Short Communication

Biodiversity of Culicidae Mosquitoes in District Bagh, Azad Jammu and Kashmir

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ABSTRACT

Present study explored the biodiversity of mosquitoes (Diptera: Culicidae) in the district of Bagh, and at some adjoining areas, Azad Jammu and Kashmir, during the period May 2017 to October 2017. The specimens were identified under the binocular microscope by following the taxonomic keys of Christophers (1933), Barraud (1934) and Rueda (2004). A total of 2895 specimens of mosquitoes were collected from the study area, belonging to family Culicidae and two subfamilies, Anophelinae and Culicinae. Eleven species were identified as Anopheles barianensis (sub-family Anophilinae), Culex barraudi, Cx. epidesmus, Cx. fuscocephala, Cx. pipiens fatigans, Cx. pipiens pipiens, Cx. pseudovishnui, Cx. vishnui, Aedes aegypti, Ae. micropterus and Armigeres subalbatus (subfamily culicinae). The most abundant species was Armigeres subalbatus.

Because of its geographical location and ecology Pakistan is one of the hotspots for mosquito-vectorial diseases (Chan et al., 1995; Stark and Schoneberg, 2012), that’s why as early as 1971, mosquito biodiversity was initiated in Pakistan (Aslam Khan, 1971, 1972). Due to the latest occurrences of dengue (Shakoor et al., 2012), it has created greatest attention in mosquito study in Pakistan (Mukhtar et al., 2011; Ilahi and Suleman, 2013; Rasheed et al., 2013).

Earlier in 1969, from the Changa Manga National Forest, Aslam Khan and Salman (1969) studied the bionomics of mosquitoes and described 29 species of mosquitoes, many of which were uncommon, rare and reported for the first time from Pakistan. In Pakistan, the first ever effort to describe the Culicidae fauna was done by Aslam Khan (1971, 1972) who recorded 134 species of mosquitoes from Pakistan, of which 91 species from West Pakistan and 89 from East Pakistan (now Bangladesh). From 1934 to 1971, one species of Anopheles and three species of Culex were included in the mosquito fauna of Pakistan (Aslam Khan, 1971). Later, Aslam Khan (1972) documented 16 endemic species of mosquito from Pakistan.

More than 3500 species of mosquitoes have been documented, which belong to 42 genera and divided into three subfamilies such as Culicinae, Anophelinae and Toxorhynchitinae (Knight and Stone, 1977).

Currently the family Culicidae is divided into two subfamilies, 113 genera, 11 tribes and 3526 species (Harbach, 2007). Nearly 3523 species have been documented globally in 111 genera from different regions up till now (Harbach, 2012). The genus Anopheles has 7 subgenera and 460 species. Culex has 763 species belonging to 26 subgenera. The genus Aedes has 927 species, which belong to 70 subgenera. Most members of the family Culicidae are public health importance (Wilkerson et al., 2015; Freitas et al., 2015).

The purpose of this study was to enhance the knowledge of the culicids.

Materials and methods

The present study was carried out at District Bagh (Supplementary Fig. S1). The biodiversity of mosquitoes of the study area was never documented before.

The current study on the culicidae was accomplished in the district of Bagh, Azad Jammu and Kashmir from May, 2017 to October, 2017. Azad Kashmir is located at latitude 33° to 36° and longitude 73° to 75° and covers an area of about 13,297 square kilometers. This state of
Azad Kashmir is the western part of Himalayan range. The geography of the study area is commonly mountainous and woody with fertile valleys and small grasslands. Its climate is sub-tropical highlands form. Average extreme temperature of district Bagh varies from 20°C to 32°C while the average lowest temperature varies from 4°C to 7°C. Average yearly rain falls ranges from 1000 to 2000 millimeter. The general elevation above sea level, ranges from south to north from 360 meters to 6325 meters, respectively (Hussain, 2013).

The mosquitoes of the study area were explored, from May, 2017 to October, 2017 in the morning and evening. The priority of collection was given to the city of Bagh and surroundings areas due to estimated advanced definite abundance in these regions while urban and agricultural zones were also measured.

The mosquitoes were collected from human dwelling (indoor) and adjoining of human dwelling (outdoor) using pyrethrum spray technique as defined by WHO (1992) in the morning between 6 am to 8 am and 6 pm to 9 pm. Apart from this, catches in outdoor shelters like gardens, nurseries and wild vegetation was also made in day time. The mosquitoes were collected at outdoor using mouth aspirator and torch light and the collected mosquitoes were identified by using the keys (Christophers, 1933; Nagpal and Sharma, 1995; Smart, 2003).

The mosquitoes were killed with the help of ethyl acetate vapours and then mounted on piece of thick paper maintained by entomological pin and nail polish. These specimens were preserved in collection boxes comprising naphthalene balls.

Mosquitoes were put into the plastic cups and shifted into the laboratory, where orphometric characters such as palps, proboscis, scutellum, hind tarsomerers IV and entire V, femora and tibia, pulvilli, postspiracular, mesepimeral bristles, pleurae scales, coloration of pleural integument and abdominal band were used for documentation and generation of keys (Barraud, 1934; Becker et al., 2010). Culicine and other anopheline species were identified by following standard taxonomic keys (Barraud, 1934; Christophers, 1933; Srivanakarn, 1976; Huang, 1972, 1979; Reuben et al., 1994).

