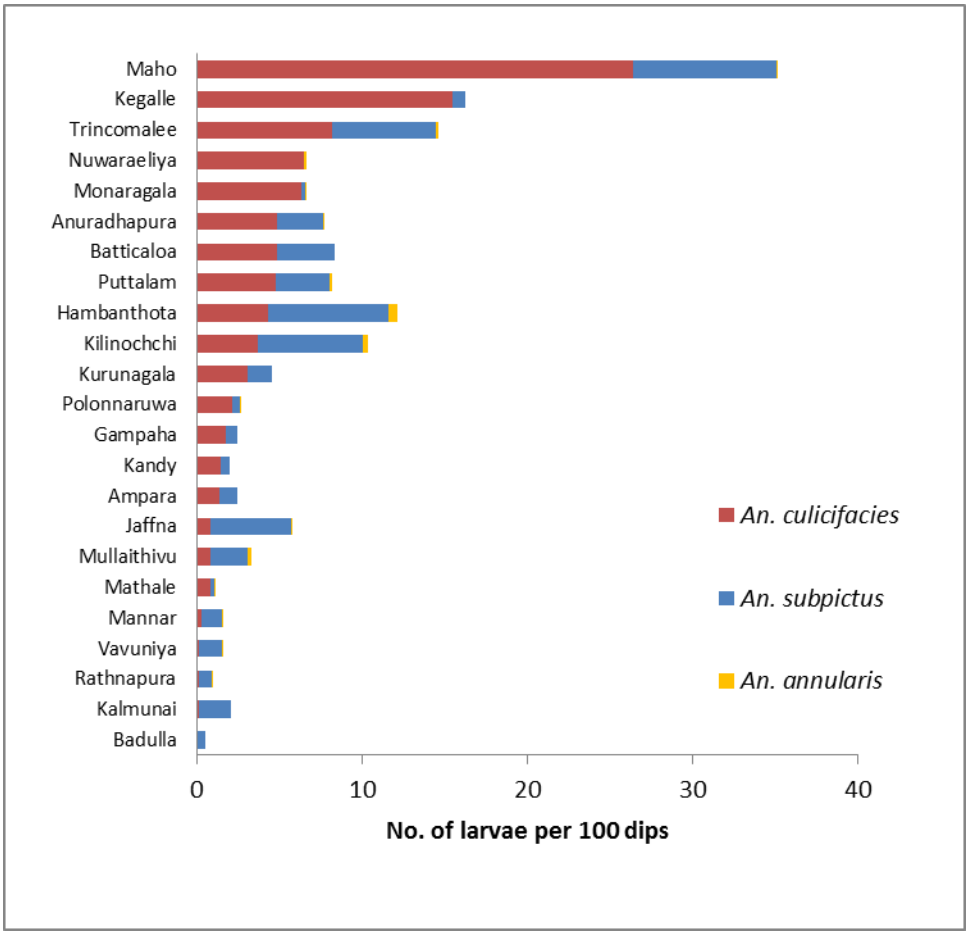


Figure 11: Mean larval density of malaria vectors in 2012 in RMO regions

All the RMO regions showed the seasonal fluctuations of larval densities (Figure 12). In the RMO regions of the Northern Province *An. subpictus* was the predominant species during the year, however *An. culicifacies* was also present in all five RMO regions of the same province.

Fig. 13 shows the breeding places of three vector species. The major breeding place of *An. culicifacies* in inland areas during 2012 was rivers and streams. However, wells and different types of pits also acted as breeding places for the main vector. Paddy fields were also positive for *An. culicifacies* in 2012 which was observed after 4 years.

