Summary and conclusion
7. SUMMARY AND CONCLUSION

Of the twenty-five species of anophelines recorded in the erstwhile Koraput district of Orissa State, *An. fluviatilis* has been considered as the major vector while *An. culicifacies* playing a supporting role. In the distant past, *An. varuna* and *An. jeyporiensis* was also incriminated as a vector, but recent studies could not find any natural infection in this species. Another five species viz., *An. subpictus, An. splendidus, An. pallidus, An. tessellatus* and *An. theobaldi* which are also abundant in the area, have not been found with natural infection. Their vector potential in the study area remained unclear. Information on susceptibility of these species to malaria parasites may be helpful in determining their relative vector potential. Literature available on the susceptibility status of some of these anopheline species were based on experiments with colonized mosquitoes and parasites of different geographical origin, and hence may not represent the local genotypes. All the nine species mentioned above were allowed to take blood meals on human volunteers infected with *P. falciparum, P. vivax* and *P. malariae*. Development of parasite species in vectors and their relative infectivity in terms of oocyst and sporozoite infections were studied.

The most significant finding was that all the nine anophelines were susceptible to the local strain of *P. falciparum*, and the degree of variation is not as great as expected from the differences in their importance in nature. Their importance in malaria transmission seems to be limited by their man feeding habit and longevity. This is the first documented experimental study showing the susceptibility of *An. jeyporiensis, An. splendidus, An. pallidus,* and *An. theobaldi* in India. Except *An. tessellatus* all the other 8 anophelines developed sporozoites in their salivary glands. As many as 10.85% *An. tessellatus* was infected with *P. falciparum* oocysts but this species could not complete sporogonic development even though the infected
individuals survived up to 21 days. Some proportions of An. fluviatilis and An. jeyporiensis also became infected to P. vivax and P. malariae but to a lesser extent as compared to P. falciparum. Only 0.42% of An. culicifacies supported the development of P. vivax but none of P. malariae. There was no development of P. vivax and P. malariae in An. subpictus.

In general, the infectivity of P. falciparum gametocytes was comparatively higher than P. vivax and P. malariae. Under laboratory conditions, An. fluviatilis was a more competent vector of P. falciparum, P. vivax and P. malariae than the other anophelines tested. The role of other anophelines in the transmission of malaria parasites may not be important in the normal situation. However, their possible role can not be ruled out during the unusual climatic conditions or when there is a change in the cattle-man ratio, as most of these anophelines are competent to develop the parasites up to sporozoite stage. The greater propensity for animal feeding explain their incapacity of vectorial status in nature, except An. subpictus, in which a shorter life span may be an important limiting factor. Infection with malaria parasite did not seem to affect the normal longevity, implying tolerance of malaria infections by all the anophelines studied.

Since eight of the nine anopheline species studied supported the development of P. falciparum up to sporozoites, there is need to monitor other parameters such as seasonal density, infection rate, longevity and anthropophilic index of these anophelines particularly when there is an unusual increase in incidence or during outbreaks and in circumstances when the major vector is less abundant. There is a possibility that some of these mosquito species may take over the vectorial role in this area during favourable conditions.
The study suggested the possibility of existence of two biologically distinct populations strains of *An. fluviatilis*, by virtue of differences in the susceptibility to malaria parasites. This has been confirmed by the cytotaxonomic identifications of the two populations. The species from Malkangiri was found to be significantly more susceptible than that from Jeypore. The variation in the vector competence of *An. fluviatilis* between the two zones might be the result of the distribution of sibling species. The study also suggests the possibility of two distinct populations strains of *P. falciparum*, the one from Malkangiri being significantly more infectious to *An. fluviatilis* than that from Jeypore.

Observations were made on the relationship of gametocyte count in the donors with infection rate in the mosquitoes. A positive correlation existed between *P. falciparum* gametocyte count and mean number of oocysts per infected mosquito. A non-linear relationship was observed between gametocyte count in the donors infected with *P. falciparum* and infection rate in the mosquitoes. It appears that the infection rate increases with the increase in gametocyte count and beyond 16-20, there is a limitation. This implies that even moderate gametocyte density in the community could facilitate transmission.

No significant correlation existed between infection rate in the mosquitoes and sex ratio of *P. falciparum* gametocytes in the donors. Similarly, there was no significant relationship between asexual parasitaemia in the donors and parasite infection in mosquitoes.

Gametocytes in the donors of younger age groups (1-14) appear to be more infectious to the mosquitoes, while the gametocytes in the donors of higher age groups (>14 yrs) are less infective. Therefore, for optimizing the control measures, it is necessary to give more emphasis on the carriers of younger age group.
When allowed to feed on the same donor, there was no significant difference in the infection rate between the mosquitoes of younger and older age.

The favourable range of temperature in terms of higher infection rate in the mosquitoes to *P. falciparum* was from 21 °C to 22 °C. The time required for development of oocyst and sporozoites at this temperature was 4 and 14 days respectively. The development of oocysts and sporozoites took only 3 and 10 days respectively at the range of 31 - 35 °C.

The infection rate determined in the study for all the nine anopheline species to different human plasmodia will be useful for quantitative assessment of their relative vector competence and for targeting and evaluating the vector control measures.