International Journal of Agriculture Innovations and Research
Volume 1, Issue 5, ISSN (Online) 2319-1473

Key for Identification of Butterflies (Lepidoptera) of Hazara University, Garden Campus, Mansehra, Pakistan

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Abstract **– The present survey of butterflies (Lepidoptera) of Hazara University, Garden Campus, Mansehra, Pakistan was conducted during March-June 2012 and the key has been made for their identification. Total 170 specimens were collected from which 10 species with 8 genera belonging to 3 families were identified from 3 study sites. According to families, 50% species were belonging to Pieridae, 30% Namphalidae and 20% Papilionidae families. According to the study sites, 53% collection were made from residential area, 34% from main campus and 12% from administration area. The species were identified, the painted lady, *Cynthia cardui* (Linnaeus); blue pansy, *Junonia orithya* Linnaeus; and plain tiger, *Danaus chrysippus* (Linnaeus) were belonging to family Nymphalidae. The lime butterfly, *Papilio demoleus* Linnaeus and common mormon, *Pa. polytes* Linnaeus were belonging to family Papilionidae. The dark clouded yellow, *Colias croceus* (Geoffroy); common grass yellow, *Eumera hecab* (Linnaeus); Murree green-veined white, *Pieris ajaka* Moore; green-veined white, *P. napi* (Linnaeus) and Bath white, *Pontia daplidice* (Linnaeus) were belonging to family Pieridae. The most encountered species found was *Po. daplidice* whose 125 specimens were collected. The least encountered species were *P. polytes* and *D. chrysippus*, i.e., for each 1 specimen was collected. The largest wingspan was found *D. chrysippus*: (7±0 cm; n=1) and the smallest was *E. hecabe*: (3.7±0.8 cm; n=4). The largest body-length was found *D. chrysippus* (2.5±0.0 cm; n=1) and the smallest was *E hecabe* and *J. orithya* (1.4 cm; n=4). It is suggests that this region may have a diverse butterfly fauna. Similar surveys on large scales are recommended to fully evaluate the butterfly fauna of Hazara division.**

Keywords **– Butterfly, Hazara University, Key, Nymphalidae, Papilionidae, Pieridae**.

I. Introduction

Mansehra is leading with its distinguishing topography due its mountain ranges, the valleys, the plains, and the lakes. The area has been blessed with the rich and symphonic combination of tall and splendid fine trees, plains, which make it, bliss of peace. Hazara University is situated in the North-East region of Pakistan. Through out history the region has remained a melting pot of civilizations including Buddhist, Indian, Chinese, Islamic civilization and cultures (Ilyas et al., 2009).

Butterflies belong to different families and Papilionidae is most conspicuous family. Butterflies of this family are relatively larger and ornate. It is commonly exemplified by a well-known genus *Papilo.* They are strong and sophisticated gliders with bright coloration. Most of them possesses tailed hind wing. They are larger butterflies with patterns of yellow, orange red iridescent blue, orange and green (Khan et al., 2000). It has been recorded that this family comprises more than 900 species worldwide (Rafi et al., 2004). Family Hesperiidae includes skippers' butterflies. They have small and stout body. Antenna have usually hooked or curved tips and widely separated at the base. The larvae are smooth with large head and constricted neck. Family Danaidae comprises brightly colored butterflies with black and white markings. Larvae feed on milkweed thus also termed as milkweed butterflies. Adults are protected by distasteful body fluids and are seldom attacked by predators (Borror et al., 1975). Butterflies of family Pieridae are white, yellow or orange in coloration, often with black spots (Carter, 2000). They pollinate the flowers on which they feed and some Pierids are significantly important as agricultural pests (Shah et al., 2001). Nymphalidae is the largest family of butterflies present all over the world. Underside of their wings is cryptically colored and they love to bask in the sun. They generally feed on ripe fruit and tree sap (Sabir et al., 2000).