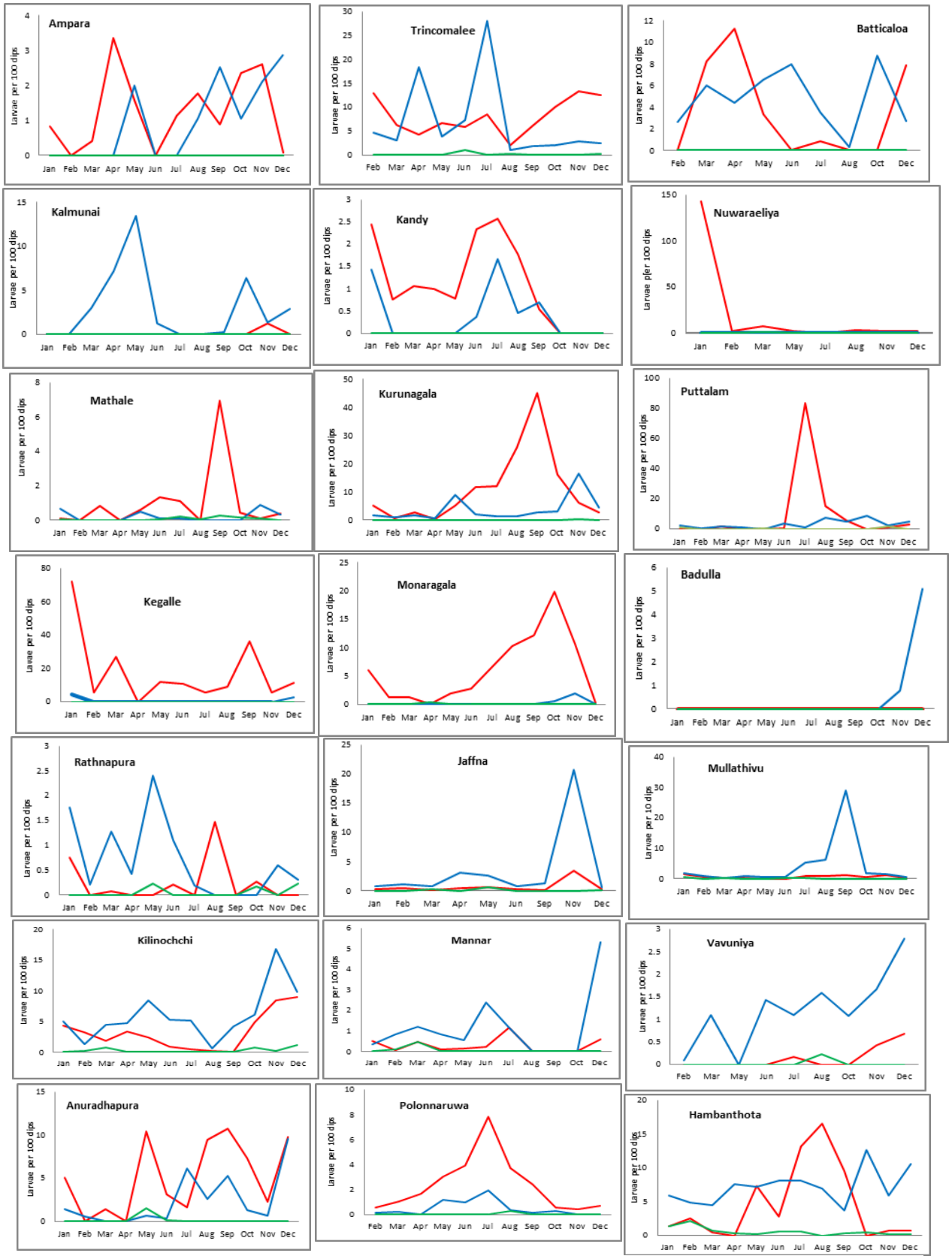


Figure 12: Fluctuations of larval densities of malaria vectors in 2012

An.cul. *An.sub.* *An.ann.*

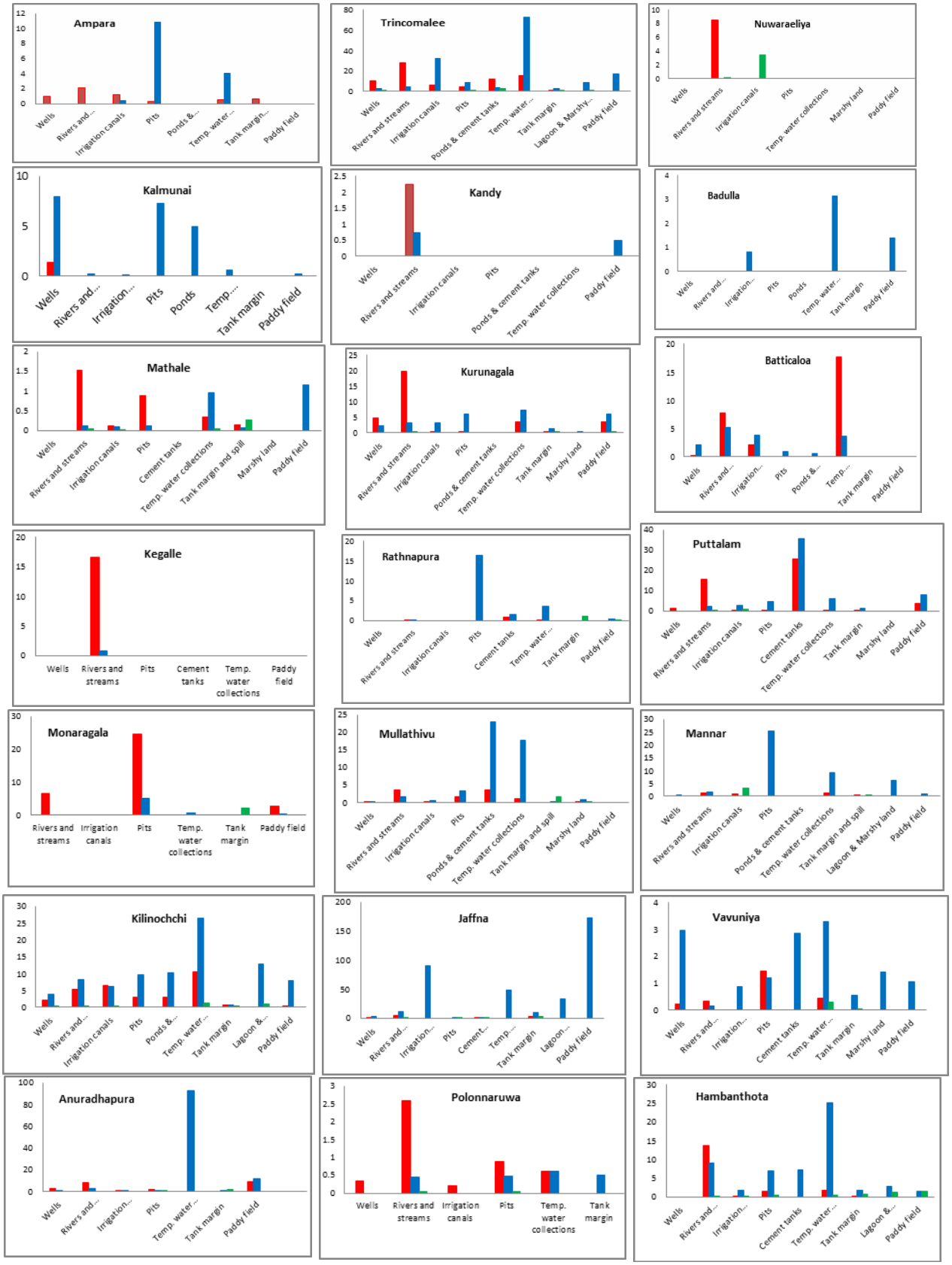


Figure 13: Larval density of malaria vectors in different breeding sites in 2012

An.cul. *An.sub.* *An.ann.*

Human landing collections

Human biting rates were determined for each RMO region by the partial night human landing collections from 6.00 pm to 9.00 pm. The human landing rates were assumed to be equivalent to the human biting rates. The outdoor biting rate of both *An. culicifacies* and *An. subpictus* was higher than the indoor biting rate (except in Kalmunai and Vauniya). This feature was observed in 2011 as well and needs further investigations. Anuradhapura, Maho, Kandy and Batticaloe had the highest biting rates for