



# Entomofaunal Study of river Tawi in Jammu J and K India

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## Abstract

*Insects represent the culmination of evolutionary development of terrestrial arthropods and have adapted to the most diverse types of environment. The transition from aquatic to terrestrial mode of life was a crucial step in the evolution of higher metazoa and undeniable so in the tracheate arthropoda. Insects of any water body plays significant role in maintaining ecological balance and becomes part of food chain, food web at specific trophic levels. Besides, they function as biological indicators for determining the water quality and pollution in respective water bodies. The present investigation also reveals the role of insects and their types in a particular water body i.e. river Tawi in Jammu. In Jammu region there are so many water bodies starting from wells, ponds, springs, lakes, and reaches upto streams but lacking coastal areas or oceans since the region is surrounded by hilly terrain. The river Tawi is considered as holy and sacred river from religious point of view and supposed to be a life line of the Jammu city and other towns located on the banks of river. During this investigation it has been observed that there are large no of insect species present in the river but maximum emphasis were given on the subject about presence of some developmental stages of insects found frequently on the river banks. The most common method used for this study was hand nets, scoops and forceps capturing and even manual capturing was also carried out keeping in view the harmless nature of insects. In this study about 2-3 kms area of river Tawi were investigated near the main Tawi bridge. It has also been observed and realized during the investigation that the impact of pollution gradually reduces the population of some important insect species in the river. There are about 4-5 species of insects were observed and studied at different developmental stages (larval, nymphal and adults).*

**Key words:** Arthropods, Ecology, Insects, Sacred, river Tawi.

## 1. Introduction

Insects constitutes about 70% of all known species of animals .Insects are the only invertebrates that can fly ( Voshell , 2002 ), most insects feed on plant material while some feed on animal tissues. Aquatic entomology is the study of aquatic insects ( Pennak , 1989 ). Aquatic insects play most significant role in the fresh water ecosystem. They are most abundant in fresh water habitats and often exhibit high diversity. In aquatic food webs they serve as food item for nearly the full range of vertebrate and invertebrate predators and many function as predators themselves. Water insects live some portion of their life cycle in the water. They feed in the same ways as other insects. There are about 45000 species of insects known to inhabit diverse fresh water ecosystems ( Balram , 2005 ). Diversity of insects in lentic water tends to increase with increased nutrients (Daly, 1998 ).

Many fishes , amphibians, shorebirds, water fowls and other animals forage heavily on both the aquatic and terrestrial stages of aquatic insects, which are essential to their survival ( Thorpe and Covish , 1991 ). Environmental scientists have become to realize that uses or changes of waterways and lakes may have dire short-term or even irreversible long- term effects not only on the quality of water itself but also on the aquatic ecosystems ( Voshell, 2002 ).

The worrying rate of habitat loss, fragmentation and simplification due to human never ending activities renders the overall scenario particularly dark pressing of the internal community of scientists and taxonomists to urgently fill the enormous taxonomic - gap ( Dubois 2011 ) also known as “ Linnaean short fall “ ( Brito 2010 ). In entomology, the basic systematic work involves , probably more than in any other animal groups .

According to Lewis and Gripenberg , 2008; aquatic insects often make good indicators because they are present in some quantity in almost every type of habitat and many are habitat specialists. Aquatic insects are used for monitoring the health of aquatic environment because of their differential responses to stimuli in their aquatic habitat and determining the quality of that environment ( Merritt ; Commins and Berg, 2008 ).

In Jammu region of (JKUT) we have only fresh water aquatic ecosystems because we don't have ocean boundaries or coastal areas. The main riverine ecosystem is that of river tawi in Jammu which is also known as life line of Jammu. As far as aquatic insects of river Tawi are concerned there are large no of species present having great ecological and scientific Importance. The burning issues of these water bodies are of series concerned for the scientific community and research work .Since our Indian culture is linked with the nature and its resources directly and indirectly for religious or ritual formalities. Some of the water bodies in Jammu region particularly river Tawi and some prominent lakes are preserved and conserved keeping in view the religious belief of the community, where some of the fauna

especially fishes are considered as incarnation of Devi, Devtas etc. But, unfortunately the Tawi river getting exposed to various types of chemicals and pollutants day by day. In the near future there might be maximum chances of exposure that can be devastating for aquatic life and ecological balance of the water bodies.

