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Abundance and Diversity of *Drosophila* fruit flies in Nepalese Condition

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Abstract

Systematics of *Drosophila* have not been investigated properly in Nepal. Therefore, the collection of different *Drosophila* fruit fly's species was carried out to record and understand their characteristics during July-October 2023 from various parts of Nepal (high Himalayas to plain condition). The collection was conducted by applying bottle traps and net sweeps. Different species of *Drosophila* fruit flies were collected and analyzed in the laboratory of Entomology Department of Agriculture and Forestry University, Chitwan, Nepal. More than 10 species of *Drosophila* were studied in detail and known for their characteristics. Most of the *Drosophila* species were recognized and recorded at higher altitudes in comparison with lower altitudes. Limited abundance and diversity of *Drosophila* fruit fly species were found in different geography of Nepal.

Keywords: *Drosophila*, family, genus, species

Introduction

The study of fruit fly *Drosophila* is considered as vital and diverse foundation in biology that helps as a model system for investigations of many developmental, cellular processes, disease, adaptation, diversity, and evolution; whose underlying fundamental principles are comparable to higher eukaryotes, including man (Reviewed in Devineni *et al.*, 2013) [7].

It is always easy and economical in culturing large numbers of *Drosophila* at once. The short life cycle, and abundant generations have helped researchers to investigate more on the *Drosophila* species at global level. Libraries of several *Drosophila* species and mutant stocks of many species are available at different laboratories in the world. Presence of polytene chromosomes added advantage for taxonomic and genetic studies. Huge sequence of *Drosophila* genome could be analyzed at various parts of world. This have created easiness to understand the diverse study of molecule, gene, adaptation, evolution, and cellular science of *Drosophila*. The species of fruit fly has also been extensively used to conduct many intricacies concerned with the relationships amongst the ecological factors and population variation (Da Cunha *et al.* 1951; Heed, 1968; Gupta and Ray Chaudhuri, 1970a,b; Rajeshwari, 1971; Reddy and Krishnamurthy, 1968, 1973; Siddaveere Gowda *et al.* 1977; Hegde and Krishnamurthy, 1979; Prakash and Reddy, 1980; Bizzo and Sene, 1982; Brncic *et al.* 1985; Singh and Chatterjee, 1987; Putman, 1995; Begon *et al.* 1996; Hegde *et al.* 2000; Nagabhushan 2002; Yeniseti *et al.* 2002; Mateus, *et al.* 2006; Toress and Ravazzi, 2006; Guru Prasad, 2008; Achumi *et al.* 2013) [6, 18, 12, 30, 31, 32, 33, 16, 27, 4, 5, 34, 29, 3, 19, 24, 37, 23, 35, 14, 1].

There are more than 3,500 species of fruit fly within the family families Drosophilidae including the genus *Drosophila* (Bachli, 1998) [2]. Approximately there are more than 2240 biologically valid species of *Drosophila* (Wheeler 1986) [36]. Indian subcontinent with its vast array of vegetation and climates harbors variety of *Drosophila* species. It was studied that more than 200 *Drosophila* species were reported from India (Hegde *et al.* 2000) [19]. Most of them are native of the countryside whereas few are cosmopolitan. Parshad and Paika reported 7 species along with 3 new species and a subspecies. Parshad and Duggal collected *Drosophila* from various parts of Kashmir (High Himalayas') and recorded 20 species.

From North-Eastern side of the country (Nepal) some species were recorded. Dwivedi and Gupta (1979) [13] reported two new species of subgenus *Drosophila* (*D. guptai* and *D. ramamensis*) from Eastern Himalayas of Nepal and India, West Bengal. Gupta and Singh (1979) [13] also reported some 7 species and two new species of *Drosophila* (*D. novaspinofera* and *D. penispina*) from Shillong, Meghalaya.

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Very few studies on *Drosophila* were carried from the Himalayas and plain region of Nepal. In order to understand the abundance and diversity of *Drosophila* species an investigation was carried by collecting different species of *Drosophila* fruit fly from the extreme elevation of Nepal.

Materials and Methods

Collection of different *Drosophila* fruit fly's species were carried out during July-October 2023 from various parts of Nepal (high Himalayas to plain condition).

Drosophila fruit flies were collected by:

Bottle trapping method

Milk bottles with 150 ml capacity with ripe banana sprayed with yeas were managed at the twigs underneath small bushes with height 2-6 feet from ground. In each radius of 1 km² ten traps were kept in the field. The flies which were attracted by the bait were collected in the bottles (soon after sun rise or just before sun set) and were changed to fresh bottles containing wheat cream agar medium (medium was prepared by adding 100 g of sugar (jaggery) to 500 ml of water and boiled by gentle stirring till jaggery dissolved. Then, 500 ml of water, 100 g of wheat powder (soji), and 8 g of agar-agar were mixed to the boiling sugar water mixture. When the medium turns sticky 7.5 ml propionic acid (anti-fungal agent) was added while continuous stirring the medium. The mouth of the bottles/vials was kept closed with cotton. Next day moisture was removed from bottles/vials and two drops of yeast solution was added to the medium. This medium was used after 24 hours).

Net sweeping method

A handmade *Drosophila* net with fine cloth cone tied at the rim of the net was applied. This type of sweeping was prepared by fermenting fruits (mixed banana was spread in shaded areas of the bushes in the wild and flies were collected after 2 days) that were spread under four shady regions in an area of 1Km² radius. After each sweep, the insects were transferred to fresh bottles.

