

Asian Resonance

Insect Fauna and Its Ecological Features in Kot Dam in the Northern Aravalli Range Bordering Indian Desert

Paper Submission: 15/10/2020, Date of Acceptance: 25/10/2020, Date of Publication: 26/10/2020



Saroj Bugalia

Associate Professor,
Dept. of Zoology,
S.K. Govt. Girls P.G. College
Sikar, Rajasthan, India



Neena Gupta

Associate Professor,
Dept. of Zoology,
S.K. Govt. Girls P.G. College
Sikar, Rajasthan, India

Abstract

The Kot dam is situated in the western foot-hills of the Aravalli bordering the Indian desert. It holds water that has narrower and lower ranges of temperature, pH, EC, TDS and alkalinity as compared to the surface waters in the Indian desert. It has better light penetration and dissolved oxygen and reveals considerably narrow range of seasonal thermal fluctuations.

Insect fauna in the dam, studied for 15 months, was represented by 19 species belonging to orders Coleoptera (8), Hemiptera (7), Odonata (1) and Diptera (3), besides some larval forms. The total insect population ranged from 5 to 112/l with an annual average of 35/l. The periodicity of occurrence was different among insect genera, however, most of the forms preferred the period of moderate environmental conditions during monsoon and early winter. The coleopteran species belonged to five families. Hemiptera was represented by eight bug species belonging to six families. *Notonecta glauca* was the most dominant bug. While *Culex* larvae were recorded during monsoon in the water column, rat-tailed larvae and *Chironomus* larvae were recorded from the littoral sediments. Former two were found only during late monsoon; whereas latter one was recorded throughout the year in considerably high number during monsoon and winter.

The dam shows many a species common with those in desert waters, however, some of them differ in their population and seasonality of occurrence. Greater component of bugs than beetles is a striking feature of this Aravalli water that is absolutely opposite to most of the desert waters which offer more tough conditions of existence that are of course well tolerated by hardy beetles.

Keywords: Kot Dam, Fauna, Limnology, Coleoptera, Hemiptera, Odonata, Diptera.

Introduction

The Aravalli is one of the oldest mountain ranges of the country. Running from Khetri in the east to Sirohi in the south, it bisects the state of Rajasthan into two unequal parts. The region northwest to the range constitutes the major part of the Indian desert while the southeast plains are relatively fertile lands. Making a fringe between two diverge land ecosystems, it acts as an ecotone representing a blend of flora and fauna of both the regions (Saxena, 1997).

Although the desert region of the state is devoid of major and perennial bodies of water but the western slopes of the Aravalli hold quite a good number of perennial waters, particularly lakes and reservoirs. As of land, the community of aquatic ecosystems in the Aravalli range was supposed to be characteristic, demonstrating the edge effect. Therefore, the diversity and population dynamics of fauna of the Aravalli waters, as compared to those of western and eastern diverge regions, was expected to project a characteristic picture.

In view of the above facts, the present study was undertaken to explore the diversity, population density and dynamics, and related ecological aspects of the fauna in Kot Dam situated in the northern Aravalli range in Jhunjhunu district, Rajasthan.

Review of Literature

A review of desert limnology was published by Cole in 1968 and Bayly & Williams (1973) have summarised further details. Cole (1979)

E: ISSN No. 2349-9443

reported about the common compounds of dilute inland waters. Details of methods involved in concentration and loss of salts in desert waters were reviewed by Hutchinson (1957) and Cole (1968). Two main groups of arid land waters have been identified and named, thalassohaline and athalassohaline by Cole (1979).

The topography of the State of Rajasthan is characteristic in itself.

The north-west part of the State, limited by the Aravalli range, constitutes a major part of the Indian desert. Although water is a scarce resource here, the region is dotted with a number of surface water bodies ranging from temporary pools, puddles and ponds to a few perennial lakes/reservoirs. These waters have attracted the interest of limnologists, particularly during last three decades.

Bhargava & Saxena (1987) made a study on primary productivity and certain correlative factors in an Indian desert reservoir. Jakher & Misra (1985) and Mehrotra (1988) investigated the macrobenthic fauna of Lalsagar reservoir near Jodhpur while Gupta (1989) explored the pollution ecology of a pond in the same region. Nama (1993) evaluated physical and chemical features of Takhat Sagar Lake, Jodhpur.

