

ECOLOGY OF *ANOPHELES FLUVIATILIS*, THE MAIN MALARIA VECTOR IN SOUTHERN PART OF IRAN, AND ITS ROLE IN THE EPIDEMIOLOGY OF MALARIA

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Abstract This investigation was carried out in several different parts of Iran during 1998-2001. Out of 9799 female *Anopheles* captured by different methods, *An. fluviatilis* comprised 35.5%, *An. dthali* 30.3%, *An. stephensi* 29.4%, *An. sergentii* 4.6%, *An. culicifacies*, *An. turkhudi* and *An. superpictus* were 0.2% of the collected mosquitoes.

In order to find the longevity, survival rate and vectorial capacity, *An. fluviatilis* were collected and dissected with Detinova method. The parous rate was found at 71.4%, 37%, 59.5%, 46.5% in the summer, winter, spring and autumn respectively. Vectorial capacity of *Anopheles fluviatilis* for *Plasmodium vivax* was 2.5, 0.2, 0.4 in summer, autumn and spring but 1.7, 0.07, 0.24 for *P. falciparum*, respectively. The stability index of *An fluviatilis* was estimated to be 0.13 in the warm and 0.58 in the cold season.

Susceptibility test using diagnostic dose of different types of insecticides on *An. fluviatilis* showed that this species exhibit complete susceptibility to DDT 4%, dieldrin 0.4%, malathion 5%, propoxure 0.1%, permethrin 0.25%, lambdacyhalothrin 0.1%. *Anopheles fluviatilis* collected from Sistan and Baluchistan, Fars, Kohgiluyeh and Boyer ahmad and Bousher provinces are similar to T sibling species belonging to an Indian species. Using PCR method, the specimens caught from Hormozgan province were different from T sibling species.

At present in Iran, malaria can be considered a health problem in three provinces of Sistan and Baluchistan, Hormozgan and Kerman. The duration of malaria transmission is up to 10 months in coastal and 8 months in mountains area, two district peaks of malaria transmission occur in this area, one in April - May and the other in October – November. *Plasmodium vivax* and *P. falciparum* are 2 malaria parasites present in this region.

Residual spraying (two rounds per year) was practiced for many years. *An. fluviatilis* James has a wide distribution in India, Pakistan, Afghanistan, Nepal, Ceylon, Burma, Thailand, Indochina, Formosa, China, Iraq, and Iran, Kazakhstan in north and Saudi Arabia, Oman, Bahrain, Yemen in south. This species is an important anopheline and vector in Sistan and Baluchistan, Kerman, Fars, Hormozgan and Bushehr provinces.

This investigation was carried out in Sياهو area during 1998-2000, with a total population of about 9790, located in north of Bandar Abbas, where the annual incidence of malaria averages about 25-35 per thousand population. Anti malaria measures are applied in this area such as indoor residual spraying with DDT, dieldrin, malathion, propoxur, actellic and lambdacyhalothrin larviciding with oil and abate, release of *Gambusia* and *Aphanius* fishes, active and passive case detection and mass drug distribution as prevention and treatment malaria transmission is still going on. All mosquito control activity had been stopped in the survey villages but larviciding was performed during the study. An entomological evaluation was carried out by space spray collection, light trap, window trap, pit shelter, human and animal bait collections in each village every 15 days intervals.

Night biting collections using man and animal baits in three villages started at the beginning of the seasonal activity of vectors and continued during the study, two cow and two men were considered as baits, collection was made between 18.00 to 06.00 hours fortnightly intervals. The anopheline species were collected and classified according to the blood digestion stage (empty, freshly fed, half-gravid, and gravid). Female mosquitoes were dissected and scored as nulliparus and parous on the basis of the tracheal skin of their ovaries and scored as number of dilatation or sac of their ovaries. Human biting rate habit, expectation of life and infective life of vector also vectorial capacity, stability index, gonotrophic cycle has been detected by Macdonald's formula. Adult susceptibility tests were carried out using field population of blood fed or semi gravid of female *An. fluviatilis* collected between 1800 to 0600 hours during the study. The method used for susceptibility test was that recommended by WHO. Papers impregnated with DDT 4%, dieldrin 0.4%, malathion 5%, propoxur 0.1%, lambdacyhalothrin 0.1%, permethrin 0.25% and olive oil as control were supplied by WHO. The anopheline female were transferred to clean holding tube after 60 minutes exposure to the toxicant tube and the mortality was calculated 24 hours maintenance in insectarium (26 °C, 60% RH). Out of the 3480 female *Anopheles fluviatilis* collected 83.2% were obtained by animal baits, 7.8% by space spray collection, 7.5% in human baits, 0.86% in pit shelter and 0.7% in light trap. Seasonal activity of *An. fluviatilis* showed two peaks in November and May. This species was active throughout the night with one peak of blood meal, 2200-2300 hours on animal and 2400-0100 hours on human. Of the 1006 females dissected, 92.3% one dilatation, 5.1% two, 0.7% three and 0.1% five dilatation was obtained.

In this study, gonotrophic cycle was obtained at 3.2, 2.7, 3 and 5 days in spring, summer, autumn and winter respectively. Adults susceptibility test using diagnostic dose of different insecticides showed that this species exhibits susceptible to DDT, dieldrin, malathion, propoxur, lambdacyhalothrin and permethrin.

In order to determine the existence of sibling species of *Anopheles fluviatilis*, several numbers of this species were collected from its distribution area and 215 species was sent to Liverpool school in England. Results showed that *Anopheles fluviatilis* collected From Sistan and Baluchistan, Fars, Kohgiluyeh and Boyer ahmad and Bousher provinces are similar to T sibling species belonging to the Indian species but the specimens caught from Hormozgan province were different from T sibling species.

Results of this study implicate that this species can play an important role as a main malaria vector in mountainous area of Hormozgan province, Iran.