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Spiders in Mosquito Control

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Abstract

Vector carries a disease causal organism from one host to another. Many invertebrates' viz. flies, mosquitoes, bugs, fleas, myriapods etc. are reported as vectors of diseases of man and animals. Mosquitoes transmit malaria and viral infections, many of which are deadly to humans. Dengue is the fastest emerging tropical disease. Spiders play a vital role in controlling these vectors thus act as potent agent of biological control of vectors Spiders of family Tetragnathidae, Lycosidae, Pisauridae and Trechaleidae which inhabits in the vicinity of water sources, where larvae flourished in large numbers, have been reported to feed on them. Family Lycosidae exhibited highest consumption rate 64.7 (±27.43 SD) followed by 60.85 (±41.79 SD) in Salticidae. Many species of spiders from Araneidae, Salticidae, Pholcidae and Oxyopidae families predate on flying mosquitoes. The present paper describes the role of spiders in controlling vectors.

Keywords: Vector, mosquitoes, spiders, biological control.

1. Introduction

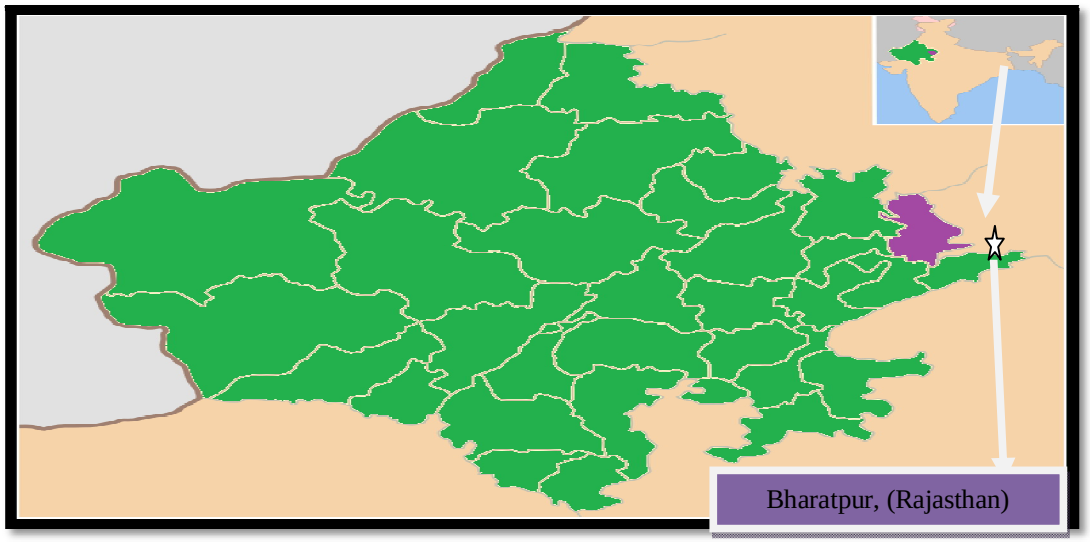
Vector-borne diseases are infections transmitted by the bite of infected arthropod species, such as mosquitoes, ticks, bugs, sand flies, and black flies (Confalonieri U *et al*. 2007). Malaria afflicts 36% of the world population i.e. 2020 million in 107 countries and territories situated in the tropical and tropical regions. Of the 2.5 million reported cases in the South East Asia, India alone contributes about 70% of the total cases (*http://www.searo.who.int/).* Mosquitoes are vectors for many important diseases in India. Mosquito borne diseases continue to be a major problem in almost all tropical