The Shannon diversity index (H) was used to characterize species diversity at eight study sites. \[ H = -\sum P_i \log P_i \] were worked out. Species Shannon-Weiner index: \( H = -\sum P_i \log P_i \), where \( H = \text{Shannon-Weiner index}, P_i = n_i/N, \sum = \text{Sum}, n_i = \text{Number of individuals of each species in the sample, } N = \text{Total number of individuals of all species in the sample.} \)

### Results and discussion

A total of 2895 specimens of mosquitoes were collected from the study area. A total of eleven species were identified (Table I).

Data show eight areas and eleven species of which the most abundant species was *Armigeres subalbatus* and minimum species was *Aedes aegypti*. *Culex pipiens* was present in all 8 areas of district Bagh. A total of 431 specimens of *Culex pipiens* were collected, greatest number was 143 from the Hodda Bari and least number was 25 which was from Kiayat. The total number of *Culex vishnui* was 244, the greatest number was 56 from the Hodda Bari and minimum number was 16 from the Kiayat. It was not present in Kotayra. The total number of *Culex pseudovishnui* was 231, the miximum number was 47 from Hodda Bari and minimum number was 20

### Table I.- Number of various collected species in different areas of district Bagh.

| Recorded species       | Selected area | Pi  | LogPi | PiLogPi |
|------------------------|---------------|-----|-------|---------|
| *Culex pipiens*        | Rey 50, Nom 35, Kot 60, Nor 143, Hod 48, Gha 25, Kia 30, Dhi 431 | 0.14 | -0.82 | -0.12 |
| *Culex vishnui*        | Rey 40, Nom 17, Kot 45, Nor 56, Hod 42, Gha 16, Kia 28, Dhi 244 | 0.08 | -1.074 | -0.09 |
| *Culex pseudovishnui*  | Rey 35, Nom 29, Kot 33, Nor 47, Hod 0, Kia 30, Dhi 231 | 0.079 | -1.09 | -0.08 |
| *Culex fatigan*        | Rey 0, Nom 0, Kot 38, Nor 33, Hod 0, Kia 26, Dhi 113 | 0.039 | -1.40 | -0.05 |
| *Culex barraudi*       | Rey 15, Nom 36, Kot 29, Nor 39, Hod 23, Kia 47, Dhi 206 | 0.071 | -1.14778 | -0.081 |
| *Culex fuscocephala*   | Rey 20, Nom 21, Kot 45, Nor 55, Hod 0, Kia 26, Dhi 24 | 0.073 | -1.17 | -0.08338 |
| *Culex epidemics*      | Rey 20, Nom 19, Kot 35, Nor 32, Hod 41, Kia 54, Dhi 24 | 0.088 | -1.05172 | -0.09336 |
| *Anopheles barriensis* | Rey 10, Nom 28, Kot 34, Nor 46, Hod 36, Kia 37, Dhi 33 | 0.089465 | -1.04835 | -0.09379 |
| *Aedes aegypti*        | Rey 0, Nom 0, Kot 0, Nor 20, Hod 0, Kia 0, Dhi 21 | 0.02038 | -1.6908 | -0.03446 |
| *Aedes micropterus*    | Rey 0, Nom 26, Kot 24, Nor 44, Hod 34, Kia 29, Dhi 24 | 0.067358 | -1.17161 | -0.07892 |
| *Armigeres subalbatus* | Rey 213, Nom 48, Kot 65, Nor 80, Hod 135, Kia 27, Dhi 65 | 0.237306 | -0.62469 | -0.14824 |
| **Total**              | Rey 373, Nom 274, Kot 334, Nor 438, Hod 573, Kia 343, Dhi 266 | 1 | -12.2763 | -0.97011 |

Rey, Reyara; Nom, Nomanpora; Kot, Kotayra; Nor, Norgala; Hod, Hoddabari; Gha, Ghaziabad; Kia, Kiayat; Dhi, Dhirkot.
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The total number of female Culex pipiens was 220, Culex vishnui (109), Culex pseudovishnui (126), Culex fatigan (59), Culex barraudi (92), Culex fuscocepha (105), Culex epidesms (117), Anopheles barrianensis (143), Aedes aegypti (27), Aedes micropterus (103) and Armigerus subbalbus (313). The maximum percentage was Armigerus subbalbus (22.13) percent and minimum percentage was Aedes aegypti (1.90%). This study shows that the percentage of male Culex pipiens was less than the female, the percentage of male Culex vishnui was greater than the female, the percentage of male Culex pseudovishnui was less than the female, the percentage of male Culex fatigan was less than the female, the percentage of male Culex barraudi was greater than the female, the percentage of male Culex fuscocepha was almost equal to the female, the percentage of male Culex epidesms was greater than the female, the percentage of male Anopheles barrianensis was less than the female, the percentage of male Aedes aegypti was greater than the female, the percentage of male Aedes micropterus was less than the female, and the percentage of male Armigerus subbalbus was greater than the female.

Conclusion

Out of a total of 2895 specimens of mosquitoes were collected from the study area 11 species were identified as Anopheles barrianensis, 7 species as Culex pipiens, Cx. epidesms, Cx. pseudovishnui, Cx. fuscocepha, Cx. fatigans, Cx. vishnui, Cx. barraudi, 2 species as Aedes aegypti and Ae. micropterus and one species as Armigerus subbalbus. The most abundant species was Armigerus subbalbus.

Supplementary material

There is supplementary material associated with this article. Access the material online at: https://dx.doi.org/10.17582/journal.pjz/20191001191052

Statement of conflict of interest

The authors declare no conflict of interest.

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Supplementary Fig. S1. Black circles show the distribution of mosquito species in different localities of district Bagh, AJK.

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