Aquatic insects gained major attention of Zoologists, many of whom were not the basic limnologists. Most of the major orders of insects are found in the Indian desert and many of them present interesting adaptations to the desert environment. The groups studied most intensively are the Isoptera (termites) and the water beetles (Dytiscidae: Coleoptera) (Roonwal, 1982). Among aquatic forms, insects are represented by adult or larvae or both the forms. The insect orders represented in the desert waters include Ephemeroptera, Odonata, Hemiptera, Trichoptera, Diptera and Coleoptera. Roonwal (1982) recorded one species of May fly (Ephemeroptera), 10 species of aquatic bugs (Hemiptera: Belostomidae, Nepidae, Notonectidae, Corixidae and Pleidae), many species of Diptera and 29 species of aquatic beetles (Coleoptera: Haliplidae, Gyridae, Dytiscidae).

The present study was devoted to the evaluation of biotopic conditions, faunal diversity and its ecology in the Kot bandh (dam) in northern Aravalli range in the Jhunjhunu district of Rajasthan.

AD Muscente, AnirudePrabhu, HaoZhong, Etal(2018) said that mass extinction documented by the fossil record provided critical benchmarks for assuring changes through time in bio diversity and ecology. Efforts to compare biotic crisis of the past and present, however, encounter difficulty because taxonomic and ecological changes are decoupled and although various matrices exist for describing taxonomic turnover no methods have yet been proposed to quantify the ecological impacts of extinction events.

Aim of the study

The aim of the study is to evaluate biotopic conditions, faunal diversity and its ecology in the Kot bandh (dam) in northern Aravalli range in the Jhunjhunu district of Rajasthan.

Objective of the Study

Asian Resonance

The objective of the research work is to explore the local water body for its diversity. In this particular paper we have given the details of diverse forms of Insects present in Kot Bandh.

As these insects are food for many of the fishes present in the bandh, their presence decides the population fishes like Catla, Rohu, Mrigal and Cat fish. So the diverse forms of Insects show the net production of food fishes present in the bandh.

Material and Method

The Kot bandh (dam), where the present study has been under taken is present on the western fringe of the Aravalli range, in Jhunjhunu district of Rajasthan. Being present towards the Indian desert region, the area typically represents an arid climate. In this region the average annual rainfall ranges from 25 to 35 cm. Scarcity of water and food, intense radiation, dry violent winds, strong dust storms, wide diurnal and seasonal variation in temperature are the common characteristic features of the area. Most of the rainfall occurs in the months of July and August in short and stormy showers with a relatively high intensity. The three monsoonal months, i.e. July to September, however, provide 75% to 90% of total rainfall.

The Kot bandh (dam) is situated in the village Kot (75°13' E 27°28' N) which is about 40 km from Jhunjhunu. It is also popularly known as Sarju Sagar Bandh. It was built in the year 1924. The dam has Satambhri temple on its bank, which is revered in the region. The dam was built by Raja Bhoop who ruled the region.

The average annual rainfall in the area is 50.8 cm of which average monsoon rainfall alone is 45.72 cm. This rainfall contributes 2.82 mcm water in the dam. This volume of water is derived from a gross catchment area of 11.65 km².

The surface water spread of the dam, when full, is 14 km². While the maximum water level of the dam is 39.31 m, the full tank level is 38.10 m from MSL. The gross command area of the dam is 52 hectares in which crops of wheat, gram and mustard are generally raised.

The study was undertaken fortnightly for a period of 15 months, i.e., from November 2008 to January 2010, covering all the three seasons and an overlapping period of three months. Water samples were collected from a depth of 0.5 m at fortnightly intervals from three study stations. Since the water was shallow, no samples could be collected from greater depths.

The microfauna from water was collected with plankton net made up of bolting silk (No. 25, 0.3 mm mesh). Insects taken from the water were placed directly into 70% solution of ethyl alcohol. Sometimes aquarium was used to maintain aquatic insects, particularly to raise the larvae to adult stage for the purpose of identification. Some minute insects and larvae were preserved as permanent slides.