and subtropical countries in the present era of climate change. They are responsible for the transmission of the pathogens causing some of the most life – threatening and debilitating diseases of man, like malaria, yellow fever, dengue fever, chikungunya, filariasis, encephalitis, etc. Biological control has a very positive role to play in the integrated control methodologies in which both pesticides and fish or other biotic agents have their own roles. Spider have largely overlooked as predators of mosquitoes and its larvae in various ecosystems. Bishop and Hart (1931) were the first to report a spider (*Pardosa sternalis)* consuming a mosquitoes larvae in a small gravel pit pool in Colorado. Garcia and Schlinger (1972) also reported conception of mosquito larvae by *Pardosa sternalis*. Service (1931) found a species of *Lycosa* and one *Pardosa* testing positive for *Anopheles gambiae* Giles in a precipitin analysis, but implied they probably attacked only emerging mosquito adults. Ximena *et al.* (2005) studied the behavior of jumping spiders and found that they possess innate predisposition to adopt *Anopheles*-specific prey-capture behavior. They proved that the spiders can recognize the sitting posture by which the small juveniles of jumping spiders identify *Anopheles.* Malaria constitutes the most widespread infectious disease, affecting over 300 million people (Snow *et al.* 2001, 2005). Resistance of *Plasmodium* species to classical anti-malarial drugs is becoming a critical problem and new drug targets against *Plasmodium* are urgently needed. Spiders consume a lot of mosquitoes (Lawania *et al.* 2013) thus their potential as a bio-control agent of mosquitoes was tested in laboratory.

2. Material and Methods

2.1 Study area-

The study was conducted in Bharatpur District of Rajasthan. The study Area is dry tropical deciduous type Maximum and minimum temperature recoded in winter and summer were 24^0C and 1^0C and 49^0C and 27^0 C, respectively and average relative humidity (RH) was 54.8%. Study area has semi-arid climatic region. The climatic conditions are good for survival and reproduction of mosquitoes and other vectors. Due to this vector-borne diseases are widespread in Bharatpur city. Many cases of dengue, malaria, were reported in Bharatpur district in last years'. 3096 cases were reported positive for malaria and 32 cases of Dengue fever were also reported from Bharatpur district 2012. The present study was conducted from June to September 2013.



Map courtesy: Google map of India

2.2 Methodology-

The water with larvae complex of *Aedes sp*., *Culex sp*. and *Anopheles sp,* was collected during the rainy seasons (June to August 2013) from rural and urban areas of Bharatpur district. The larvae were collected from domestic and peri-domestic containers. Bushes tree trunks, forest floor, foliage and grass lands were all searched for the adults mosquitoes and spiders and collected by using various methods such as hand picking , pitfall trapping, sweep netting, cryptic searching. Collected mosquitoes and spiders were preserved and identified by using standard reference. The identification of spiders was done following Tikader (1980, 1982, and 1987), as well as pictorial guide (Levi, 2002; Sebastian & Petar 2009) and identification of mosquitoes was done following (Leopoldo M. and Rueda 2004). The mosquito larvae were identified by trained persons of Malaria Department, Bharatpur. The Collected spiders and mosquitoes specimens were preserved in 70% ethyl alcohol with a few drops of glycerin (Prasad, 1985), and after this the experiments were conducted and studied the predatory potential of spiders on mosquitoes and its larvae in the laboratory, at room temperature, and average consumption rate was calculated.

3. Results

Experiment was conducted to study of the predatory potential of 7 spider families on larvae and adults of mosquitoes. Spider were collected from different habitat (Table-I) and maintained in the experimental setup, made by glass and cover by cloth sheet (Size- length 2”, breadth 1” and height 4”). Each was provide one species of spiders. At first, equal quantity of mosquito larvae was introduced in all 7 experimental setup. After 24 hours the reading were taken and average consumption rate of each spider

families on mosquito's larvae was calculated. The same experiment was repeated for adult mosquitoes.

Table I: List of spider families and species, use as a predator on mosquitoes during the experiment.