major vector whereas Maho, Hambanthota, Trincomalee and Killinochchi had the highest biting rates for *An. subpictus*. *An. annularis* showed low biting rates except in Hambanthota compared to the above species (Fig 14 & 15).

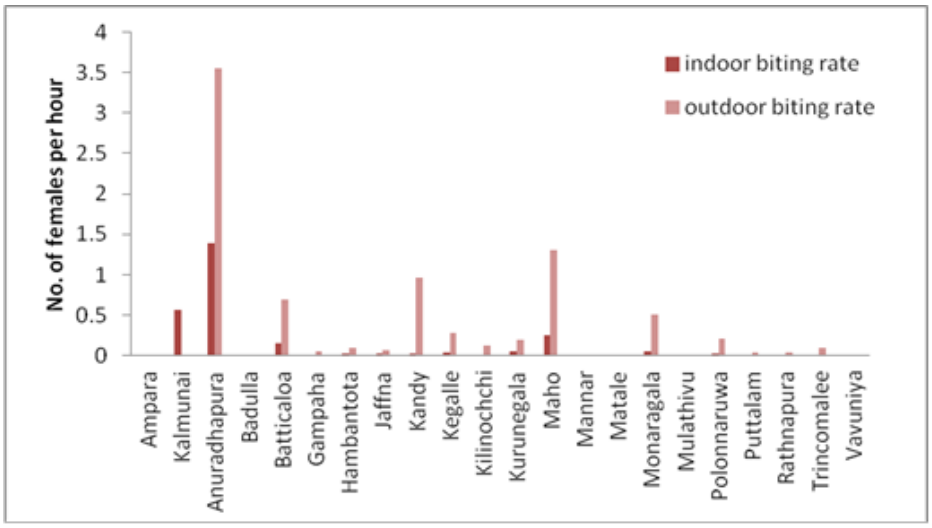


Figure 14: Human biting rates for *An. culicifacies*

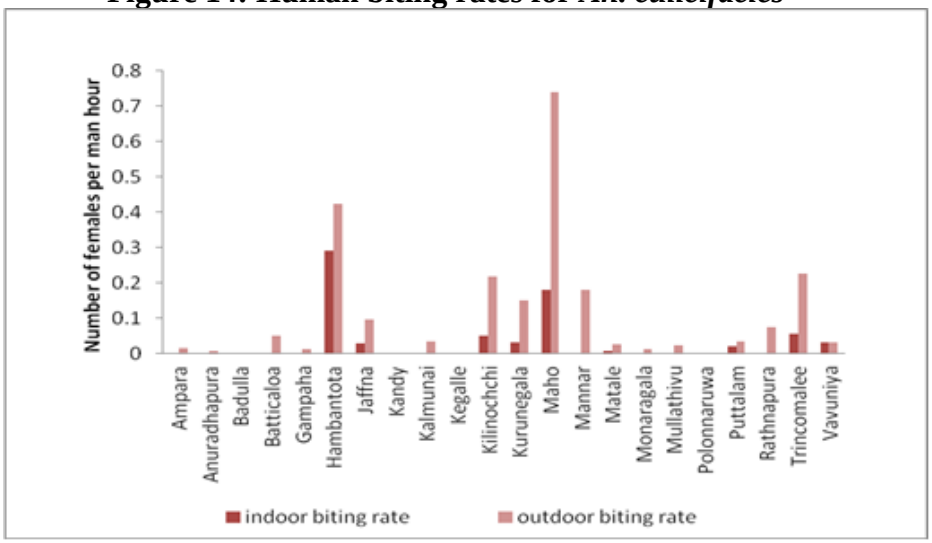


Figure 15: Human biting rates for *An. subpictus*

Indoor hand collections

Indoor resting densities for major vectors were determined by indoor hand collections for the RMO regions. *An. subpictus* was the main indoor resting species among the selected four species (Fig 16). The indoor resting density of *An. subpictus* was high compared to the major vector despite the fact that indoor biting rates of *An. culicifacies* was higher than *An. subpictus*.