The present condition of river Tawi is deteriorating day today because it is flowing very close to Jammu city that is densely populated and also winter capital of J and K UT. All the drainages containing sewage waste effluent coming from different regions of City joins the river Tawi directly and indirectly. This effluent exposing the river with hundreds of chemicals or pollutants . Besides, Solid wastes lying near the river banks and inside the river also causing adverse effect on its aquatic fauna. It has also been witnessed that during the festivals like Navratras, Ganesh chaturthi and other social or family functions people used to through garbages or solid waste and other non- biodegradable material to the river. All such mismanagements of different types of wastes causing huge physical, chemical and biological damage to river .During the investigation it has been observed that there are scattered population of entomofauna or insects in the river. Attempts were made to observe and study the insects randomly in the selected sites located near the main tawi bridge and its extended stretches up to 2-3 kms in both the directions( North and South ).

Generally, aquatic water bodies possess several types of insect species such as plecoptera, neuropteran, ephemeroptera, hemiptera, coleopteran and collembolan. This investigation also witnessed some of these insect species from the river tawi after repeatedly collected the data from the specific sites.

## 2. Overview of study area

Tawi river (Fig1) is considered as sacred and holy river as the case with most of the rivers in India. The length of river tawi is 141 kms. It is flowing in two countries viz India and Pakistan. Tawi river is a major left bank tributary of Chenab river. Tawi River also called as Surya Putri in ancient tezet. Tawi river is also known for it rich repository or mineral resources. Tawi river originates from a glacier that lies at an elevation of 4250 m in the north of the Bhaderwah town of district Doda in Jammu and Kashmir. Tawi River is also known for its rich biodiversity and ecosystem that is comprised of fishes, Amphibians, phytoplanktons ,Zooplanktons and insects etc.



Fig-1-Jammu Tawi river

### 3. Historical review

Insects are present almost all the habitat of the nature. They are present in scorching sun of the tropic to frozen Antarctica. They may be aerial, terrestrial or aquatic forms. Insect originated in lower Devonian period and are considered to be descent of Subphyla- Myriapoda or Protoptera (Tembhare, 2012). Insects represent about 80% of the animal kingdom (kumar and Nigam, 2001), study of Insects was first initiated in 1779 in south India by S.G.Koenig. Donovan was the first who published general work on Insect of Asia in the beginning of 19<sup>th</sup> century. Linnaeus (1758-68) first classified an entire group of insect into nine orders- Coleoptera, Orthoptera, Hemiptera, Lepidoptera, Neuropteran, Hymenoptera, Diptera, Thysanura and Aptera.

Insects those who spend some part of their life cycle closely associated with water, either living beneath the surface or skimming on the surface of water are called aquatic insects. Several workers have done work on aquatic insects in India and other parts of the world. Literature showed scattered work on the taxonomy of aquatic insect along the terrestrial forms (Distant, 1902,1906,1910), d'Orhymont(1928). Insect diversity of British India was reported by Ochs (1930).

Studies of Needham (1957) showed diversity of freshwater aquatic insects with other aquatic invertebrates. According to Cheng (1976) about 3% of the total population of insects are aquatic, while according to Pennak (1978) aquatic insects forms about 1% of the total animal diversity. Mc-cafferty (1981) observed that a few of aquatic insects inhabit the limnetic and profundal zones and recorded that Odonata naiads are most common in ponds, marshes, lake margins and shallow water streams. The functioning of the fresh water ecosystem is somehow depend on aquatic insects (Roy and Sharma,

1983).Larson (1985) revealed that small and temporary water bodies have more species as compare to large and permanent water bodies. Cheng (1985), Glausiusz, (1997) and Daly (1998) reported that there are almost no insects associated with the marine environment.