Family	**Species**	**Habitat**
Araneidae	(i) Argiope aemula	Gardens
	(ii) Argiope anasuja	Gardens
Lycosidae	(i) Lycosa pictula	Common in grassland, near water bodies
	(ii) Perdosa biramnica	Common in grassland, near water bodies
Oxyopidae	(i) Oxyopes biramanicus	Grass and low shrubs
	(ii) Oxyopes sp.	Grass and low shrubs
Pholcidae	(i) Artema Atlanta	Human habitation
	(ii) Pholcus phalangiodes	Human habitation
Salticidae	(i) Plexippus paykuli	Bushes and medium size plants
	(ii) Phidippus pateli	Walls of bulding and tree trunks
Tetragnathidae	(i) Leucauge decorate	Gardens near water bodies
	(ii) Leucauge sp.	Gardens near water bodies
Pisauridae	(i) Pisaura sp.	Gardens near water bodies

Table II: Average consumption rate (%) of the spiders on mosquitoes (larvae and adult).

Name of spider Family	**Mosquitoes**		**Average rate of consumption (%) Mean (±SD)**
	Adults	**Larvae**	
1. Araneidae	87.2	19.4	**53.3 (±47.94)**
2. Lycosidae	45.3	84.1	**64.7 (±27.43)**
3. Oxyopidae	78.7	17.6	**48.15 (±42.75)**
4. Pholcidae	75.4	16.7	**46.05 (±41.50)**
5. Salticidae	90.4	31.3	**60.85 (±41.79)**
6. Tetragnathidae	11.7	82.8	**47.25 (±42.05)**
7. Pisauridae	14.5	76.7	**45.6 (±43.98)**
Average (%)	**57.6**	**46.94**	

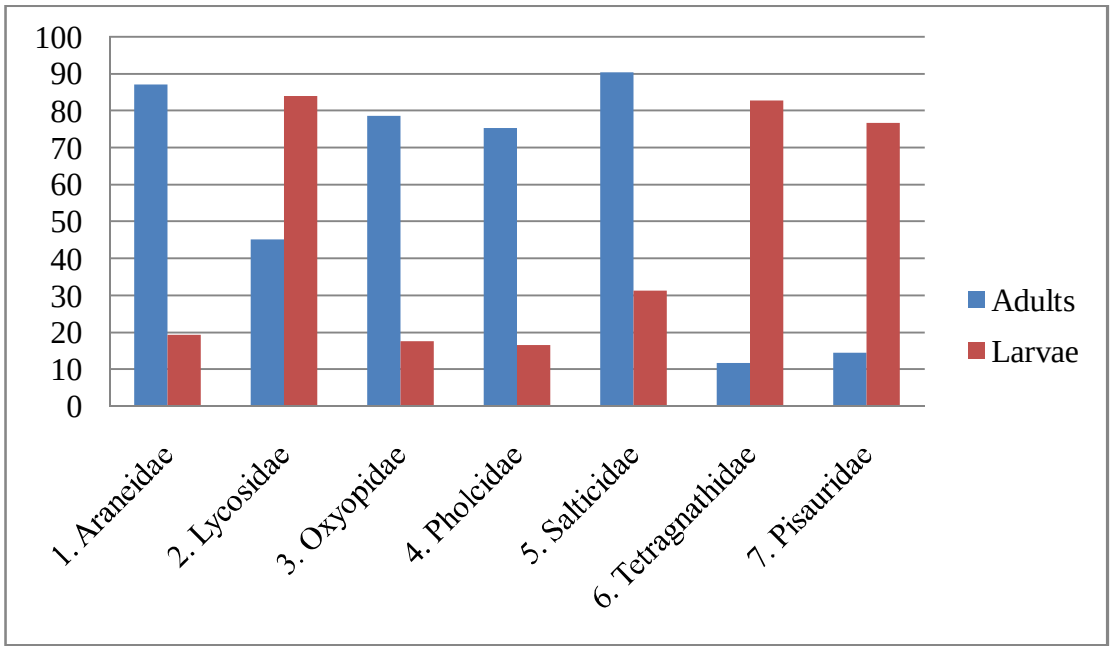


Fig. 1: Percent (%) consumption of mosquitoes by spider families.