Result and Discussion

Biotope

Unlike the thermal trend of desert, the seasonal fluctuations in water temperature were moderate, accounting for only 7°C. The narrow

E: ISSN No. 2349-9443

magnitude of water temperature was found not to influence much the other variables of water as evident from its insignificant correlations. The water was clear with the Secchi disc transparency ranging between 0.9 to 2.0m, averaging 1.66m. No great deviation was observed in transparency. This feature was again in contrast to that of desert waters which are mostly shallow and turbid. The water was alkaline, showing a pH in the range of 7.0 to 8.5. The annual average pH was noted as 7.8. EC of water was low, ranging between 0.2 to 0.5 mmho/cm, its annual average was noted as 0.31 mmho/cm. The TDS presented a precisely similar trend as that of EC. The TDS values ranged from 200 to 500 mg/l with an annual average of 312.66 mg/l. The two parameters were also observed to be lesser compared to many of the Indian desert waters. Dissolved oxygen ranged from 2.0 to 10.45 mg/l and it presented a negative correlation with temperature, EC, TDS, free CO₂ and hardness of water. Free carbon dioxide was absent in a few months and its maximum value was noted in extreme summer month. The water was moderately alkaline. The total alkalinity ranged from 90 to 173 mg/l with an average of 133.8 mg/l. Similarly the hardness of water was also moderate and presented a trend as that of alkalinity. It ranged from 92 to 400 mg/l, with an annual average of 171.26 mg/l. The two parameters presented strong positive correlations with EC and TDS. Sediments of the dam were also alkaline, the pH of sediment ranged from 8.0 to 8.6, the annual average being 8.2. EC of sediment ranged from 0.2 to 0.5 mmho/cm with an annual average of 0.36 mmho/cm. The organic matter in the sediment was high, ranging from 4.07 to 29.34 mg/l, with a peak during monsoon months.

Insect fauna

All the major orders of insects are found in the Indian desert and many of them present interesting adaptations to the desert environment (Roonwal, 1982). The groups studied most intensively are the Isoptera (or termites) by M.L Roonwal and the water beetles (Dytiscidae: Coleoptera), by T.G Vazirani, while interesting studies of special habitats have been made by Baid (1959, the Sambhar Salt lake, 17 species of Coleoptera, Diptera and Hemiptera) and Kushwaha (1977, forage and pasture insects).

The most tolerant and versatile group of invertebrates, insects are the important faunal component of aquatic ecosystems as well. In spite of the fact that insects are no lesser important denizens of aquatic environment, no sincere efforts seem to have been made on aquatic insects of Rajasthan except the contribution of Vazirani (1964), Tak & Sewak (1987), Tak (1996), Srivastava & Saxena (2004), Saxena (2008 b), and Srivastava (2009).

During present study the insect fauna was represented by 19 species belonging to orders Coleoptera (8), Hemiptera (7), Odonata (1) and Diptera (3), besides some larval forms. The total insect population ranged from 5 to 112/l with an annual average of 35/l. The periodicity of occurrence was different among insect genera, however, most of the forms preferred the period of moderate

Asian Resonance

environmental condition during monsoon and early winter. The composition of insect community in the dam water was as below:

Order	Coleoptera (Beetles)
Family	Hydrophilidae (Water scavenger beetles) Genus & Species Tropristernus lateralis Dist. Laccobius sp. (Larvae) Berosus sp. (Larvae)
Family	Dytiscidae (Predacious diving beetles) Genus & Species Hydaticus fabricii MacLeay. Agabus sp.
Family	Psephenidae (Reffle beetles) Genus & Species Eubranax sp.
Family	Helodidae (Marsh beetles) Genus & Species Scrites nigropunctatus Motsch.
Family	Donacilidae (Leaf beetles) Genus & Species Donacia sp.
Family	Hemiptera (Bugs) Veliidae (Broad shouldered water striders) Genus & Species Microvelia diluta Dist.
Family	Corixidae (Water boatmen) Genus & Species Corixa lima (Dixon)
Family	Notonectidae (Back swimmers) Genus & Species Notonecta glauca Linn.
Family	Nepidae (Water scorpions) Genus & Species Laccotrepes maculatus (Fabr.)
Family	Gerridae (Water striders) Genus & Species Gerris remiges Fabr. Limnomeltra fluviorum
Family	Hebridae Genus & Species Hebrus pusillus Fallen
Order	Odonata (Dragon flies)-Nymphs
Order	Diptera
Family	Tendipedidae (Midges) Genus & Species Chironomus sp. (Larvae)
Family	Culicidae (Mosquitoes) Genus & Species Culex sp. (larvae)
Family	Syrphidae (Flower flies) Genus & Species Eristalis sp. (Rat-tailed maggot)

O. Coleoptera

Members of this order are commonly called beetles and this is one of the largest orders of class Insecta. Beetles are usually characterized by the modification of the forewing into horny or leathery elytra which almost always meet to form a straight mid-dorsal suture. The hind wings are membranous, folded beneath the elytra (Tak, 1996). A majority of beetles are terrestrial but few families are aquatic where their larvae and the adults live in water. The aquatic groups include both the herbivorous and predacious species. There are four families of aquatic

E: ISSN No. 2349-9443

beetles namely Haliplidae, Gyrinidae, Dytiscidae and Hydrophilidae (Tak, 1996).