A number of aposematic butterfly and diurnal moth species sequester inedible or lethal substances from their host plants rather than manufacturing their own defensive materials. In spite of countless diversity in their life histories, there are some general features in the selective use of secondary metabolites of plants for achieving effective protection from predators (Nishida, 2002). An interesting illustration of deceptive coloration is that the ventral wing pattern of lycaenid butterflies (Lepidoptera: Lycaenidae) creates head impression at the posterior end of the butterfly that distracts predator attacks towards the less vulnerable end of the insect. Predators may direct their attacks towards eyespot markings on lepidopteron wings and lizards preferentially attack the false head of lycaenid butterflies, frequently getting a mouthful of hindwing while the butterfly escapes otherwise unharmed. The constituents of wing arrangement and morphology that contribute to an impression of a head, though, differ prominently amongst lycaenid species (Robbins and Robert, 1981).

Butterflies have great economic importance. They are most efficient pollinators of flowers in addition to moths and bees. They help in production of food crops, seeds and fruits so essential for the survival of man and animals (Maheshwari, 2003). Butterflies are frequently used as bioindicators of ecosystem health and as surrogates for

whole biodiversity (Bonebrake and Sorto, 2009). Several characters of the butterflies make them good candidates for indicator species. They have a widespread distribution, are comparatively easy to sample and recognize, and both as individuals and as species, they show significant numbers in different ecosystems. They are strongly influenced by local weather and highly sensitive to environmental changes besides being charismatic insects that could fascinate the public attention. They are extremely sensitive to changes in vegetation composition and structure and different types of vegetation show different butterfly species composition. Therefore, the butterfly assemblages may be used to characterize different habitats. Plants are the vital source of nourishment of butterflies; some specific plant species provide the trophic resources for caterpillars, while others provide nectar for adults. The vegetation can also play an important role for butterfly survival offering particular structural elements for sun-basking or mating and determining certain suitable microclimates. Therefore, it would be expected that butterflies respond more strongly to vegetation gradients than to edaphic gradients (Sawchik et al., 2005). Increased urban features, including roads, buildings, and mowed lawns, correspond with decreases in butterfly species richness, diversity and abundance. As might be predicted, butterfly species that specialize on particular plant species for ovipositing, and disturbance sensitive species are more affected by urbanization than are generalist species (Clark et al., 2007). Throughout history, butterfly images have been used more frequently in decorative objects than most other living organisms. Indian decorations have used butterfly images for centuries. Items adorned with butterflies are often considered ornamental (Gagliardi, 2012). The objective of the present research is to prepare key for identification of butterflies of Hazara University, Garden Campus, Mansehra, Pakistan in future.

II. Materials and Methods

i) Hazara University

The present research was conducted in Hazara University, Garden Campus, which is located in the tehsil Dhodial, district Mansehra, Pakistan (Online, 2012). For the convenience of the present research, it was divided into 3 quadrants: residential area: A; administration area: B; main campus: C.

ii) Methods

The study was conducted to prepare the key for butterflies of Hazara University. The butterflies were collected by visiting mentioned quadrate daily twice or thrice during March-June 2012. Then they were killed, stretched, pinned and identified by already preserved specimen, internet, literature available (Sabir et al., 2000; Munir et al., 2007), keys (Abbas et al., 2002; Munir et al., 2007) and entomologists on the bases of their characteristics.

III. Results

Present study was conducted to prepare the key for butterflies of Hazara University, Mansehra, Pakistan. Total 170 specimens were collected from 3 quadrates of study sites of the university, i.e., residential area: A; administration area: B; main campus: C. The 92 specimens were collected from residential area, 20 from administration area and 58 from main campus. Identification of these butterflies showed that 10 different species from 8 genera belonging to 3 different families were present in the area (Table 1). Family Pieridae comprised the largest number of individuals, i.e., 144 followed by 16 individuals of Nymphalidae and 10 of Papilionidae (Figure 1).