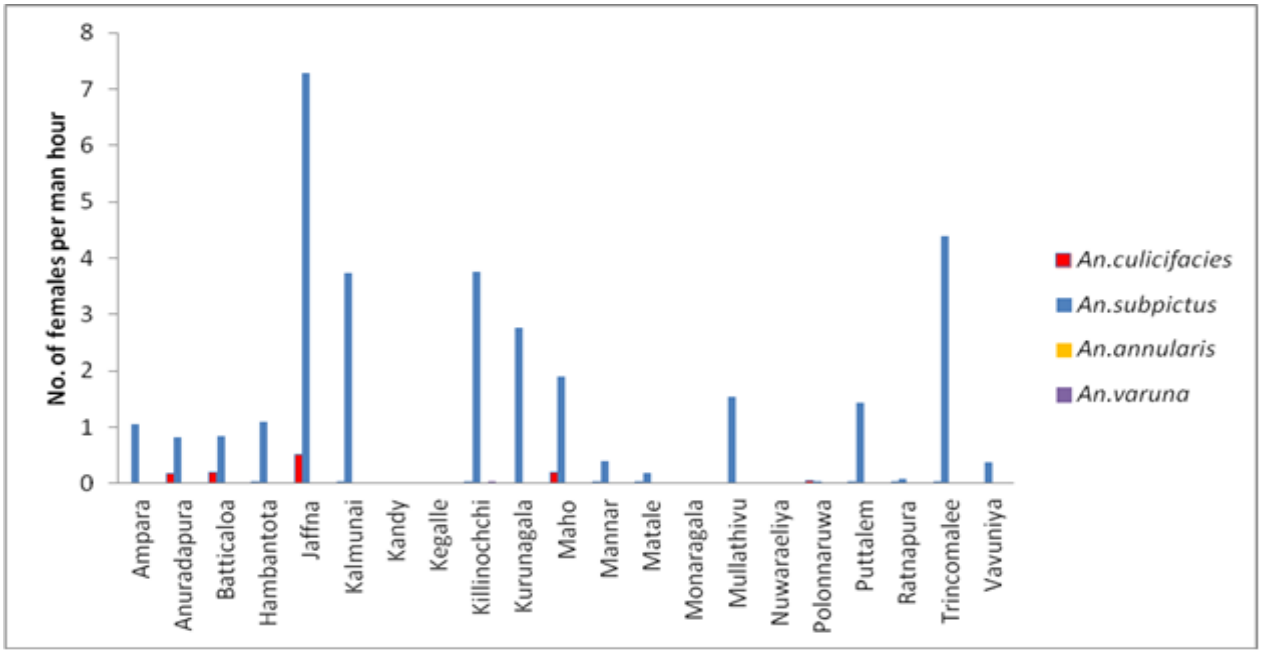


Figure 16: Indoor resting densities of malaria vectors 2012

Insecticide susceptibility tests

Eleven vector and potential vector species were tested for susceptibility for 13 insecticides during 2012. Resistance and possible resistance for some insecticides in some localities were observed (Fig 17,18,19 and Table 3).

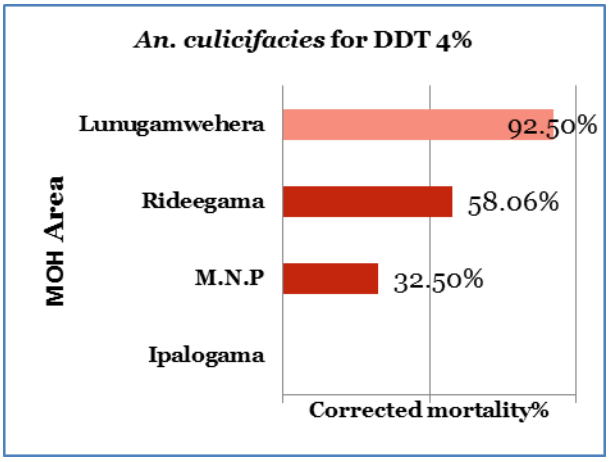
DDT: DDT resistance was observed in 03 localities in Hambanthota, Kurunegala and Anuradhapura districts for *An. culicifacies* and in 2 localities in Kurunegala and Hambanthota for *An. subpictus* (Fig 19).

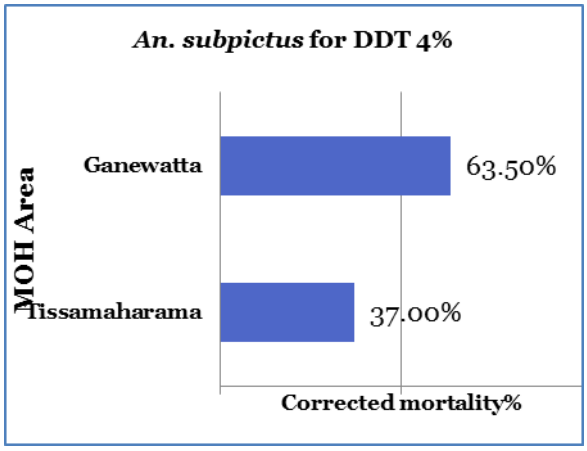
Malathion: Resistance to Malathion in *An. culicifacies* was observed in Kurunegala, Anuradhapura and in Embilipitiya while possible resistance reported from many sites. *An. subpictus* also showed resistance to Malathion in many sites.

