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Taxonomic studies on the occurrence of the snails (Mollusca: Gastropoda) in the agroecosystem

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Abstract

Gastropods have a very important position in our ecosystem as pest, intermediate host, food source and as bioindicators for environmental quality but the taxonomic work regarding snail species has not been carried out in this part of the world after 19th century. Total 19290 snails were collected from agro ecosystem of Faisalabad for their taxonomic characterization. The identification of the specimens was made on the basis of number of whorls, coiling of the shell, umbilicus, shape, colour, shape of the aperture, presence or absence of operculum, height (mm), diameter (mm) and the diameter of the aperture (mm) using vernier caliper. Microscopic identification was done by using recent identification keys and diagrammatic description provided in them. We found snails belonging to 2 orders 7 families 9 genera and 15 species. This is a baseline study to get the basic information about the malacofaunna of Faisalabad which will be important in various applied fields. However, new sibling species might be proposed of *Zooctecus insularis* after molecular characterization.

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Introduction

Land snails are generally considered as typical herbivores, fungivores and detrivores (Burch and Pearce, 1990) that show intraspecific competition at weak levels (Cain, 1983, Barker and May hill, 1999). Annual litter input of about 0.5% per year can be consumed by land snail communities (Mason, 1970). They are designated as serious pests of ripening fruits i.e. tomatoes and strawberries as they are grown near the ground. However, they also depend on foliage and fruit of some trees like citrus (Flint, 2003).

It has an important position in the food webs of different ecosystems as snails are mostly consumed by fish, water fowl, crayfish, leeches and sciomyzid flies (SWCSMH, 2006). Most of the studies on the land snails have been carried out approximately a century before in the Indian subcontinent. Hutton (1842) collected and studied the land snails of neighborhood of Bolan pass, from Suliman range and the hills of south laying west to Indus. According to the Blanford and Godwin (1908), in the areas of Saw at, Dir or Chitral no terrestrial snails have been observed except *Petraeus* snails, while in the Kuram valley only very few species were found. They worked chiefly on the conchological side of the families Testacellidae and Zonitidae of Indian subcontinent.

Pokryszko *et al.* (2009) collected 3500 dry shells and described 22 species out of which 12 were new species from 77 localities. The specimens were preserved in alcohol. The shell variations in most species were described and nine species were illustrated with Figs of detailed reproductive system. In the Northern area of Pakistan there is highest diversity of Pupilliods due to wetter climate and wider altitudinal range. Ten out of twenty two species were considered to be endemic to Pakistan, while the distribution of the rest of species was extended to other regions i.e. Asia, Europe and Holarctic.

Pupilloid fauna showed great diversity of Palaearctic/Holarctic influence on general. Recently researches have been conducted on the biodiversity of soil macro inverteberate in the low and high input fields of wheat and sugarcane in District Faisalabad (Rana, 2012; Siddiqui, 2005) with the major focus on impact of chemical on the diversity of different macroinverteberates. Rana (2000) studied the ecological distribution of earthworm species along some water bodies in the agro ecosystem of Faisalabad Division. Khanum (2010) studied the taxonomy of the plant nematodes of sugarcane fields.

Very less work has been done with reference to the taxonomy and ecology of snails in the agro ecosystem. Previously Ali (2005), Altaf (2006) and Rahman (2011) have attempted to study the diversity of snails in agro ecosystem of Faisalabad which has augmented the previous information of the malacofaunna in Faisalabad. The work of the Ali (2005) and Altaf, (2006) was just about the sugarcane fields and wheat fields near Gutti village area; however Rahman (2011) covered only few villages of Faisalabad focusing only one family of snails. The diversity index was found highly significant in agricultural fields however the results were non-significant in case of ditches. It can be concluded that due to environmental degradation and water pollution the snail diversity is non significant, in ditches however in the agro ecosystem it is a pest (Altaf *et al.* 2016).

This study is focuses mainly on the taxonomic account of the different species found in the agro ecosystem of Faisalabad, Pakistan.