In India, Vazirani has carried out an extensive work on aquatic beetles. In 1955 he work on Gyrinidae and describe two new species. Apart from fauna of India Coleoptera-family Gyrinidae and family-Haliplidae (1984), he also published catalogue of oriental Dytiscidae (1977) and worked on aquatic beetles (Dytiscidae) of Rajasthan (1970) and Gujarat (1972). He also worked on Indian Haliplidae and Gyrinidae from Maharashtra and Madhya Pradesh. Tak & Sewak (1987) dealt with aquatic beetles of Lake Kailana in Jodhpur.

Among insects, Coleoptera and Hemiptera were the major orders. The Coleoptera was represented by eight species belonging to five families. These beetles included three water scavenger beetles, of which only *T. lateralis* was found as an adult form in water while the rest as larvae in the mud. Larvae of *Laccobius* were recorded during monsoon and those of *Berosus* during early summer. Predacious diving beetles were represented by two species, of which *H. fabricii* was found as adults in water and *Agabus* as larvae in the mud during monsoon months. Rest of the three families was each represented by single beetle species. Srivastava (2009) noted 14 coleopteran species in some desert waters, which includes present records as well. She found, among other, *H. fabricii* as the most frequent beetle while *T. lateralis* and *Donacia* sp. were the least frequent ones. Three of the present records are common with the beetles noted by Saxena (2008b). Srivastava (op.cit.) observed that numeric contribution of beetles compared to bugs was manifold higher in the studied desert waters whereas the situation was just the reverse in the present Aravalli water.

O. Hemiptera

Commonly known as bugs, Hemiptera are the largest and most important exopterygote insects. They are in general phytophagous and feed on root, leaves, stems, fruits and seeds.

Indian Hemiptera consists of about 6500 species distributed over 77 families and constitutes a little over 8% of the hemipteran known from the world. Among 77 families, aquatic and semiaquatic hemipterans cover a little over 200 species belonging to 63 families. Progress on their species, family-wise, has been evaluated recently (Director, Z.S.I., 1991). Earlier, Distant (1902-1918) published 7 volumes on this insect group in the "Fauna of British India" Series (Ghosh et. al. 1996). Our Knowledge on the hemipteran fauna of the Thar Desert is meager. Roonwal (1963, 1977, and 1982) reviewed the animal wealth of Rajasthan, a major part of the Thar Desert, but unfortunately very little information as to the faunal picture of Hemiptera of the desert has been focused.

From India 230 species of aquatic and semiaquatic bugs are known, of which 13 are reported from the Thar desert, belonging to families, Belostomatidae (1), Corixidae (1), Gerridae (2), Notonectidae (3), Nepidae (3) and Pleidae (3) (Ghosh et al., 1996). Lately, Saxena (2008b) recorded seven aquatic bugs among common aquatic invertebrates of Rajasthan.

Asian Resonance

During present study, the order Hemiptera was represented by eight bug species belonging to six families. Except for family Gerridae, which was represented by two species, all other families were represented by a single member. All the bugs showed the periodicity of occurrence during late monsoon and early winter and *Notonecta glauca* was the most dominant bug. The records go common with those of Srivastava & Saxena (2004), Saxena (2008 b), and Srivastava (2009).

O. Odonata

Dragonflies and damselflies are included in this order which is terrestrial in habit but their nymphs are aquatic. The Odonata nymphs are found in all freshwater habitats where there is abundance of oxygen and water is unpolluted (Tonapi, 1980). On the basis of several works, Prasad (1996) reported 31 species of Odonata belonging to 22 genera under five families from the Thar Desert. During present study dragonfly nymphs were noted in the water column close to surface. These were prevalent throughout monsoon and winter. Srivastava (2009) noted such nymphs in some desert waters during winter season when dissolved oxygen was high, as also during present study.