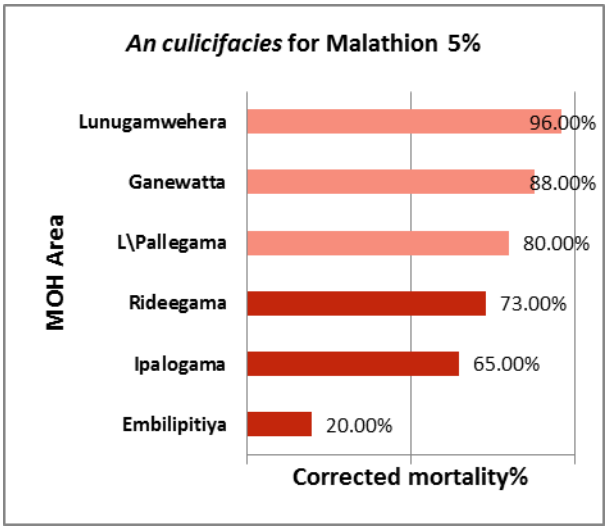
Fenitrothion: *An. culicifacies* was susceptible to Fenitrothion. However resistance to this insecticide was observed in *An. subpictus* in Matale district.

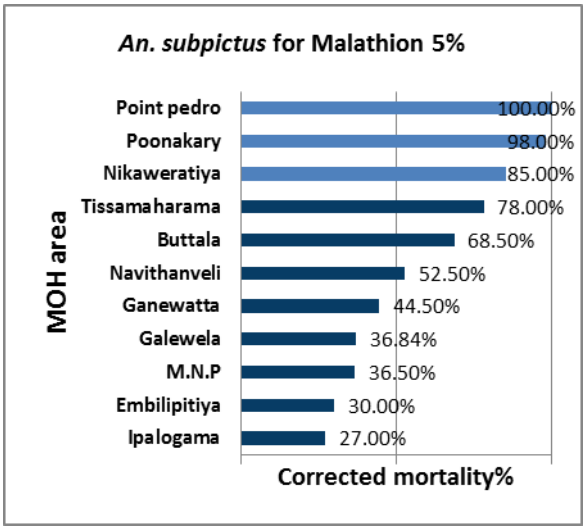
Permethrin: *An. culicifacies* showed possible resistance to Permethrin in two localities in Kurunegala district. It was susceptible to Permethrin in 14 tested localities. However, *An subpictus* showed resistance to permethrin in three localities and possible resistance in many sites.

Deltamethrin: For Deltamethrin *An. culicifacies* showed possible resistance in one locality in Maho RMO region. In all the other places it was found to be susceptible. *An. subpictus* was found to be resistant in severel localities for Deltamethrin.