Materials and method

Study area

The third largest city of Pakistan, Faisalabad, is situated in the central Punjab covered an area of 122 km^2 at spherical coordinates of 31025/N and 73009/E located at an altitude of 300 m above mean sea level (Kahlown, 2006) (Fig. 1). Faisalabad City has total land area of 52130 acres of which 19805 acres is cultivated land areas (Final Mouza List, 2008). 24 villages were sampled in agricultural areas of Faisalabad city from March 2011 through August 2011 (Fig. 2).

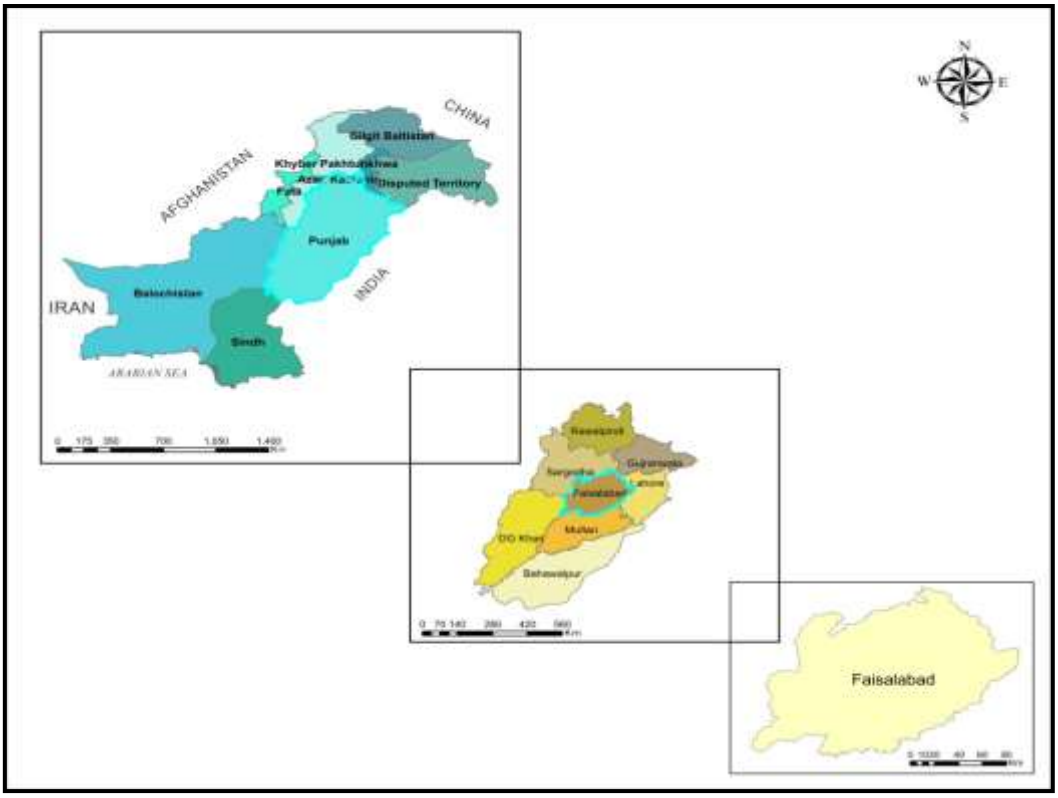

Fig. 1. Location of Faisalabad, Punjab, Pakistan (Saleem, 2014).