Table 1: Number of butterfly species collected from 3 localities during the present survey of Hazara University, Mansehra, during March-June 2012

S.No.	Common name	Species collected	No of specimen collected (%) from 3 quadrates		
			Residential	Administration	Main Campus
1.	Painted lady	Cynthia cardui	1 (0.6)	0 (0)	1 (0.6)
2.	Blue pansy	Junonia orithya	2 (1.2)	1 (0.6)	10(6)
3.	Plain tiger	Danaus chrysippus	0 (0)	0 (0)	1 (0.6)
4.	Lime butterfly	Papilio demoleus	2 (1.2)	0 (0)	7 (4.2)
5.	Common mormon	Papilio polytes	1 (0.6)	0 (0)	0 (0)
6.	Dark clouded yellow	Colias croceus	4 (2.4)	0 (0)	1 (0.6)
7.	Common grass yellow	Eurema hecabe	3 (1.8)	0 (0)	1 (0.6)
8.	Murree green-veined white	Pieris ajaka	2 (1.2)	0 (0)	0 (0)
9.	Green-veined white	Pieris napi	7 (4.1)	1 (0.6)	0 (0)
10.	Bath white	Pontia daplidice	70 (41)	18 (10.6)	37 (22)
*Digits in brackets: %; digits outside the brackets: number of individuals					

International Journal of Agriculture Innovations and Research
Volume 1, Issue 5, ISSN (Online) 2319-1473

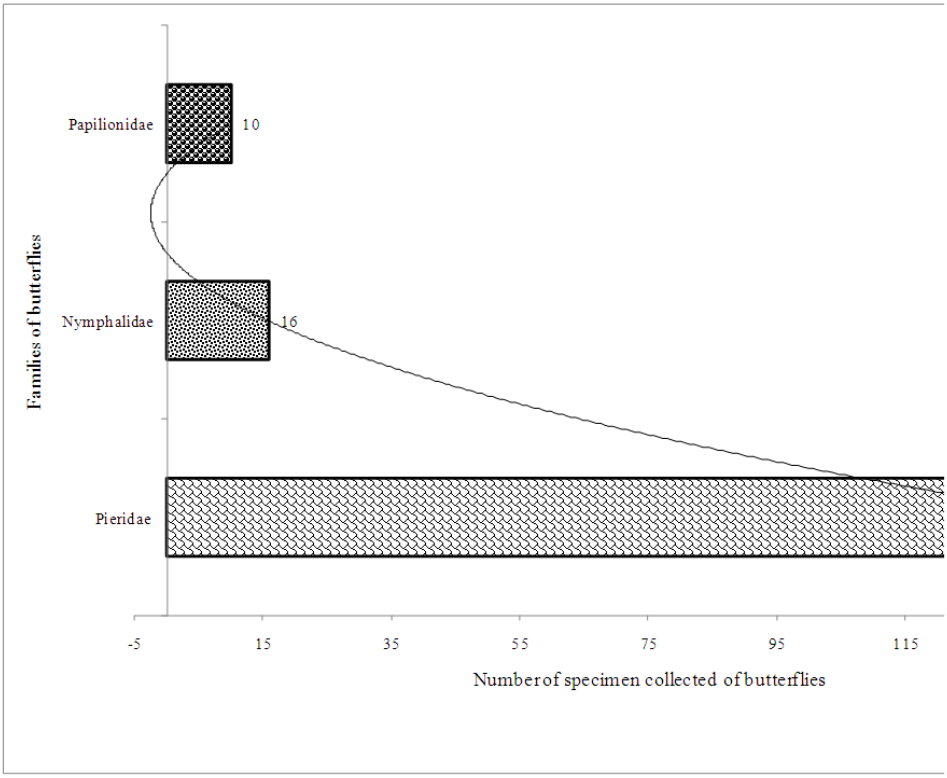

Fig.1. Number of specimen of 3 families of butterflies collected from Hazara University, Mansehra, Pakistan during March-June 2012