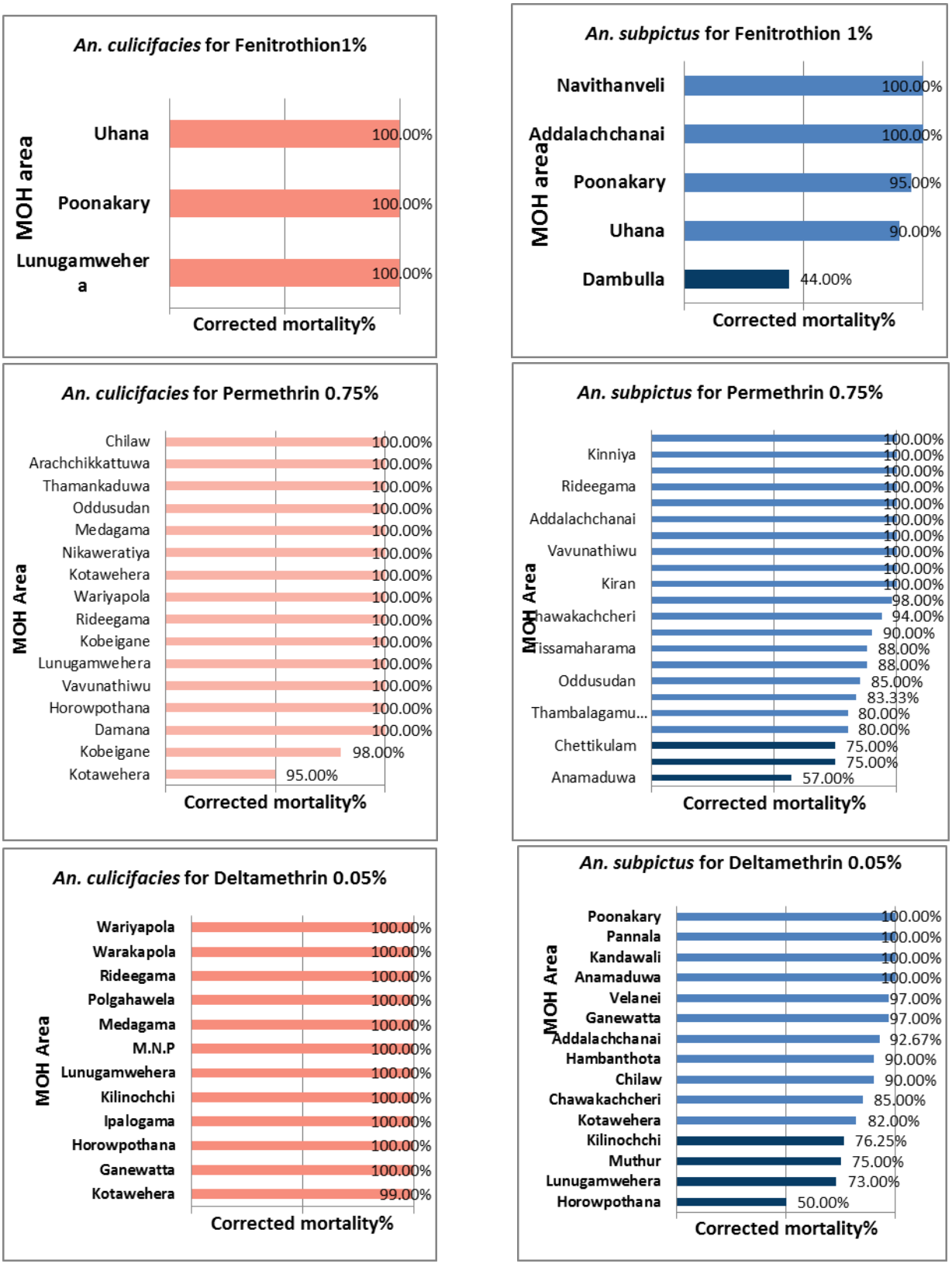


Figure 17: Susceptibility of malaria vectors to insecticides

Table 5. Susceptibility of malaria vectors to insecticides in Sri Lanka

Insecticide	*An.culicifacies*	*An.subpictus*
D.D.T 4%	Resistant	Resistant
Malathion 5%	Resistant	Resistant
Fenitrothion 1%	Susceptible	Possible resistance
Bendiocarb 0.1%	Resistant	Resistant
Deltamethrin 0.05%	Susceptible	Resistant
Etofenprox 0.5%	Susceptible	Possible resistance
Bifenthrin 2%	Susceptible	Possible resistance
Lambdacyhelothrin 0.1%	Resistant in one location	Resistant in one location
Cyfluthrin 0.15%	Susceptible	Possible resistance
Permethrin 0.75%	Possible resistance in two locations	Resistance in few locations

LLIN Bioassys

Bioassay tests conducted for LLINs showed the mortality rates of the major malaria vector for Olyset net reduced even before washing in the areas tested (Table 6 and 7). Anopheles subpictus also showed low level of mortality when exposed to the Olyset net.

Available data are not adequate to conclude on the efficacy of LLIN after washing. Further studies on usage and bioassay data are required to conclude on the residual efficacy of Olyset nets.

Table 6. *An.culicifacies* mortality for Olyset nets before wash

MOH area	Species	No. Of replicates	No. Of mosquitoes	Mean corrected mortality %
Ganewatta	*An.culicifacies*	24	120	100
Gokarella	*An.culicifacies*	18	90	90
Rikillagaskada	*An.culicifacies*	8	40	72.5
Lunugamwehera	*An.culicifacies*	14	70	54.8
Buttala	*An.culicifacies*	23	115	39.1
Nikaweratiya	*An.culicifacies*	19	95	45.15
Kotawehera	*An.culicifacies*	21	104	24.6
Maddyama Nuwaragam Palatha	*An.culicifacies*	17	72	5.68

Table 7. *An. Subpictus* mortality for Olyset nets before wash

MOH area	Species	No. Of replicates	No. Of mosquitoes	Mean corrected mortality%
Ganewatta	*An.subpictus*	16	80	18.75
Kandawali	*An.subpictus*	8	40	80
Kandawali	*An.subpictus*	8	40	42.5
Kinniya	*An.subpictus*	8	40	48.3
Kobeigane	*An.subpictus*	8	40	65
Muthur	*An.subpictus*	16	80	50.4
Navithanveli	*An.subpictus*	12	60	100
Punagary	*An.subpictus*	24	119	56
Punagary	*An.subpictus*	8	40	81

Distribution of entomological items

Several entomological items were distributed by AMC HQ to RMO regions during the year 2012 (Table 8).

Table 8. Distribution of entomological items to regional entomological teams in 2012

Issuing goods 2012	Folding Bed	Folding Table	Dissecting Set	Larval Vials	Pin Vice	Hand Sprayer	Cotton wool	Dippers with Handle	Pipettes (Droping)	Inset Box	Minuten pin (Pkt)	Back Pack Aspirator	Beakers 1000ml/600ml	Plastic cups	Polyporus strips	Insect pin (Pkt)	Larval test kit	Susceptibility test kit	Bio Assay test kit	Aspirator	Insecticide Papers	Petry Dish	Cover Slip	Forceps	Digital Hygrometers
Badulla	6	2		50		4		4	12	1		1				5		1	1		8	40	1		
Monaragala	10	2	1	150		3		5	83	1		1					1	1	1		16				
Maho	6					3												1	1		9				
Puttalam	6	2				3	2								3			1	1		11				
Matale	12	2				4						1						1	1		10				
Baticaloa	12	2				2						1						1	1		10				
Polonnaruwa	12	2	1	50		2			20			1						1	1	10	10				
Hambantota	12	2				4		5	20	1	1				2	10		2	2		15		1		
Kurunegala A	6	2				2									2			2	1		11				
Kurunegala B	9	2				2						1						2	1		9				
Anuradahapura	8										1		5.6		5		1		1		10			3	
Mulathiv	8	2																			10				
Kilinochchi	10	2										1									13				
Mannar	7	2																			11				1
Embilipitiya	8	2										1									8				
Kandy	8	2																			9				
Trincomalee	8	2										1									11				
Ampara	8	2		150					30	1		1									10				
Jaffna	7																1		1		12				
Kegalle	8							10	10					50			2	2	1	10	9				
Kalmunai	8	2										1									9				
Vavuniya	8																				8				