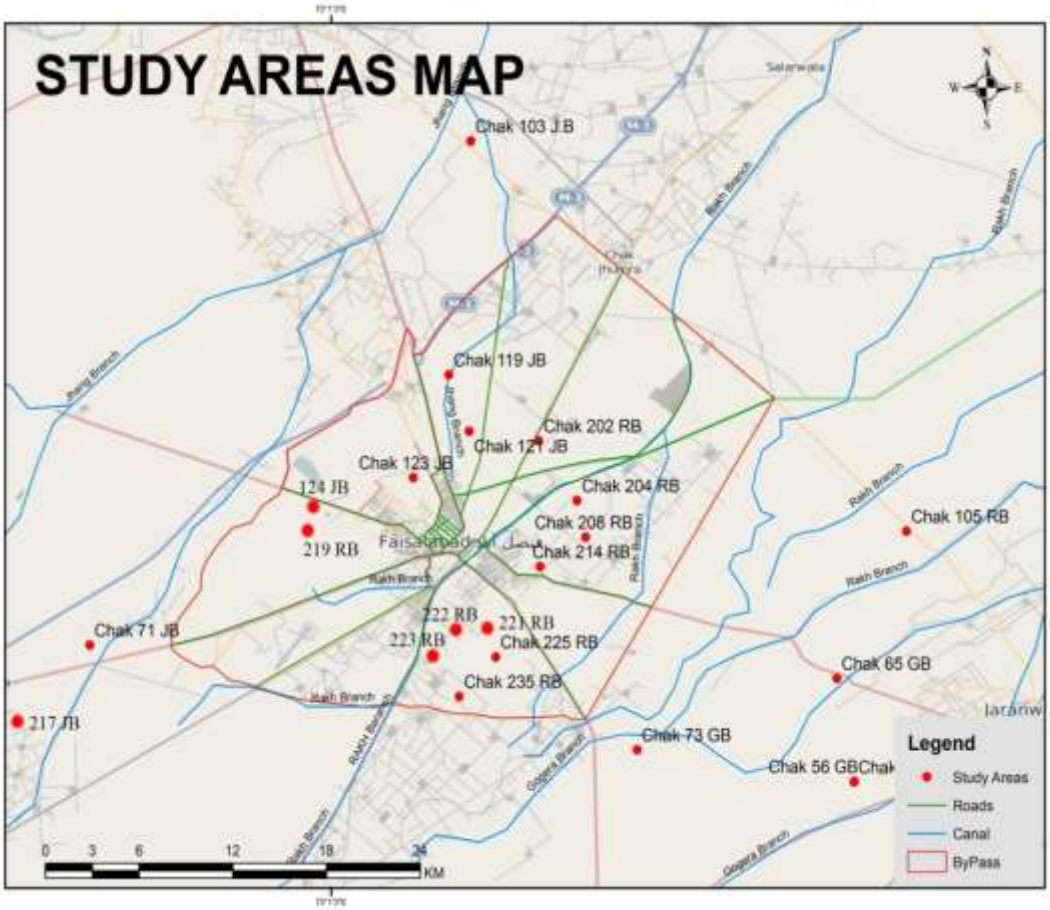

Fig. 2. Map of the study areas.

Identification of species

The identification of the specimens was carried out on the basis of number of whorls, coiling of the shell, umbilicus, shape, colour of shell, shape of the aperture, presence or absence of operculum, height and diameter of the snails. The diameter of the aperture was measured with the help of vernier caliper. The snail's samples were studied under the microscope and are identified by using the keys and diagram provided by the Blandford and Godwin (1908), Bouchet and Rocroi (2005), Sturm *et al.* (2005), Anderson (2008), Watson and Dallwitz (2005) .

Results

In the 24 different villages the different areas of the agroecosysem were sampled. 19290 snail specimens were collected which were identified according to the different available keys. The snails were found to belong to two suborder, seven families, nine genera and fifteen species.

There were found 6 families from the suborder Stylomatophora and only one family was found belonging to the suborder Bassomatophora. Out of nine genera two genera named Ariophanta and Oxychilus belong to the family Zonitidea, two genera named Monacha and Cernuella belong to family Hygrommiidea. Only one genera belong to family Succineidae, Subulinidae, Pupillidae, Ferussaciidae each referred as Ox Loma, Zootecus, Pupoides, Cecilioides respectively.

Checklist of the species of the class gastropoda

Out of fifteen species, six species belong to the genus Ariophanta, named as *Ariophanta bistrialis ceylanica, Ariophanta bistrialis cyix, Ariophanta bistrialis taprobanensis, Ariophanta bistrialis, Ariophanta solata, Ariophanta belangeri bombayana,* while *Oxychilus draparnaudi, Monacha catiana, Cernuella virgata, Oxyloma elegans, Zootecus insularis, Juvenile Zootecus insularis, Pupoides albilabris, Cecilioides acicula* and *Physa fontinalis* belong to other genera (Table 1).