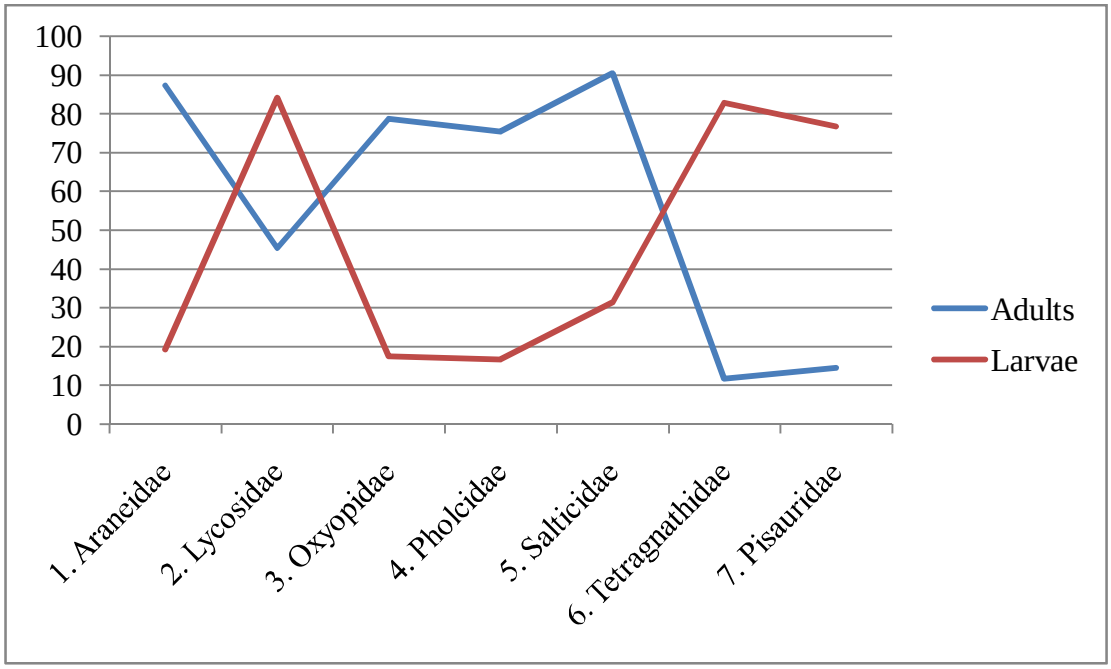


Fig. 2: Line diagram showing consumption (%) of larvae and adult mosquitoes by different spider.

4. Discussion

The result (Table II) shows that families Salticidae and Araneidae exhibited high predatory potential on adults' mosquitoes followed by Lycocidae and Tetragnathidae followed by Pisauridae and Salticidae.

The rank wise sequence of 7 spider families base on the consumption of larvae and adults of mosquitoes, were found as-

On the mosquitoes larvae - Lycocidae > Tetragnathidae > Pisauridae > Salticidae > Araneidae > Oxyopidae > Salticidae.

On the adults mosquitoes – Salticidae > Araneidae > Oxyopidae > Pholcidae > Lycocidae > Pisauridae > Tetragnathidae.

5. Conclusion

Mosquitoes cause more human suffering than any other organism -- over one million people worldwide die from mosquito-borne diseases every year. Not only can mosquitoes carry diseases that afflict humans, they also transmit several diseases and parasites that dogs and horses are very susceptible to. In addition, mosquito bites can cause severe skin irritation through an allergic reaction to the mosquito's saliva - this is what causes the red bump and itching. Biological control has a very positive role to play in the integrated control methodologies. As biological mosquitoes control agent, larvivorus fish are being used extensively all over the world since early 1900S (Pre DDT era). Spiders (Families like Salicidae, Lycocidae, Areneidae, and Tetragnathidae) can be effective predators of mosquitoes and other disease vector organism and can exert considerable top-down control. Spiders exhibit the ability to both lower and stabilize mosquitoes and other disease vector's populations, making them excellent biological vector management candidates.

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