After each collection the insects were brought to the laboratory of Entomology department, Agriculture and Forestry University, Chitwan Nepal to recognize, record and investigate the characteristics of *Drosophila* fruit fly species.

Results and Discussion

Following species were recognized, recorded, and characterized after collection from the field and study at laboratory condition:

1. ***Drosophila bipectinate***: Small fly, yellow body with dull brown band, large red eyes with one pair of wings. Found from Patan and Kathmandu range.
2. ***Drosophila kikkawai***: Have insertion that translates into 18 additional ammino acids, with two prominent red eyes, grayish body. Found form Kakani and Kathmandu range.
3. ***Drosophila melanogaster***: Found in Patan and Kathmandu range.
4. ***Tephritidae* fruit flies**: With colorful markings, colorful body, head short, 2-8 frontal bristles, lacks dorsal preapical bristle. Found in Sindhuli, Syanja and Ramechhap district.
5. ***Bactrocera correcta***: With pair of transverse elongate black spots almost meeting at center, postpronotal lobes

and notopleura yellow, male abdomen reddish behind the middle, thorax with different markings on the scutum. Found in Chitwan and inner terai of Nepal.

6. ***Bactrocera cucurbitae***: Long third antennal segment, thorax reddish yellow and have yellow markings, head with yellow and blackish spots. Found in plain region of Nepal.
7. ***Zeugodacus tau***: Face with circular to oval black spots, postpronotal lobes and notopleura yellowish, have lateral and medial postsutural vittae. Found in Sindhuli district of Nepal.
8. ***Zeugodacus scutellaris***: Yellow brown in color, 3 mm long and 2 mm width, scutum black with the large area of red-brown centrally and anteroventrally. Found in Sindhuli, Dhankuta, Pokhara, Kathmandu region of Nepal.
9. **The tribe *Dacini***: Black to brown scutum with or without yellow vittae and primarily hyaline wing a with well-developed costal band and anal streak. Found in Pokhara and Kathmandu range.

Dacine fruit flies have been variably assigned to species complexes, species groups, and sub-genera; Drew (1989)^[8] proposed 4 groups of *Dacini*: *Bactrocera*, *Zeugodacus*, *Melanodacus* and *Queenslandacus*. Furthermore, Drew *et al.* (1998)^[8] and Drew and Hancock (1999)^[9] classified four genera within *Dacini*: *Dacus*, *Bactrocera*, *Ichneumonopsis* and *Monacrostichus*. Norrbom *et al.* (1999)^[25] reported the tribe *Dacini* which comprises the subtribes; *Ceratitidina*, *Dacina* and *Gastrozonina*. Korneyev (1999)^[21] studied the morphological framework for the phylogenetic relationships and concluded that the relationships among sub-families and tribes have not yet been satisfactorily defined.

It was found that Dacine fruit flies were phenotypically very similar, making them one of the most difficult groups of *Tephritidae* to identify at species level. *Bactrocera* was considered a sub-genus of *Dacus* until Drew (1989)^[8] elevated both taxa to the status of genera, based on distinguished characteristics in abdominal tergites. *Zeugodacus* was also known as a sub-genus of *Dacus* but was later assumed as a sub-genus under *Bactrocera* (Drew 1989)^[8].

The first information on *Tephritidae* fruit flies (*Dacinaei*: *Dacini*) in Nepal was reported in 1964 based on the 20 specimens collected from eastern part of Nepal during 1961-62 (Hardy, 1964)^[15]. This study reported four sub-families (*Dacinaei*, *Aciurinae*, *Trypetinae* and *Tephritinae*), six tribes, nine genera and eleven species, including tribe *Dacini*. The first fruit fly species, i.e. *Dacus* (*Callantra*) *nepalensis* (Hardy, 1964)^[15] reported from Nepal within the tribe *Dacini* is still holotype (NHM, 2023). Kapoor *et al.* (1979)^[20] reported two species, *D. (Zeugodacus) caudatus* Fabricius and *D. (Zeugodacus) scutellaris* Bezzi of fruit flies within the tribe *Dacini* from specimens collected in the Kathmandu valley. Subsequently, numerous studies have discussed fruit fly species, although taxonomic studies on species diversity and identification have been made by only a few researchers. Leblanc *et al.* (2019)^[22] conducted a comprehensive study on dacine fruit fly species identification, reporting 26 species with new country records of 11 species including *B. tuberculata*. However, Tiwari had reported the *B. tuberculata* in the earlier study. Environment have direct relation with the evolution in any group of animals or plants implies knowledge of the number

and distribution of the species involved and the population structure and habits of the species (Heed, 1957) ^[17]. Genus *Drosophila* with its cosmopolitan nature and complexities in species have large components that provides an excellent knowledge and portfolio to understand the eco distributional pattern of various species. The colonizing character of the insect could be known from the trait of insects where the occurrence and the distributional pattern also observed correlating with the type of vegetation and climatic conditions of the site in constant situation (Prakash, 1979) ^[28]. The studies were supported by the similar study of O'Grady and Markow (2006) ^[26] who described numerous taxonomies of *Drosophila* species including their typical specialties.

Conclusion

Collection of different *Drosophila* fruit fly's species were carried out during July-October 2023 from various parts of Nepal (high Himalayas to plain condition). The collection was done by applying bottle traps and net sweeps. Different species of *Drosophila* fruit flies were collected and analyzed in the laboratory of Entomology Department of Agriculture and Forestry University, Chitwan, Nepal. More than ten species were studied and recognized in detail. Limited abundance and diversity of *Drosophila* fruit fly species were found in extreme geography of Nepal.

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