Table 1. Checklist of the Species of the Class Gastropoda in Agroecosystem of Faisalabad.

Suborder	Family	Genus	Species
Stylomatophora	Zonitidae	Ariophanta	*A. bistrialis ceylanica*
			A. bistrialis cyix
			A. bistrialis taprobanensis
			A. bistrialis
			A. solata
			A. belangeri bombayana
		Oxychilus	*O. draparnaudi*
	Hygromiidae	Monacha	*M. catiana*
		Cernuella	*C. virgata*
	Succineidae	Oxyloma	*O. elegans*
	Subulinidae	Zootecus	*Z. insularis*
			Juvenile Z. insularis
	Pupillidae	Pupoides	*P. albilabris*
	Ferussaciidae	Ceciloides	*C. acicula*
Bassomatophora	Physidae	Physa	*P. fontinalis*

Comparative morphometery

The mean maximum height was found in *Zooctecus insularis* reaching up to 12.45mm. while the least mean height was found of the specimens belonging to species *Cecilioides acicula* which is 4.25mm. The mean height of the specimens belonging to genus *Ariophanta* ranges from 6.10mm -6.60mm however, the mean height of *Ariophanta bistrialis ceylanica* was the least of all species belonging to genus *Ariophanta*. (Table 2)

However, the specimens of *Monacha catiana* and *Oxyloma elegans* have nearly similar mean height i.e. 6.88mm and 6.80mm.

The mean height of the *Zooctecus insularis* and *Oxychilus draparnaudi* is 8.00mm to 8.60mm respectively. The specimens of *Pupoides albilabris* and *Physa fontinalis* is 9.20mm.

The mean height of the shell becomes a useful parameter when used with mean measurement of the diameter which helps us in the classification of the snails after the calculation of the height over diameter ratio i.e. H/D ratio.

When the diameter of species belonging to the genus Ariophanta was measured it was found to range from 8.10mm to 9.70mm. When these measurements were subject to find the H/D ratio, it was observed that the species having less than 0.65mm had much flattened spire as compared to the species of the genus Ariophanta with a value of 0.75mm. This type of shell shape is reffered as sub-globose, which is also observed in *Oxychilus draparnaudi*, *Monacha catiana* and *Cernuella virgata* having sub-globose shell shape. They have been placed under these species due to the variation in peristome, their ecological habitat and their colour, which is pale straw in genus Ariophanta while in *Oxychilius draparnaudii* the shell are horny coloured, with *Monacha catiana* having white shells but in *Cernuella virgata* the white shells have dark line around.

Table 2. Characterization of the Snails on the Basis of Morphometery.

Sr. no.	Species/Habitats	Mean Height (H) mm	Mean Diameter (D)mm	H/D ratio	Mean Aperture Height	No. of whorls	Shell coiling	Peristome	Umbilicus	Shape	Color
1	*Ariophanta bistrialis ceylanica*	5.70	9.10	0.63	4.50	4.5-5.5	Dextral	Thin / simple	Present	Sub-globose	Pale straw color. Dark line around the periphery and in sutures
2	*Ariophanta bistrialis cyix*	6.50	9.40	0.69	4.72	4.5-5.5	Dextral	Thin / simple	Present	Sub-globose	Pale straw color. Light black/reddish brown line around the periphery and in sutures.
3	*Ariophanta bristrialis taprobanensis*	6.60	9.70	0.68	4.91	4.5-5.5	Dextral	Thin / simple	Present	Sub-globose	Pale straw color. White shade/line around the periphery and in sutures
4	*Ariophanta bristrialis*	6.20	8.90	0.70	5.79	4.5-5.5	Dextral	Thin / simple	Present	Sub-globose	Pale straw color, dark line around the periphery and in sutures and dark lines around the umbilicus on the lower side of the shell.
5	*Ariophanta solata*	6.10	8.10	0.75	4.12	4.5-5.5	Dextral	Simple/ Thin	Present	Sub-globose	Pale straw color. Dark line around the periphery and in sutures and bluish tings on the spire
6	*Ariophanta belangeri bombayana*	6.40	9.10	0.70	4.42	4.5-5.5	Dextral	Simple/ Thin	Present	Sub-globose	Pale straw color. Very faint line around the periphery and in sutures
7	*Oxychilus draparnaudi*	8.60	14.22	0.60	8.61	4.5-5.5	Dexral	Thin deflected	Present	Sub-globose	Horny coloured, translucent, thin
8	*Monacha catiana*	6.80	9.91	0.69	4.51	4.5-5.5	Dextral	Simple/ Thin	Present	Sub-globose	Shell white/ dusty white
9	*Cernuella virgata*	7.10	9.72	0.73	5.10	4.5-5.5	Dextral	Thin	Present	Sub-globose	Shell white/dusty white, with Dark line around the periphery
10	*Pupoides albilabris.*	9.20	3.10	2.97	2.82	7.5-8	Dextral	Simple/ Thin	Small	Fusiform tapering towards apex	White