In most fresh water ecosystems aquatic insects comprise bulk of the biomass along with other three groups viz. Molluscs, Crustaceans and Fish (Odum, 1996).Daly (1998) reported that with increased nutrients in lentic water tend to increase in the diversity of insects. Khan and Ghosh (2001) revealed presence of 70 species of aquatic insects from 20 different wetlands of West Bengal, India. According to Balram (2005), about 45000 species of insects are known to inhabit diverse fresh water ecosystems.Deep and Rao (2007) reported 8 species of Hemiptera from the Pochram lake of Andra Pradesh, India. Saikai (2007) reported presence of 25 species aquatic insects in Deepor Beel of Assam. Bath (2008) reported 8 orders of aquatic insects from Harike wetland in Punjab.

The insects are estimated to comprise more than 75% of the known species of the animals and approximately 0.9 million species of insects have been described throughout the world (Jain et al.,2010). Thakare et al.,(2011) reported 13 water beetles in Kolkas region of Melghat Tiger reserve of central India.Vasantkumar and Roopa (2014) reported that presence of 15 species belonging to 6 orders.They recorded highest number of aquatic insects from the order Hemiptera and the most abundant order was the Coleoptera. Barman and Gupta (2015) recorded presence of 21 species of aquatic insects belonging to 14 families and 7 orders in Bakuamari stream of Chakrasila wildlife sanctuary of Assam.

Limnological studies of rivers have been carried out extensively in USA and European countries by various workers (Kofoid, 1903, Fritsch, 1903; Allen, 1920; Clanen, 1927; Reinhard, 1931; Rice, 1938; Butchner, 1947; Fijerdingstad, 1950; Lacky and Hupp, 1956; Blum, 1956; Klein, 1957; Palmer, 1959; Waslik, 1965; Weber and Moore, 1967; Lam, 1971; Lack, 1971; Willium etal, 1942; De Smet etal, 1987; Irmer, 1992; Hussain and Saudi, 1996;).

However, it has been studied that an insect can undergo complete metamorphosis to attain its adult form (Peckarsky etal 1990), While some insects undergo incomplete metamorphosis where eggs hatches into nymphs (Resh and Rosenberg, 1984;).Aquatic entomology by Pennak, 1989. Insects are of various types in the fish pond (Merritt and Cummins, 1996; ).

There are 11 orders of aquatic insects but most common insects are Coleoptera (beetles), Homeoptera, Hemiptera (bugs) and Odonata (dragon flies).Likewise, large no of publications on limnology and ecology of fresh water bodies have appeared in India. The high rate increase in human population and rapid pace of industrialization have created an acute problem of waste product disposal.



Rishi and Kachroo (1981) studied the effect of sewage and fertilizer on phytoplankton and its indirect effect on insects of the Doodhganga river (Kashmir). Patra and Nayak (1982) investigated limnobiological survey of Mahanadi during winter season only. Shukala et al. (1989) studied physio-chemical and biological characteristics of river Ganga from Mirzapur to Ballia.

Vass et al. (1977) studied hydrobiological features of river Jhelum in Kashmir. Prakash et al. (1978) have carried out ecological study of river Jamuna at Agra while Verma et al. (1970) have studied the physico-chemical and biological characteristics of Yamuna at Delhi.

The review of literature indicated that very few studies were conducted to assess the aquatic insects diversity in the Jammu region in general and river tawi in particular. Therefore, an attempt was made to investigate and study the entomofauna of river tawi that showed favourable results to some extent. The key focus of the investigation was to find out frequently found insect species at different developmental stages.