O. Diptera

Order Diptera includes mosquitoes, flies and mages. This order is poorly studied in the Indian desert (Rathore, 2004). The dipteran fauna of Rajasthan is known by works of Kaul et al. (1973), Vazirani & Advani (1976 b, 1977, b), Joseph & Parul (1990), Nandi (1990), Parihar (1993) and Kumar & Kumar (1996). Srivastava & Saxena (2008 b) noted no dipteran fauna while reviewing the diversity of entomofauna of western Rajasthan.

Adult dipterans are terrestrial insects but in many families larvae and some of the pupae are aquatic. As few other studies from the region (Saxena 2008 b), during present investigations larvae of *Anopheles* and *Culex* mosquitoes and *Chironomus* midges were frequently found. Rat-tailed maggot of *Syrphid* fly was recorded only during late monsoon. The other record of it from region seems to be of Chadha (1999) and Srivastava (2009) who found it in some ponds during summer with very infrequent count. During present study, while *Culex* larvae were recorded during monsoon in the water column, rat-tailed larvae and *Chironomus* larvae were recorded from the littoral sediments. Former two were found only during late monsoon; whereas latter one was recorded throughout the year in considerably high number during monsoon and winter. Similar observations with respect to mosquito and chironomid larvae are also made by Babar (2002), Saxena (2008 b) and Srivastava (2009), who recorded larvae of the both in some desert ponds.

Conclusion

Present dam situated in the western foot-hills of the Aravalli bordering the Indian desert, holds water that has narrower and lower ranges of temperature, pH, EC, TDS and alkalinity as compared to the surface waters in the Indian desert. It has better light penetration and dissolved oxygen and reveals considerably narrow range of seasonal thermal

E: ISSN No. 2349-9443

fluctuations. It shows many a species common with those in desert waters, however, some of them differ in their population and seasonality of occurrence. Poor diversity and density of rotifers, greater component of bugs than beetles, and dominance of prosobranch snail *B. bengalensis* over pulmonate. *exustus* are some the striking features of this Aravalli water that are opposite to most of the desert waters.