Sr. no.	Species/Habitats	Mean Height (H) mm	Mean Diameter (D)mm	H/D ratio	Mean Aperture Height	No. of whorls	Shell coiling	Peristome	Umbilicus	Shape	Color
11	*Physa fontinalis*	9.20	5.70	1.61	6.41	4	Sinistral	Thin reflected from the base	Absent	Succiniformes	Pale horn color to dark brown
12	*Zooctecus insularis*	12.45	4.87	2.56	3.93	7.0-8.0	Dextral	Thick	Small	Elongate conic	White, Dull White
13	*Juvenile Zooctecus insularis*	8.00	4.50	1.78	3.12	5.5- 6	Dextral	Thin	Small	Conical oval	White
14	*Cecilioides acicula*	4.25	1.35	3.15	8.56	5.0-6.0	Dextral	Simple/ Thin	Small	Fusiform tapering towards apex	White
15	*Oxyloma elegans*	6.80	3.21	2.12	4.10	2.5-3	Dextral	Simple/Thin	Absent	Succiniformes	Amber, greenish

The other important morphological character is the perisome which is thin and simple in all species of *Ariophanta* and *Monacha catiana*, and thin but not simple in the case of pupoides species while in the case of *Oxychilus draparnaudi* it is thin and deflected. All the above species have a dextral symmetry, with number of whorls ranging from 4.5-5.5 whorls.

The mean aperture height is another major characteristic in classifying snails in which the three subspecies of the *Ariophanta bristrialis* ranges from 4.50-4.91mm. and in *Ariophanta solata* it is 4.72mm. and 4.42mm. in *Ariophanta belangeri bombayana*. However the mean aperture height is 8.61mm in *Oxychilus draparnaudi* and 4.51mm in *Monacha catiana*. The significant difference of *Monacha catiana* from other species is of colour. The mean aperture height of *Ariophanta bristrialis* and *Cernuella virgata* is 5.79mm and 5.1mm respectively. The diameter of conical shells is much less as compared to the discoidal shell species with maximum mean diameter in *Physa fontinalis* i.e. 5.70mm and least in the *Ceciliodes acicula* it was 1.35 mm. while the diameter of *Zooctecus insularis* and Juvenile *Zooctecus insularis* is 4.87mm and 4.50mm respectively. The diameter of *Pupoides albilabris* and *Oxyloma elegams* is 3.10mm and 3.21 mm respectively.

According to our findings the H/D ratio is greater than one in the case of conical snail shells and ranges from 1.61mm to 3.15 mm.