#### 4. Methodology/Material

Although various methods exist for sampling aquatic Insects (Heteroptera and coleopteran) in standing water as well as in running water. On the basis of methods already used for studying or research work on aquatic insects, we have evaluated and compared the efficiency and selectivity of different sampling methods. The most common and effective methods used in this investigation are given below:-

1. Hand netting
2. Bottle traps baited with some food material in grinded form.
3. Bottle traps baited with canned cat food.
4. Manual capturing near the banks of water bodies.
5. By using mosquitoes net traps.

The material used for collection, capture, identification and preservation of insects is as follows:

1. Hand net or a Scoop net.
3. A few cloths or polythene bags.
4. Specimen bottles and plastic jars/ buckets.
5. A pair of sanitized hand gloves.
6. A pair of blunt forceps.
7. Enamel trays and petri-dishes.
8. Hand lense.
9. Commercial formalin.

10. A high quality camera.

11. well classified labels, field note book and data sheets.

#### Collection Techniques:

A hand net made of a fine mosquito net tied around iron ring and fitted to wooden handle was commonly used. The net is usually a metallic one with 30 cm X 30 cm ring made from steel bars and wire netting and scoop about 10cm deep with 8 cm wide blade soldered to the frame. A wooden handle should be attached at the other end. By dragging hand net or scoop net over the aquatic vegetation it was filled with aquatic elements especially insects and then contents poured over the spreaded out cloth piece. The entomo fauna were also picked up with the help of a pair of blunt forceps from the collected material.

The fixation and preservation of insects were carried out by keeping the collected specimen in 10% formalin solution in glass containers or in polythene bags by the methods adopted after Lefroy (1990) and Subba Rao (1989). The time of fixation varies from 20-24 hours and it depends on the size before thoroughly washing in running tap water and finally specimen were preserved in ethanol (70%) and in commercial formalin (10%). The results of previous investigations show that the effectiveness of the method differs in different habitats.

The efficiency of the methods depends upon the sample collected because we have collected the same numbers of samples at the same sampling sites over the different period of time. The sampling efforts for each method must be equal but chance of obtaining samples would be different. The captured specimens were preserved in 70% or 80% ethanol for identification and sampling. Some specimen of same species when found in large nos were immediately released back after identification. All other preserved samples or specimen were stored for their identification and study. To make research work very effective about aquatic insects we have made measurement on sites and in direct contact with the water source that included temperatures, P<sup>H</sup> dissolved oxygen, conductivity, oxygen reduction potential, turbidity and secchi disk depth of water bodies

#### 5. Observations and results

The characteristic features of insects are paired appendages, six walking legs and hence called 'Hexapods'. Some of these characters are given below systematically:

1. Insects are found in freshwater and majority of them are found on land.
2. Usually they crawl in shallow water.
3. Fore legs are modified for capturing the prey.
4. Apterygota lack wings; pterygota possess wings.
5. Mostly parasitic forms.
6. Head has 6 segments, thorax 3 segments and abdomen 11 segments.

7. Mouth parts are adopted for different types of feeding.
8. Thorax region is with three pairs of walking legs and a pair of wings.
9. Abdominal appendages are reduced.
10. Tracheal respiration and open type of circulatory system is present.

During the investigation, insects belonging to following orders were collected from river Tawi at specified site where water was clear and current was of moderate speed i.e water was clean within the stretch of 2-3 kms.

### **Placoptera ( Stone flies )**

The adults can be distinguished by the presence of two long anal cerci at the posterior end of the body. The antennae are long and filiform . The wings are well developed in many species and they are folded on one another. But in some species especially in males the wings are not so well developed .These forms are not good fliers and so many of them were found resting on river shore.Female lay eggs on the water surface while flying or may alight for sometime to crawl under water to deposit eggs. The collected specimens were mostly in Nymphal stages found hidden under the stones in debris. The placopterans nymphs cannot survive in the absence of abundant oxygen.These are sluggish forms not exceeding in length from fifty mm excluding antennae and cerci. Nymphs are similar to small adults except that in not having genitalia, wing pads and tracheal gills.This is smaller group yet contributing to the richness of fresh water entomofauna. Mostly immature stages of plecopterans were found in the sites having crystal clear running water of river Tawi.

