3. VECTOR BORNE DISEASES

3.1. Post Tsunami situation analysis of environmental factors with reference to risk in vectorproliferation andmalarialoutbreak

The earthquake under the sea, which caused the tsunami on 26 December 2004, caused extensive damage in the Andaman & Nicobar Islands, which are classifiedasseismiczone5,indicating high level of risk duetoearthquakes. Run-up level of seawater (abovenormaltideormeansealevel)duringtsunami variedfrom1.4to7.0min selected locationsandthe distancepenetration from thecoast ranged from 100 to250m.MostofthenorthernAndamanIslandswere

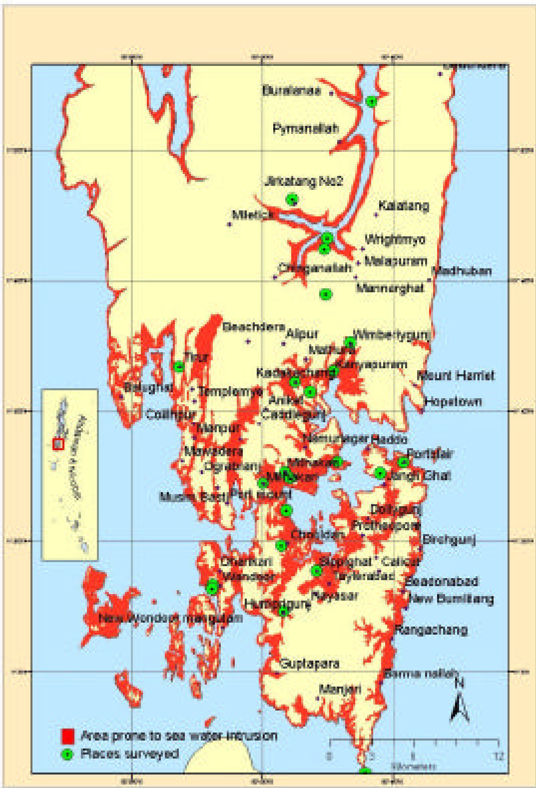

Fig. 3.1.Map showing the locationofvillages and areas vulnerable for sea water intrusion from the seaorcreeks inSouthAndaman

uplifted, but subsidence of 1to 1.5 m was reported from Port Blair and Ross Island (South Andaman). LittleAndamaninAndamandistrictwasuplifted by 1 m. The damage to human lives and belongings was highestinNicobar,lessinAndamandistrict.

We carried out an extensive survey in collaboration with the Vector Control Research Centre (ICMR), Pondicherry in Andaman district covering both the SouthAndamanandMayabundersubdivisionsduring March 2005, two months after the disaster. The objective was to assess the environmental risk and consequentrisk ofmalariaduetoseawaterinundation following the tsunami. Two sub-districts (Port Blair and Ferrargunj), with a population of approximately 208,000 in South Andaman, are still affected by seawater inundation. There are two major creeks, WrightMyointhemiddleandShoalBayinthenorth. 22locationsweresurveyed(Figure3.1).Detailsofthe source and frequency of seawater intrusion, environmental risk in terms of altered ecological parameterssuchassalinity,damagetothecrops,type, and extent of habitats flooded were collected. Mosquito breeding waschecked in differenthabitats. Water samples along with larval samples were collected from these habitats. Salinity, pH, mosquito speciescomposition,andtheirimmaturedensity were recorded. Density of anopheline species was categorizedbased onaveragenumberoflarvaeperdip into level 1 (1-10), 2 (11-100) and 3 (above 100). Larvae, collected from the selected habitats were reared toadultsforspeciesidentification. Both larval and adult characters were used for species identification.

Fig. 3.2.Destruction of arecanut and coconut grooves due toseawater inundation

Seawater inundation was observed to recur both directly from the sea (Chouldari and Wandoor) and through the network of creeks (Sippighat in Port Blair, Bambooflat, and Wimberlygunj). The areas inundated havebeen categorized intothreetypes: (i) areaswhereseawater intrusion occurred onceduring the tsunami leaving sheets/pools of stagnant water which were gradually drying up, (ii) areas where intrusion of seawater recurs periodically at spring tide depending on the lunar cycle and (iii) areas whereinundation takesplacetwicedaily duetohigh tides. Damage to the areca nut (Figure 3.2) and coconut grooves, banana plantations and paddy cultivation (Figure 3.3) was extensive in the seawater-floodedareas.Inafewpockets(Sippighat), even mangroveswereaffected and this could be due to sudden rise in salinity. Areas associated with Wright Myo creek in between Port Blair and Bambooflatwereextensively affected. Inundationof inland low-lying areas during high tide became a concern to thelocal population as their houses were marooned in seawater. Shoal Bay in the north traverses through reserve forest, which is elevated and was not prone to seawater intrusion. Similarly, LittleAndaman, which is the Southern most part of the Andaman, was free from seawater intrusion, though there werewaterlogged areas created by the tsunami waves. Middle and North Andaman are

Fig. 3.3.Paddy field flooded with seawater

elevated areas within short distance from the seacoast. Due to cliff and forests, there was no area prone to seawater inundation. Apart from seawater logging inthepaddyfieldsandfallowlands,intrusion of seawaterhadresulted in thefloodingoffreshwater pondsand canalsandcreation of a numberof swamp poolsandstagnantpools.