Physa fontinalis has the least H/D ratio and is almost equal to *Juvenile Zooctecus insularis*. *Ceciliodes acicula* has the maximum H/D ratio i.e. 3.15mm. In case of *Oxyloma elegans* and *Zooctecus insularis* the H/D ratio is 2.12mm and 2.56mm. respectively which is followed by *Pupoides albilabris* species with a value of 2.97mm. Almost all the conical species are white in colour having small umbilicus with exception of *Physa fontinalis* having pale horn colour and *Oxyloma elegans* having amber greenish colour. In both species umbilicus is absent. There is a great difference in the coiling patterns of both species, however both have succiniformes shell shape, as *Physa fontinalis* is the only species with sinistral coiling with 4 number of whorls and the latter is the dextrally symmetrical with just 4 whorls.

For the comparison of these conical snails the other character for identification is aperture height. The maximum aperture height was found in *Ceciliodes acicula* i.e. 8.56mm and the minimum aperture height was found in pupoides 2.82mm with thin and simple peristome in both species. The aperture height is quite similar in *Zooctecus insularis* and *Juvenile Zooctecus insularis* i.e. 3.93mm and 3.12mm respectively but they are different from each other in terms of peristome and number of whorls. In *Zooctecus insularis* the peristome is thick with 7-8 numbers of whorls while on the other hand *Juvenile Zooctecus insularis* has thin peristome with 5.5 to 6 whorls due to which we suspect that it may be some new species which previously has not been described or reported in this part of the world.

Fig. 3. *Ariophanta bistrialis ceylanica* Zeitschr, 1837.

Fig. 7. *Ariophanta solata* Godwin- Austen, 1898.

Fig. 4. *Ariophanta bistrialis cyix* (Beck, 1837).

Fig. 8. *Ariophanta belangeri bombayana* Desh, 1847.

Fig. 5. *Ariophanta bistrialis taprobanensis* (Dohm, 1859).

Fig. 9. *Oxychilus draparnaudi* (Beck, 1837).

Fig. 6. *Ariophanta bistrialis* Beck, 1837.

Fig. 10. *Monacha catiana* (Montagu 1803).

Fig. 11. *Cernuella virgata* (Da Costa, 1778).

Fig. 12. *Pupoides albilabris* (C. B. Adams, 1841).

Fig. 13. *Physa fontinalis* (Linnaeus, 1758).

Fig. 14. *Zooctecus insularis* (Ehrenberg, 1831).

Fig. 15. Juvenile *Zooctecus insularis* (Ehrenberg, 1831).

Fig. 16. *Cecilioides acicula* O. F. Müller 1774.

Fig. 17. *Oxyloma elegans* (Risso, 1826).

Discussion

Freshwater and land snails belong to order Pulmonata of class Gastropoda (Blandford and Godwin Austen, 1908). However the order Pulmonata now is considered to be an informal group according to Bouchet and Rocroi (2005). The suborder Stylomatophora was identified on the basis of the presence of two pair of tentacles and is in conformity

with Dayrat and Tillier (2002) illustrating two major characters i.e. a long pedal gland placed beneath a membrane and two pairs of retractile tentacles that are shared by the members of this suborder. However the suborder Bassomatophora bears only on pair of tentacles.

The snail specimens have perforated shells with sub-globosely depressed shape with thin, fine striations and are decussated on the dorsal surface. On the ventral side there are spiral lines impressed with polished surface. They are pale horny in color, encircled by two rufous lines with a whitish band between them, the upper line continued insides the suture. The shells are spirally low to nearly flat or 4.5 convex whorls with rapidly increasing last whorl. The aperture is large with lunately ovate shape. The peristome is thin with the columellar margin slightly reflected is identified as *Ariophanta bistrialis*. However the shell of the form present in the south India is pale in its colour with two rufous lines. The form of the Ceylon is darker in colour with a single line is classified as *Ariophanta bistrialis ceylanica* (Zeitschr, 1837); however both varieties occur in each area. There is another variety from Ceylon classified as *Ariophanta bistrialis taprobanensis* with shell having no band and is a large rather thick variety. The species classified as *Ariophanta bistrialis cyix* (Beck, 1837) is a dwarf form rather globose, generally with the color-line faint (Blandford and Godwin Austen, 1908).