Key to the butterfly families of Hazara University, Mansehra, Pakistan

1a: Forelegs are reduced ……2
1b: Forelegs are not reduced……3
2a(1a): Primarily, blue, pale brown or orange colors, antennae tips are with large conspicuous knobs …… …….. **Nymphalidae**
2b(1b): Multi-coloration , i.e., yellow, blackish-brown, white or orange and antennae tips are with or without knobs ……4
4a(2b): Medium to large in size……..**Papilionidae**
4b: Mostly with creamy, white, yellow or light orange colors……5
5(4b): Underside and upper side of wings with distinct spots……**Pieridae**

Key to the butterfly species of Hazara University, Mansehra, Pakistan

1a: With predominantly orange or pale brown color…..……2
1b: With predominantly black or dark color……3
1c: With predominantly white, creamy, yellow or light orange color……4
2(1a): Forelegs are reduced, antennae tips are with large conspicuous knobs……**Nymphalidae**
2a(1a)(i): A pale greyish-buff under hindwings is present but brown bands are almost obsolete, across cell narrow black paired lines are present under forewings……..……..***Junonia orithya***
2a(1a)(i)I: Excluding apex upper forewing is black, apex is a buffy white with narrow brown bands and a small section of blue in tonal area is absent, iridescent blue upper hindwings with two red-brown centered black ringed, more conspicuous ocelli ……**female**
2a(1a)(i)II: Apex of upper forewing is a buffy white with contracted brown bands and a tonal area with small blue panel, Black upper forewing, iridescent blue upper hindwings with two red-brown centered black ringed ocelli……**male**
2a(1a)(ii): Both wings are heavily marked with black and white, apical half of forewing with white spots, apex is round at tip, smooth brown hairs (cilia) are present on base of hindwings, sexes are alike …..……***Cynthia cardui***
2a(1a)(iii): Body color is tawny, upper margin of forewing is black with white spots, hindwings have a thin black border enclosing a sequence of hemispherical white spots……***Danaus chrysippus***
2a(1a)(iii)I: Smaller than female with 3 black spots on hindwing, bright coloration, 2 brush-like organs, which can be pushed out of tip of the abdomen ……..……..**male**
2a(1a)(iii)II: Hindwings with 2 black spots …….**female**
3(1b): Mainly with black or dark colors ……**Papilionidae**
3a(1b)(i): Body is black with pale yellow and orange markings, a single large red spot along with bluish black spot is present on hindwings and both sexes are alike. ……..……***Papilio demoleus***
3a(1b)(ii): Mainly black with conspicuous tails on hind wings, post-marginal area of hindwings are with distal band of elongated white spots…….……***Papilio polytes***
3a(1b)(ii)I: Lacks white spots band on hindwings…**female**

International Journal of Agriculture Innovations and Research
Volume 1, Issue 5, ISSN (Online) 2319-1473

3a(1b)(ii)II: Band of white spots or often creamy-yellow spots are present on hindwings prolonging up to vein 7……..…**male**
4(1c): With distinct spots underside and upper side of wings…….……**Pieridae**
4a(1c)(i): Tinged black veins on upper side, veins of underside of hindwings are dusted with pale greenish-yellow and have conspicuous black color, tip of fore wing is black with a distal black spot in between veins 3 and 4.……..…… ***Pieris napi***
4a(1c)(i)I: Black areas of forewing tip is heavily marked and no under hindwings tend to be yellowed…… …….……**female**
4a(1c)(i)II: Heavy marking in forewing tip are absent ……..……**male**
4a(1c)(ii): Undersides of both fore and hindwings are pale yellow, borders dusted with gray scales.……***Pieris ajaka***
4a(1c)(ii)I: Upper forewing with prominent black spots, veins heavily defined in black color, noticeable black spot between veins 3 and 4……..…….……**female**
4a(1c)(ii)II: Upper forewings contain black weak markings, black spot is absent between veins 3 and 4….. ……..……..**male**
4a(1c)(iii): Commonly yellow with expansive black apical and terminal area of forewings, forewings with black inner margin, sexes are alike……..……..***Eurema hecabe***
4a(1c)(iv): A large black spot end cell on forewings, hind wings are dark basally being dusted with blackish-orange, a prominent bright orange disco-cellular spot, underside is dark greenish-yellow ……..***Colias croceus***
4a(1c)(iv)I: Black margins with sequence of small orange-yellow spots of irregular size…….**female**
4a(1c)(iv)II: Upper surface orange with broad black external edges without any small orange spot……..…….**male**
4a(1c)(v): Forewing is white except apex which is dusted with black, green hindwings with white inner margin……***Pontia daplidice***
4a(1c)(v)I: Upper hindwings with unclear row of terminal and marginal spots, extra discal spot is present in 1b……..…….**female**
4a(1c)(v)II: Markings on upper side of forewings, apex of the forewings is black with white spots and lines, cell end with black spot……..…..**male**