A total of 46habitatsweresurveyed and 38 of them wereeithercreatedbyorundertheinfluenceseawater intrusion.Thelocation of thesurveyandthetypeof habitats in relation to frequency and source of seawater intrusion are given in Table 3.1. Examination of thesehabitatsshowedthebreedingof Anopheline mosquitoes in 35 habitats *Anopheles sundaicus* was found in at least 19 (54%) of these habitats. Habitats supporting breeding of this vector species were widespread in South Andaman. Vector breeding wasobserved in 77% of the habitats under the influence of spring tide while it was 46% in habitats flooded once during tsunami and 25% in habitatswithdailyseawaterintrusionduringhightide. The larval density was dense (11-100 larvae/dip) in habitats prone to spring tidewhileitwassparse(1-10 larvae/dip) in habitats under continuous influence of tidal waves (Table 3.1). These habitats were also found to support thebreeding of *Anopheles subpictus* (71% of the positive habitats) and *Anopheles vagus*, vectors implicated elsewhere. The salinity in the habitatsundertheinfluenceofseawaterintrusionwas found to range between 3,000 and 42,505 ppm (parts per million). The salinity in the habitats such as streams, ponds and stream pools, swamps was less than 1,000 ppm. The mean salinity level was 30,668 and 28,026 ppm respectively in habitats under the influence of spring tide and every day high tide. Habitats flooded with seawater once during tsunami were recorded with a mean salinity level of 18,250 ppm. Breeding of *An. sundaicus* was found in habitats with salinity ranging between 3,331 and 42,505, with a mean of 25,150 ppm. pH was found to range between 6.0 and 8.7 in different habitats.

Temporal analysis of malaria data (active and passive surveillance of fever cases) from the Directorate of Health Services showed that Slide Positivity Rate (SPR) for malaria in Andaman district fluctuated between 0.2 and 0.4% in different months during 2003 and 2004. There was about 56 fold increase in SPR during the months following tsunami.

Thus an extensive survey carried out in the Andaman district shows risk of vector proliferation and consequent risk of malaria outbreak in the tsunami-affected areas in the Andaman district of the Andaman and Nicobar Islands. Environmental damage with altered ecological factors was observed in South Andaman, covering Port Blair and Ferrargunj sub-districts. With the evidence of land subsidence, this area with a population of approximately 208,000 is bound to suffer from the recurring phenomenon of seawater intrusion either directly from the sea or through the network of creeks. Both daily cycles of high tides and periodical spring tides continue to cause flooding. Low-lying paddy (destroyed) fields and fallow land habitats with freshwater, hitherto considered the least potential sites for *An. sundaicus*, are now a major breeding source due to saline water, with the salinity ranging from 3.000 to 42,505 ppm. The extent of these tsunami-influenced breeding grounds and the likelihood of them becoming permanent due to continued flooding are indicative of vector abundance. Both vivax and falciparum malaria occurred in this area but the incidence was low. Proximity of houses to flooded paddy fields and paucity of cattle may lead to higher degree of man/vector contact causing a threat of malaria outbreak in this densely populated and low endemic area. Temporal analysis of malaria cases in Andaman has shown an increasing trend following tsunami. There is an urgent need for a long-term and systematic monitoring of environmental risk and vector surveillance. Considering the man-biting and daytime resting behaviour of *An. sundaicus*, promotion of the use of personal protection measures with long-lasting insecticide-treated bed nets and intensified Early Detection and Prompt Treatment (EDPT) of malaria cases are recommended to prevent the possible outbreak of malaria.

3.2. Assessment of microfilaraemia prevalence and intensity post single round Mass Drug Administration of Diethyl carbamazine

Annual mass drug administration (MDA) using diethyl carbamazine (DEC, 6 mg/kg) combined with albendazole (alb, 400 mg) is recommended by the Global Programme to Eliminate Lymphatic Filariasis (GPELF) for at least four to five years. This approach has been shown to reduce microfilaraemia of *Wuchereria bancrofti* and *Brugia malayi* efficiently.

The National Health Policy 2002 laid down by the Government of India envisages elimination of Lymphatic Filariasis (LF) by the year 2015. In the

Andaman and Nicobar islands, the programme to eliminate LF was launched in 2004 by the Directorate of Health Services, Andaman & Nicobar Administration. The programme was implemented through the Primary Health Centre (PHC) network. It was intended to cover the total population except children less than 2 years of age, pregnant women and very sick patients.

One round of MDA using DEC was administered in these islands during the month of July 2004. The impact of MDA on diurnally subperiodic (*Wuchereria bancrofti-Ochlerotatus niveus*) transmission has not been evaluated. Therefore, a survey was carried out to assess the effect of a single dose DEC mass treatment programme on Teressa Island, endemic for diurnally subperiodic form of filariasis, using a cross sectional study design.