Research

AMC HQ carried out a research project in collaboration with regional entomology teams in Kurunegala and Anuradhapura and Wayamba University of Sri Lanka to evaluate the efficacy of using larvivorous fish to control Anopheline larvae in some selected breeding places in North western, Western and North-Central provinces. Another transmission study which was started in 2011 was completed in 2012 by AMC HQ in the transmission areas in Northern Province. AMC HQ also had a technical cooperation with International Atomic Energy (IAEA) to study the feasibility of using sterile insect technique for integrated control of mosquitoes. Under this project the Entomology laboratory received equipment and consumables for the insectary and two expert visits during 2012 which was the first year of the two year project.

Vector Control Activities

Integrated vector management is the main strategy of malaria vector control in Sri Lanka. Integral components of this strategy are the rational use of insecticides in rotation for Indoor Residual Spraying (IRS), distributing Long Lasting Insecticide treated Nets (LLINs), breeding and introduction of larvivorous fish, environmental modulation and modification through the filling of abandoned gem pits and space spraying for special occasions. Tables 9 and 10 show the insecticides that had been used for indoor residual spraying in different districts.

Lavivorous fish were introduced in to wells and abandoned gem-pits as a biological method of vector control.

Table 9. Insecticides that had been used in different districts for indoor residual spraying

District	Deltamethrin	Cyfluthrin	Etofenprox	Lambda-cyhalothrin	Bifenthrin
Matale			√		
Hambantota	√				
Jaffna	√				
Mannar	√		√		
Kilinochchi	√				
Mullativu	√				√
Ampara					√
Trincomalee	√				
Kurunegala					
Puttalam	√				√
Anuradhapura					
Polonnaruwa	√				
Moneragala					√

During the year 2012, the total number of houses fully sprayed was 20320, partially sprayed was 638 and the total population covered was 75354.

Table 10. Utilization of insecticides for malaria vector control operations in 2012

Insecticides	**Usage during 2012** (kg)
Deltamethrin 5% wdp	886.93
Bifenthrin10% wdp	251.04
Lambda-cyhalothrin 10% wdp	116.75
Etofenprox 20% wdp	116.04
Fenitrothion 40% wdp	64.87

Table 11. Distribution of Long Lasting Insecticides Treated Nets (LLIN) for Malaria Control - 2012

District/ Institution	**No. of LLINs distributed**
Kandy	49,000
Matale	45,000
Hambantota	20,087
Jaffna	28,262
Kilinochchi	20,500
Vavuniya	27,500
Mannar	10,878
Mullativu	13,849
Batticaloa	38,318
Ampara	11,650
Kalmune	70,000
Trincomalie	95,000
Kurunegala	49,000
Maho	38,894
Puttalam	41,000
Anuradhapura	153,250
Polonnaruwa	7,500
Badulla	16,250
Moneragala	58,837
Ratnapura	1,500
Kegalle	2,975
Total	**799,250**

Infrastructure and Human Resources

At the end of year 2012, AMC Headquarters had following category of staff. The below Table 12 shows the number of staff in each category as at the end of year 2012.

Table 12. Staff position at Anti Malaria Campaign Headquarters – 2012

Category of staff	Approved cadre	In position	
		Male	Female
Administrative Grade MOO	2	2	0
Community Physicians	3	1	1
Parasitologist	1	0	1
Entomologist	2	0	2
MOO Gr I	5	2	0
MOO Gr II		0	1
MOO Preliminary		0	0
Accountant	1	0	1
Development Officer	5	0	0
Development Assistant	4	2	2
Health Education Officer	1	0	0
Information, Communication & Technology Officer	1	0	0
Information, Communication & Technology Assistant	2	0	1
Public Management Assistant Services	17	3	6
Public Health inspectors	2	2	0
Planning & Programme Assistant	1	0	0
Entomological Assistant	6	4	2
Entomological Assistant (Special Grade)	1	0	0
Medical Supplies Assistant	3	0	0
Medical Record Assistant	1	0	0
Medical Laboratory Technicians	3	0	0
Public Health Field Assistant	10	2	1
Public Health Laboratory Technicians (Special Grade)	2	0	0
Public Health Laboratory Technicians	22	4	8
Cinema Operator	1	0	0
Driver	19	19	0
K.K.S.	1	2	0
Roneo Operator	0	0	0
Lab Orderly	3	0	1
Spray Machine Operator	19	9	0
Saukya Karya Sahayaka (Junior)	20	3	3
Saukya Karya Sahayaka (Ordinary)	25	30	2
Labourer (Casual)	0	1	0
Registered Medical officer	1	0	0
Ward Clerk	0	0	1
Lift operator	2	2	0
Total	***186***	***88***	***33***

Vehicles

Adequate number of vehicles in good condition is an important factor in effective malaria control activities throughout the country including the north and east. In 2012 AMC Headquarters had the following number of vehicles.