The specimens have sub-globosely depressed perforate shell, which is thicker with smooth striations. The colour is white in mostly specimens with bluish tinge, being washed with the brownish shade on the last whorl with narrow, spiral rufous band inside the sutures. There are numerous small brownish spots that are distributed irregularly along with traces of other bands. The spire is low or flatly convex above. The last whorl is slightly swollen from the ventral surface at periphery. The aperture is oblique with lunately ovate shape, generally reddish brown from within. The peristome is simple and thin. The columellar margin is slightly reflected are identified as *Ariophanta solata* (Blandford and Godwin Austen, 1908).

The species identified as *A. belengeri bombayana* have 5 whorls. They are pale tawny to whitish in color with low spire. The shell is convex with impressed suture. The shell is openly perforate having a depressed globose shape. The specimens have obliquely striated shells with more or less decussated spiral lines impressed on the dorsal surface while the ventral surface is smoother. The aperture is roundly lunate. The peristome is thin and columellar margin slightly reflected (Blandford and Godwin Austen, 1908).

The specimens have narrow to wide umbilicus of the shell, however only a few species are without umbilicus. The members of this genus have spiral or reticulate patterns with smooth gloss is classified as *Oxychilus* (Welter-Schultes, 2010). The *Oxychilus* shell is generally brown or amber in colour and the size of the shell range from 6-16mm. The shell is nearly transparent. The lip of shell is thin. *Oxychilus draparnaudi* is generally is a large zonitid glass snail. They are reffered as glass snails snail with the maximum diameter of 14mm of shell. The shell is translucent and glossy. The shell is glossy and the colour is translucent yellowish-brown on the dorsal side and somewhat whiter on the underside. The diameter of the shell range from 12 to 16mm diameter when fully grown. There are 5 to 5.5 whorls and the last whorl expands more rapidly due to which the width of last shell whorl about 2.1 times width of penultimate whorl; (Watson and Dallwitz, 2005).

The shell colour in the members of *Monacha catiana* species ranges from creamy white to brownish red, while juvenile specimens have hairs on dorsal surface of the shell. The colour of shell is white to transparent with pinkish tinge near mouth. The shells are slightly convex with a spire which ranges from flattened to almost conical. The aperture colour of this species ranges from whitish to reddish lip. This colour is less distinct in other species of *Monacha*. The umbilicus is slightly wider than in *Monacha cartusiana*.

The dimensions of shell width range from 16mm-20mm and a shell height of 11mm-14mm having 5-6 whorls. The body colour of the snail is reddish from body's front and the tentacles are greyish brown (Hlavac and Peltanova, 2010).

The shell shape of *Cernuella virgata* is more globular than that of *Monacha* species. The surface of the spire is irregularly ribbed with a height of nearly 3/4th of width, with slight curve. The shape of the shell aperture is circular with a narrow umbilicus. The umbilicus is covered by the apertural lip. The shell colour and form ranges from whitish to reddish yellow with dark brown bands which may be besring discontinuous or dissolve spots. There is the presence of variable stripes on the shell or can be absent. The shell width ranges from 8-25mm and a height of 6-19mm with 5-7 whorls in number (Fischer and Duda, 2004).

These snails have dextral symmetry. They have inoperculate shells. They have rising-spiral with 6-7 whorls. The maximum height of the shell ranges from 1.2mm to 5mm. with a width of 1.7-1.9mm. It is estimated that the height is nearly 1.74-2.1 times the width. However the spire height is about 0.48-0.62 X that of shell. The spire shape is obtuse. The shell shape is ovoid-symmetric with rather shallow suture to deeply suture. The shape of the body whorl and spire whorls is moderately convex. The whorls are neither keeled nor shouldered. The shell has striations that may be conspicuous, regular across the whorls or these may be striated with very dim lines. There may be the presence or complete absence of teeth/calluses. There is the presence of umbilicus with folded columella. The shell lip is having a deflected mouth edge or simple, having thin or thick edges which may be translucent to opaque. The colour ranges from brown to horn-coloured with glossy, dull or plain appearance. In some genera the shell colour is white. There apertural lamellae is a very important taxonomic character with special focus on their number and arrangement for species identification in snails. The number of apertural lamellae ranges from 0-9mm (Watson and Dallwitz, 2005).