Teressa Island is one of the islands in the Nancowry region. Prior to the tsunami/tidal wave hits, the Nicobarese were residing in 11 villages. As an aftermath of the tsunami, the native Nicobarese have been displaced from their respective villages and are currently staying in temporary shelters/camps located within the forests. In addition, the inhabitants of the adjacent islands viz., Chowra and Bompoka have also been rehabilitated in this island. This island has an area of 87.04 sq.km and currently a population of 3328 Nicobarese is residing in 9 camps. This island was first characterized in 1999 and was found to have a mean parasite load of 27.30 (1-318) among the microfilaraemics, Mf prevalence of 11.83%, disease rate of 5.2% and an overall endemicity rate of 16.2%. Subsequently, another cross sectional survey was carried out in 2000.

The sample for the present survey was drawn from temporary shelters through systematic random sampling, selecting every alternate shelter. Each selected shelter was considered as a sampling unit and all individuals present at the time of survey were screened for microfilaraemia through shelter-to-shelter visits. A total of 1205 (36.20%) individuals residing in different camps were surveyed during the period September-October 2005. The survey was carried between 12:00 and 17:00 h. The Mf prevalence and parasite intensity obtained from surveys carried out in 1999 and 2000 were used as the baseline information to compare the current survey results. Comparisons of coverage and microfilaraemia prevalences of the past surveys and the present survey are shown in Table 3.1 & 3.2).

Fifteen months post single MDA, microfilaraemia (Mf) was assessed by finger prick method. Difference in Mf prevalence was compared using Pearson's $?^?$ statistic. The observed frequency distribution of microfilariae (mff) from the human host was fitted to negative binomial probability distribution model and zero truncated negative binomial distribution. The changes in the mff density distribution were compared using the non-parametric Mann-Whitney U test for independent samples.

Of the 1205 Nicobarese surveyed, microfilaraemia was detected in 151 individuals with an overall Mf prevalence of 12.53% (151/1205, 95% CI 10.71-14.53). Mf rates were found to range between 3.2% (Bengali) and 23.1% (Bompoka) The youngest mf carrier was 1 year old and oldest was 71 years. The prevalence of microfilaraemia was not significantly different ($?^?$ 1.62, p=0.203) between the sexes (Males 56.3% = 85/620 Vs Females 43.7%=66/585). The mean parasite load among the microfilaraemics was 37.31 (range: 1-492). The zero truncated negative binomial distribution model fitted to the data indicated to be a good fit for both pre and post MDA mff count distributions. The estimated 'k' (the degree

Table 3.1.Coverageandmicrofilaraemiaprevalencesintheerstwhilevillagesof TeressaIslandbeforeMDA

			1999			2000-PreMDA	
Sl	**Village**	**Population**	**Sample**	**Mfrate**	**Population**	**Sample**	**Mfrate**
1	Aloora	111	43	16.28	113	33	12.1
2	Aloorang	266	140	13.57	271	86	14
3	Bengali	464	191	8.9	473	157	8.3
4	Chukmachi	158	62	14.52	161	87	18.4
5	Enam	148	74	14.86	151	52	7.7
6	Kalara	31	7	14.29	32	ND	ND
7	Kalasi	326	137	5.11	332	142	7.04
8	Kanahinot	43	20	25	44	ND	ND
9	Luxi	162	86	16.28	165	107	13.1
10	Minyuk	190	86	10.47	194	127	7.1
11	SafedBalu	36	16	18.75	37	25	16
	Total	**1935**	**862**	**11.83**	**1971**	**816**	**10.51**

Table 3.2.Coverageandmicrofilaraemiaprevalencesinthecampsof TeressaIslandafter MDA in2002

Sl	**Village**	**Population**	**Sample**	**Mfrate**
1	Aloorang	284	160	15
2	Bengali	400	93	3.2
3	Chukmachi	204	89	16.9
4	Enam	228	129	20.9
5	Kalasi	467	186	10.22
6	Luxi	160	100	23
7	Minyuk	247	91	11
8	Chowra	1300	344	7.8
9	Bompoka	38	13	23.1
	Total	**3328**	**1205**	**12.53**

of parasite aggregation) values for pre MDA (k= 0.18, 95% CI= 0.018 -0.37) and MDA-I (k= 0.23, 95% CI= 0.10-0.38) do not differ significantly (95% CI for 'k' overlap). This suggests that the degree of parasite aggregation is not different between pre and post MDA. Geometric mean intensities (GMI) of mff in 2000 (pre MDA) and 2005 (MDA-I) did not show any significant difference (Z= -1.38, P=0.17) between pre (GMI=0.3283, 95% CI=0.2453-0.4162) and MDA-I (GMI=0.4044, 95% CI=0.3264-0.4869).

There was no significant difference in the mf prevalence and GMI of mff densities between pre MDA and post MDA. Thus, there is no perceivable impact of single round MDA on the parasite intensity and the prevalence of microfilaraemia on Teressa Island. The findings have implications for fine tuning the future rounds of MDA to accomplish the ultimate goal of eliminating filariasis from these islands.

DR. S.J. HABAYEB DURING HIS VISIT TO THE CENTRE DURING THE HANDS-ON WORKSHOP ON LEPTOSPIROSIS, AUGUST 2005