Table 13. Vehicles available at Anti Malaria Campaign Headquarters

Type	Reg. No.	Road Worthy	Available at HQ
Mitsubishi Fuso Lorry	42-1607	Yes	Yes
Mitsubishi Fuso Lorry	42-9399	Yes	Yes
Mitsubishi Fuso Lorry	LC-0249	Yes	Yes
Mitsubishi Pajero jeep	32-6520	Yes	Yes
Mitsubishi L200	42-1615	Yes	Yes
Mitsubishi L300	GP-2558	Yes	Yes
Mitsubishi L300	GP-2556	Yes	Yes
Mitsubishi Double-cab	JL 8129	Yes	Yes
Toyota D/Cab	GQ-2646	Yes	Yes
Nissan Caravan	NA-3117	Yes	Yes
Ford Ranger D/Cab	PA-4589	Yes	Yes
Micro D/Cab	PB 6537	Yes	Yes
Micro D/Cab	PB 6539	Yes	Yes

Drugs

A buffer stock of antimalarial drugs to face any emergency is available in the Headquarters. The following table shows the distribution of drugs for districts in the year of 2012.

Table 14. Distribution of anti malarial drugs from Headquarters by recipient

Recipient	Chloroquine tablets	Primaquine tablets	Quinine tablets	Quinine injection
Ampara	1000	1500	-	-
Anuradhapura	-	2000	-	-
Badulla	-	1500	-	-
Colombo	2000	1920	250	100
Embilipitiya	2000	1500	-	-
Hambantota	-	1500	-	-
Kandy	1000	3000	-	35
Kegalle	3000	1500	-	50
Kilinochchi	-	2500	-	-
Kurunegala	-	3000	-	-
Maho	1000	1500	-	-
Mannar	-	2000	-	-
Matale	-	1500	-	-
Moneragala	-	1500	-	-
Puttalam	1000	1500	-	-
Trincomalee	-	1500	-	-
Vavuniya	-	2000	-	-
Batticaloa	4000	2500	-	-
Jaffna	-	1700	-	-
Mullativu	-	2000	-	-
Polonnaruwa	-	1500	-	-
Kalmune	-	500	-	-
Total	**15000**	**39620**	**250**	**185**

Buildings

The Anti Malaria Campaign Headquarters is located at the Public Health Complex at 555/5, Elvitigala Mawatha, Colombo 5. The Director's room, Deputy Director’s room, Project Director's room of GFATM, Consultant Community Physicians room, Medical Officers room, GFATM project office, library, computer room, telephone exchange and auditorium are in the 3rd floor. The Administration branch, finance branch, record room and stores are located in the 5th floor. The Central Parasitology Laboratory and Entomology Laboratory are located in the 6th floor.

Foreign funded malaria control activities in the year of 2012

During the year 2012, GFATM and WHO assisted malaria elimination activities in Sri Lanka.

Assistance from the Global Fund to fight AIDS, Tuberculosis and Malaria (GFATM)

During the year 2012, National Malaria Elimination Programme continued to receive support from the GFATM in the form of one grant for malaria elimination under the Round 8. The Round 8 project is jointly implemented through a partnership between the Ministry of Health, Tropical Disease Environment Associates (TEDHA) and Lanka Jathika Sarvodaya Shramadana Sangamaya of Sri Lanka.

GFATM Round 8 Malaria Elimination Project

This project aims at scaling up efforts of the National Malaria Control Programme and focus on elimination of *P. falciparum* malaria by end of 2012 and elimination of *P vivax* malaria by end of 2014. Round 8 GFATM Project covers all the districts in the country.

The following activities were carried out during the year 2012 under this project.

- **Conducting malaria mobile clinics**

Two thousand six hundred and forty malaria mobile clinics were conducted (97% of target achieved) to reduce malaria transmission among vulnerable and mobile populations through early detection and treatment. A total of 194,110 blood smears examined from all project districts and no positive cases detected.

In general, the criteria for selection of a site to conduct mobile malaria clinics were:

- malaria case/s reported from the locality
- remote areas with poor access to health care institutions (>10 kms from an institution)
- traditionally malarious areas
- mobile high risk occupational groups – (eg. chena cultivators, gem miners, people working in quarry pits)
- development areas
- new settlers

- **Distribution of Rapid Diagnostic Test-kits (RDTs) to improve diagnostic facilities**.

  A total of 35,000 Rapid Diagnostic Test kits were purchased and distributed to districts for enhancing malaria diagnosis. These RDTs were mainly distributed to medical institutions without a Public Health Laboratory Technician to carry out microscopy. In addition other government medical institutions in project districts were also provided with RDTs to strengthen diagnosis and management of malaria patients.

- **Enhanced entomological surveillance**

  Fourteen additional days per month were funded through the project to augment the entomology component of the Provincial Malaria Control Programme with a view to forecasting and preventing malaria outbreaks and epidemics.

- **Strengthening of entomological and parasitological laboratories at district level by providing necessary equipment & consumables**

  Hand lenses, digital hygrometers, dissecting sets, forceps, larval vial tubes and chemicals for entomological investigations were purchased during this period for strengthening of regional laboratories.

- **District level in-service training programmes.**

  Thousand five hundred and seventy one field staff were (PHII, PHFOO, PHLTs, PHFO & SMOO) trained on malaria elimination activities.

- Monthly review meetings were carried with the participation of Regional Malaria Officers, Technical Staff of AMC Headquarters and representatives from Sarvodaya and TEDHA, at Anti Malaria Campaign Headquarters assess to the progress of malaria elimination activities qualitatively and quantitatively.