The apertural lamellae range from 0-9 or more, as the number and arrangement of the apertural lamellae being important for species-level taxonomy (Perez *et al*., 2008). This is highly distinguishable species when compared with other species as it height is greater than 4mm. The shells are conical with brown cover however the apertural margin is strongly whitened. The apertural lamellae are absent.

The shell of *Physa fontinalis* is inoperculate with rising-spire. The shells are 4-7 whorled. They have sinistral symmetry. The shell is higher than wide. In *Physa fontinalis* the shells are 8-12mm high or it may even range from 10-18mm high as found in some introduced specimens. The height of the shell is about 1.5-1.7 times the width. The body whorl is predominating having a small and short spire small as in Physa. The height of the spire is about 0.1-0.2 times the height of shell. The shell is much less elongate having a shape of inverted-pyriform. The whorls of the shell are neither keeled nor shouldered. The aperture is with neither calluses nor teeth. The shell is ranges from thick-lip to thin-lip which may be thin and glossy with translucence. The colour of the shell ranges from pale horn to dark brown or blackish or plain. The colour of the animal is grey to nearly black (Watson and Dallwitz, 2005).

The shells of *Zootecus insularis* snails belonging to this species are thick and white in colour. The shells are turreted with conical and broad shape of the apical whorls. The teleoconch whorls are nearly cylindrical in shape with very fine axial riblets, arched subsuturally. However irregular wrinkles are present on the protoconch. The axial sculpture may be interrupted by the irregular spiral grooves. The peristome is thick. The shell aperture is subquadrate. The shell has an open umbilicus however due to the reflection of the peristome near columellar rim, it may be covered partially. The size of the specimens ranges from 11-15 x 3.5-6mm approximately. In many specimens there is a connection between the peristomial rims through a thick parietal callosity (Welter Schultes, 2010).

Cecilioides acicula which is reffered as common blind snail, or ground snails which are tiny and small snails having a slender turricular shell and a thin wall (Bouchet and Rocroi, 2005) which are in accordance with the other taxonomists stating that which has a very small, thin needle-shaped shell having 5.5-6 whorls with a height of 4-5mm and a width of 1-1.3mm. The colour of the shell pale yellow to off-white and is glossy having a sculpture of irregular low radial corrugations. The body whorl is almost around half the shell height and the aperture is elongate, which is around 1.5mm high by 0.5mm wide (Watson and Dallwitz, 2005).

The shell of *Oxyloma elegans* (Risso, 1826) is higher than wide with a dextral symmetry. The height ranges from 5-22mm. The width of the shell is approximately 4.25-7mm. The height is 1.6-1.9 times the width of the shell. The aperture is round to ovate and bears no teeth or calluses or lamellae. The shells are inoperculate with rising spire. There are 3number of whorls which are moderately to strongly convex and gradually tapers from the body whorl. The spire is small or short to high spire however the body whorl is predominating. The height of the spire about 0.1-0.23 times that of the shell. The spire of the shell ranges from acute to obtuse. The shape of the shell is succiniform i.e. it is either ovoid-asymmetric or inverted-pyriform. The shell is deeply sutured. The whorls are neither keeled nor shouldered. The columella of shell is smooth. The shell umbilicus is absent. The shell has thin-lip. The colour of the shell is greenish or amber. The shell is plain, thin and translucent (Watson and Dallwitz, 2005). This study is an effort to show the complete picture of the snail fauna of the agro ecosystem of Faisalabad. However other aspects of the impact of different ecological features on the diversity and distribution of the snails need to be assessed.

Conclusion

The snails belonging to 2 orders 7 families 9 genera and 15 species were found in the agro ecosystem of Faisalabad. There are 4 species which have been reported for the first time in Faisalabad. This is baseline information of this fauna and opens many different avenues to explore.

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Conflict of interest

The authors hereby confirm that there are no known conflicts of interest associated with this publication.

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