When wingspan and body-length of butterfly species collected from Hazara University, Mansehra, Pakistan during March-June 2012 were compared, the descending order of both parameters were found as given below (Table 2):

Wingspan (cm): *P. polytes*: 7.5±0.0 > *P. demoleus*: 7.1±0.8 > *D. chrysippus*: 7.0±0.0 > *Pi. ajaka:* 5.9±1.0 > *C. cardui*: 5.7±0.6 > *Pi. napi*: 5.1±1.3> *Co. croceus*: 4.6±0.1 > *J. orithya*: 3.9±0.5 > *Po. daplidice*: 3.8±0.4 > *E hecabe*: 3.7±0.8.

Body-length (cm): *D. chrysippus*: 2.5±0.0 > *P. polytes*: 2.3±0.0 > *P. demoleus*: 2.2±0.2 > *Pi. ajaka*: 1.9±0.1 > *Pi. napi*: 1.7±0.3> *Co. croceus*: 1.7±0.1 > *C. cardui*: 1.6±0.4 > *E. hecabe*: 1.4±0.2 = *J. orithya*: 1.4±0.1 > *Po. daplidice*: 1.4±0.2.

Table 2: Wingspan and body-length of butterfly species collected from Hazara University, Mansehra, Pakistan during March-June 2012

SNo	Common name	Species collected	n	Wingspan (cm) (Mean±SD)	Body-length (cm) (Mean±SD)
1.	Painted lady	Papilio demoleus	9	7.1±0.8	2.2±0.2
2.	Blue pansy	Eurema hecabe	4	3.7±0.8	1.4±0.2
3.	Plain tiger	Junonia orithya	13	3.9±0.5	1.4±0.1
4.	Lime butterfly	Pieris napi	8	5.1±1.3	1.7±0.3
5.	Common mormon	Pieris ajaka	2	5.9±0.9	1.9±0.1
6.	Dark clouded yellow	Colias croceus	5	4.6±0.1	1.7±0.1
7.	Common grass yellow	Pontia daplidice	125	3.8±0.4	1.4±0.2
8.	Murree green-veined white	Cynthia cardui	2	5.7±0.6	1.6±0.4
9.	Green-veined white	Papilio polytes	1	7.5±0.0	2.3±0.0
10.	Bath white	Danaus chrysippus	1	7.0±0.0	2.5±0.0

IV. DISCUSSION

The present study is the first documented reports for butterfly fauna survey in Hazara division during March-June 2012. Shah et al. (2001) made a survey of Kohat and collected 10 species belonging to only family Pieridae from seven different localities over a period of 7 months during 1999. In the present survey, species belonging to different families were reported. *E. hecabe* and *P. daplidice* were recorded from both the surveys whereas *P. ajaka. P. napi* and *C. croceus* were only recorded from the present research. It may be due to the difference in climatic conditions of both the areas.