### **Megaloptera (Alder flies)**

The alder flies are winged forms with large antennae. These are not very good fliers and adults were found in near river , during breeding season. Female deposits egg masses on some exposed under water plants. After hatching larvae drop in to the water and spend two to three years in aquatic medium.

These black coloured larvae are conspicuous and have thoracic legs with the help of which they cling to some substrate. Mouth parts are of biting type. These predatory insects feed on all kinds of organisms especially aquatic forms. These larvae can live outside the water in a damp place for a considerable time as they have functional abdominal spiracles .After completion of larval period they crawl to the surface and pupate in the sand. Adults emerges after a week.

### **Trichoptera (Caddis flies)**

The aquatic larvae of caddis fly were also found in slow running water of Tawi river. The cruciform or campodeiform larva builds a case, at the bottom which is made up of debris, sand and other small materials like cuticular pieces of many arthropods

cemented by the sticky substances secreted by the labial glands .The case enlarges as the larvae increases in size and the new case is built leaving the old one.

The head and thorax of larva is sclerotised but the abdomen is soft.The legs have claws and they are used to catch prey as well as build the case.Abdominal segments possess long filamentous tracheal gills and the last bears a pair of hooked appendages. The adults are terrestrial and are small moth like insects found near the ponds, streams and lakes .Female lays eggs while flying on the water surface or it may even go into the water to deposit eggs. The pupation takes under the submerged stones and during emergence of adult pupa comes to the surface of the water.Caddis fly larvae are omnivorous and feed on diatoms, other algae, crustaceans, annelids and insect larvae.

### **Ephemeroptera (May flies)**

The name of this group is derived from the Greek name: 'ephemeros' means living a day and 'pteron' means a wing. The name itself expresses a brief aerial life of May- flies which in some cases lasts only a few hours. These delicate forms were found in the vicinity of river.

The adult forms are solely meant for reproduction. Adults are with three long cerci and small antennae. When female enters into the mating swarm it is caught by one of the males and pair flies away from the swarm. After copulation the oviposition occurs. The eggs fall from the body of the female may fly into streams, lake or pond and sink into the bottom. Thereafter ,this descent of eggs an enormous crowd of minute larvae each with six legs make their appearance.

## **6.Significance**

Aquatic insects are common subject of ecological research and environmental monitoring and assessment. Insects are food for fish, amphibians and wildlife. They are important contributors to energy and nutrients and returning them to terrestrial ecosystems and purifying water.

In River tawi of Jammu, there are diverse form of Entomofauna that makes a stable food chain in the existing ecosystem and also play very crucial role in indicating pollutants . It has been observed from the previous studies and different research work on the aquatic insects of river Tawi that some of the insect species have been either disappeared or reduced in numbers. It was very interested and important area to investigate randomly to get favourable results.

The survival of fishes and birds directly or indirectly depends on existence of different species of insects, zooplankton, phytoplankton, algae and weeds. Keeping in view the whole scenario of ecological balance this investigation was carried out and mostly river banks and shallow water areas were exposed.

After observing 4 orders of ecologically important insects in this investigation, it has been realized that these insects are important part of food for invertebrate macrofauna and vertebrates and contributing for stable food chain in the existing ecosystem.

## 7. Conclusion

It is concluded from this investigation that Entomofauna plays crucial role in the aquatic ecosystem and also witnesses some draw backs or imbalances if persists with in the ecosystem. There might be numerous species of insects in the river Tawi that need to be investigated and some of them have already been studied. During this investigation Attempts were made to study atleast frequently found species of insects. Such type of attempts would be helpful for ecological, social and scientific point of view to greater extent in the near future.

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