References

1. AD Muscente, AnirudePrabhu, HaoZhong, Etal (2018) Quantifying ecological impacts of mass extinction with network analysis of fossil community proceedings of the national academy of science 115(20), 5217-5222.
2. Babar, P. 2002, Biodiversity and ecology of a man-made ecosystem in the India desert - The Gang canal. Ph.D Thesis, M.D.S. University, Ajmer. pp. 138.
3. Baid, I. 1959. Some preliminary notes on the insect life in Sambhar Lake. *J. Bombay nat. Hist. Soc.*, 56 : 361-363.
4. Chadha, Monika 1999. A Comparative study on the quality and trophic status of some desert waters employing bioindicators and Indices. Ph.D. Thesis, M.D.S. University, Ajmer, pp. 127.
5. Director, Z.S.I, (ed). 1991. Animal Resources of India-Protozoa to Mammalia, State of the Art. *Zool. Surv. India*, Calcutta: 1-694.
6. Ghosh, L.K., Biswas, B. and Ghosh, M. 1996. Faunal diversity in Hemiptera of the Thar Desert. In: *Faunal Diversity in the Thar Desert: Gaps in Research*, eds. Ghosh, A.K., Baqri, Q.H. and Prakash, I. 191-202, (21) Scientific Publ., Jodhpur.
7. Gothwal R and Gupta G, *Limnological study of Lentic Fresh Water Ecosystem during Summer Season: Nakki-Lake Mount Abu Rajasthan India. World Scientific News* 114 (2018) 44-54
8. Joseph, A.N.T. & Parui, P. 1990. A review of the Asilidae (Diptera) from India. *Rec. zoo/. Surv. India. Occ. Paper No.* 113:1-122.
9. Kaul, H.N., Dhanda, V. and Modi, G.B. 1973. The Phlebotomine Sand-flies (Diptera : Psychodidae) from Rajasthan, India. *Indian J. Med. Res.*, 61 : 528-539.
10. Kumar, S. & Kumar, S. 1996. Diptera fauna at the Thar Desert. In : *Fauna/ Diversity in the Thar Desert : Gaps in Research*, eds. Ghosh, A.K. Baqri, Q.H. and Prakash, I. Scientific Publ., Jodhpur. pp. 241-251.
11. Kushwaha, K.S. 1977. A review of progress in studies on forage and pasture insect pests of Rajasthan. In: *The Natural Resources of Rajasthan*. ed. M.L. Roonwal. Vol. 1, pp. 367-411. Jodhpur University Press, Jodhpur.
12. Nandi, B.C. 1990. Sarcophagid flies (Diptera : Sarcophagidae) from Rajasthan, India, *J. Beng. nat Hist. Soc.*, (N.S) 9 : 49-45.
13. Parihar, D.R. 1993. Insect fauna of Khejri (*Prosopis cineraria*) of arid zone of India. *Indian J. Forestry*, 16(2) :132-137.
14. Prasad, M. 1996. Odonata in the Thar Desert. In : *Faunal Diversity in the Thar Desert: Gaps in Research*, eds. Ghosh, A.K. Baqri, Q.H. and Prakash, I. Scientific Publ., Jodhpur. pp. 145-149.
15. Rathore, N.S. 2004. Desert National Park - An overview. In: *Fauna of Desert National Park. Zool. Surv. India - Conservation Area Series*, 19: 1-32.
16. Roonwal, M.L. 1963. *Fauna of Rajasthan, India. Pt. 1. General introduction with a list of collecting habitats and a biogeography of Rajasthan Zoology. Rec. zoo/. Surv. India*, 61: 291-376.
17. Roonwal, M.L. 1977. *The Natural Resources of Rajasthan. Vol. I & II. Jodhpur Univ. Press*; 1-520, 521-1311.
18. Roonwal, M.L. 1982. *Fauna of the Great Indian Desert. In : Desert Resources and Technology Vol. 1. ed. Alam Singh. Geo -Environ Academia, Jodhpur*: 1-86.
19. Saxena, M.M. 1997. Hydrozoological diversity of the Aravalli range with special reference to Pushkar Valley: Present status and future scope of research. *Abst. Nat. Conf. Env. Eco-dev. Pushkar Valley of Rajasthan, Ajmer*. p. 91
20. Saxena, M.M. 2008b. Common aquatic invertebrates of Rajasthan. In: *Conserving Biodiversity of Rajasthan (With emphasis on wild fauna and flora)* ed. Verma, Ashok, Himanshu Publ., Udaipur.
21. Srivastava, Deepti & Saxena, M.M. 2008. Diversity and population turnover of faunal component in some wetlands in the Indian desert: Threats and conservation needs. In *Ground water resources: conservation and management*, eds. Puranik, V.D. et al. Vayu education of India Publ., New Delhi, pp. 510-512
22. Srivastava, Deepti. 2009. Faunal diversity and its ecology in some village pond ecosystems, with special reference to insect fauna in the Indian desert. Ph.D. Thesis. MGS University. Bikaner. pp. 123.
23. Tak, N. & Sewak, R. 1987. On the collection of aquatic beetles (Coleoptera) from Lake Kailana, Jodhpur, India. *Oikoassay*, 4(2): 33-38.
24. Tak, N. 1996. Aquatic beetles of Thar Desert. In: *Faunal Diversity in the Thar Desert: Gaps in Research*, eds. Ghosh, A.K., Baqri, Q.H. and Prakash, I. Scientific Publ., Jodhpur. pp. 221-226.
25. Tonapi, G.T. 1980. *Fresh water animals of India - An ecological approach. Oxford & IBH Publishing Co., New Delhi*, pp. 341.
26. Vazirani, T.G. 1955. On a collection of Gyridae (Coleoptera) in the zoo/. *Surv. India with description of two new species. Rec. Ind. Mus.*, 53(1%2):13-18.
27. Vazirani, T.G. 1977. Catalogue of oriental Dytiscidae. *Rec. zoo/. Surv. India. Misc. Pub. Occ. paper no. 6*, pp. 111.
28. Vazirani, T.G. 1972. Contribution to the study of aquatic beetles (Coleoptera) 12. On a collection of Dytiscidae from Gujarat with description of a new species. *Rec. zoo/. Surv. India*. 67: 287-302..
29. Vazirani, T.G. & Advani, R. 1976b. Some ectoparasites of bats from Rajasthan (Diptera:

Asian Resonance

- Streblidae*) with description of a new species.
Oriental Insects, 10:453-457.
30. Vazirani, T.G. and Advani, R. 1977b. Preliminary report on the Nycteribidae (Diptera: Pupipara) ectoparasites on bats of Rajasthan. *Abst. Sec. Ori. Ent. Sym., (Madras)*. pp. 72-73.