Perveen and Ahmad (2012) evaluate the butterfly fauna of Kohat, Pakistan during September-December 2008. Twenty-one species were recognized belonging to 3 different families. Pieridae covered 57%, Nymphalidae 33% and Papilionidae 10%, of total numbers of collected butterflies of Kohat. Pieridae is reported as dominant family during survey. Similarly these three families were also reported in the present survey from Hazara University. Family Pieridae constitute large number of

individuals followed by Nymphalidae and Papilionidae as reported in Kohat fauna.

Martinez et al. (2003) reported biodiversity and biogeography of butterfly's fauna in Mexico. About 1800 species of butterflies were documented, constituting about 10% of the butterfly fauna of the world. The 21 sites were acknowledged in Mexico for the abundance of butterfly fauna and comparisons were made between these sites. Perveen et al. (2012) reported the characterization and Perveen (2012) described the distribution of butterflies of 5 sites of Kohat, Khyber Pakhtunkhwa, Pakistan. About 21 species of butterflies were documented. The collected species covered families Namphalidae, Papilionidae and Pieridae yielded 33, 10, and 57% butterfly diversity of the area, respectively. In contrast, only 10 species were recorded from the present survey but difference was due differences in area covered in 3 studies. Comparison cannot be possible, however, almost same ecological conditions were found in the study areas.

Khan et al. (2007) reported 16 species from Kotli, 20 from Mirpur and 19 from Bhimber, which showed great resemblance with species collected from Hazara University. The present research matched with butterfly faunal study of Skardu region by Khan et al. (2004a and b) as it revealed 16 species belonging to 5 families. Ahsan and Iqbal (1975) surveyed butterfly fauna of Lahore from a number of localities. In another study, 21 species were identified belonging to 3 different families from Kohat, Pakistan during September-December 2008. The reported families Namphalidae covered 33%, Papilionidae 10%, and Pieridae 57% biodiversity of butterflies of Kohat (Perveen, 2012; Perveen and Ahmed, 2012a and b; Perveen et al., 2012). The butterfly species from fore mentioned studies, i.e., *P. demoleus, P. polytes, D. chrysippus* and *E. hecabe* were recorded showed resemblance with 10 species of butterflies from Hazara University.

Ambrose and Raj (2005) evaluated Kalakad-Mundanthurai Tiger reserve Southern India butterfly fauna. Survey was done from September 2002-March 2003. Study revealed 24 species of butterflies. Only 10 species were recorded from the present research. Reported species of India belongs to 9 families but only 4 families were studied in detail, however, presently, only 3 families were reported.

Borang et al. (2008) yielded 134 species of butterflies from area of Dihang Dibang Biosphere Reserve of Arunachal Pradesh, India. Recorded butterflies belong to 81 genera and 8 families whereas in the present research 8 genera belonging to 3 families were reported. Nymphalidae comprises 28 genera, Papilionidae 9 and Pieridae 10 genera from the India. In contrast from the present survey, it was found that Pieridae comprises 4 genera, Nymphalidae 3 and Paplionidae 1.

It is evident from the result that the study site comprises different species belonging to 3 main families. It may be due to increase construction and population pressure in the natural areas of Hazara University that administration area and main campus show least butterfly fauna as compare to residential area because species composition and abundance is always dependent upon maintenance of natural habitat. Another reason is the scarcity of time. If more time was spend for survey there would be increase in number of butterflies.

V. Conclusion and Recommendation

Total number of collected and preserved specimens from 3 different study sites were 170. Eight genera comprising 10 different species with 8genera belonging to 3 families were recorded from the area. A large number of specimens were collected from residential area i.e., 92 and least from administration area, i.e., 20. The most encountered species found was *P. daplidice* whose 125 specimens were collected from all localities.

Similar surveys on large scales are recommended to fully evaluate the butterfly fauna of Hazara division as it is least documented region of KP. Natural habitat should not be lost; therefore, proper preventive measures should be taken in order to conserve the butterfly fauna. They are dependent upon proper environmental conditions.

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AUTHOR'S PROFILE

Dr. Farzana Perveen

is born in Karachi, Pakistan. She is BSc (Hons) in Biochemistry, Microbiology and Zoology and MSc in Zoology specialized in Entomology (Toxicology) from University of Karachi. She was selected for Cultural Exchange Scholarship for Nagoya University, Japan. In Japan, she did 6 months Japanese language course; 2 years Master in Agricultural Sciences (MAS) and 4 years Monbusho Scholar Research Fellow (MSRF) in Agronomy. She is Ph.D. from Karachi University specializes in Integrated Pest Management, did course and research work from Nagoya University, Japan. HEC scholarship was awarded for Post-Doctorate at Aukland University, New Zealand.

She has started his professional career as Research Fellow from University of Karachi. Then she is qualified Sindh Public Service and served as HOD and Asstt Prof, Department of Zoology, Government Degree College of Karachi. She also served as Teaching and Research Associate in the Laboratory of Applied Entomology, Nagoya University, Japan. After returning from Japan, she served as Research Fellow and Teaching Associate in University of Karachi. She is Founder Chairperson of Department of Zoology of three different National Universities, Kohat University of Science and Technology (KUST), Hazara University (HU) and Shaheed Benazir Bhutto University (SBBU). Presently, she is serving as Founder Chairperson and Associate Professor, Department of Zoology, SBBU, KP, Pakistan. As research supervisor, she appears as Zoologist guiding the students in different fields of Zoology including Entomology, Toxicology, Wildlife Management, Conservation Biology, Integrated Pest Management, Biochemistry, Microbiology, Agriculture, Parasitology, Ornithology, Genetics, Molecular Biology, Biotechnology, and Bioengineering.

She has published 70 papers, 57 in International and 23 in National reputable scientific Journals with impact factors, 13 with solo authorship. Internationally, she is author of 3 chapters, 32 books and editor of 2 books. She is supervised 20 M.Phil. and 45 MS students in their theses.

Gold Medal has been awarded her for obtaining PhD in Toxicology from University of Karachi. She has been presenting her research and delivering lectures in International (America, Japan and London etc) and National conferences, meetings and workshops. Many shields have been awarded her for recognition her academic contribution. She has fellowships of International and National reputable research societies and professional organizations. She is a member of the World Commission on Protected Areas (WCPA), International Union for Conservation of Nature (IUCN). She is member of editorial boards of many International and National journals. She is good in computer and modern languages. She has organized many seminars/workshops/ conferences/symposium. She is HEC Approved Supervisor for BS/MSc/MS/MPhil and PhD Students. She has approved scientists for Research Productivity Award 2011-2013, nominated for Award of Pakistan Academy Science Gold Medal 2012 in Zoology from HU, nominated for Director, Chair for woman in Science and Technology from HU in 2012. She can be contacted via e-mail: farzana_san@hotmail.com

She likes most her 3 publications:

Farzana Perveen & Anzela Khan (2012) Pearl Culturing Industry. 1-123; ISSBN: 978-3-8465-8380-7; Lambert Academic Publisher (LAP), Germany; Online: https://www.lap-publishing.com.

Farzana Perveen (Editor) (2012) Biochemical analyses of action of chlorfluazuron as reproductive inhibitor in *Spodoptera litura*. In: Insecticides-Advances In Integrated Pest Management; ISBN 978-953-307-780-2; InTech Book Publisher, Rijeka, Croatia; 293-326; Online: http://www.intechopen.com/books/show/title/insecticides-advances-in-integrated-pest-management

Farzana Perveen (2009) Effects of residual chlorfluazuron on haemolymph-borne oviposition-stimulating factors in *Spodoptera litura*(Lepidoptera: Noctuidae). Entomologia Experimentalis et Applicata 132: 241-249; **(**I. F.: 1.404: T.C.: 4728**);** DOI: 10.1111/j.1570-7458.2009.00888.x.