INTRODUCTION

Biodiversity is the term used to describe all the variety of life on earth or in a specifically mentioned particular area. It includes all the ecosystems and living organisms in that region. It also includes diversity within species, between species, and of ecosystems. Due to several reasons there have been reported sudden drops in biodiversity that has led to great loss of plant and animal life. It also affected human welfare. Conservation of biodiversity is now an international issue. For understanding of biodiversity knowledge about taxonomy is very important. Without taxonomic work on the organisms in any area, it is not possible to estimate the total number of species in that area. Taxonomy, in addition to the identification and classification of organisms, gives direction to the study of total biological diversity and its significance in the evolutionary biology. It also provides knowledge about the basic components of biodiversity.

The class Insecta is the largest and the most diverse class of phylum Arthropoda constituting more than 80% of the total animal species known. It includes about one million known species (Myers, 2001; Murphy, 2006). The order Hemiptera is one of the largest orders of class Insecta. General characters of this order Hemiptera include: diversity in shape, size and color of bugs; sucking mouth parts, in the form of segmented beak; incomplete metamorphosis; compound eyes usually well developed; wings well developed forming a hemelytron, some may be wingless. The order is divided into 5 suborders: Heteroptera, Sternorrhyncha, Cicadomorpha, Fulgoromorpha and Coleorrhyncha. The term true bug is used for Hemiptera order as a whole.

Members belonging to Heteroptera have different types of front wings and hind wings. In front wings, the basal half is leathery and apical half is membranous hence the term hemelytron. Hind wings are smaller than front wing. At rest, wings lie flat and crossed over their back. These insects have piercing- sucking type of mouthparts which are elongate and arise from the ventral (hypognathous) or anterior (prognathous) part of the head capsule. The mandibles and maxillae are long, thread like and interlocking with one another to form a feeding tube which is known as
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proboscis or also rostrum or labium. This stylet or rostrum contains two canal: the salivary canal and food canal. In some families such as Reduviidae, rostrum is very long. Due to these stylets, they bypass defensive mechanism of the plants against biters and chewers and it also protects them from many pesticides. Some bugs that feed on plants are helpful for the control of weeds. A species *Zulubius acaciaphagus* Schaffener belonging to the family Alydidae has helped to reduce seed bank of *Acacia cyclops*, a weed introduced from Australia to South Africa.

General characters of Heteroptera include- slender antennae usually with four to five segments; rostrum or proboscis three to four segmented which arises from front of head and curves below ventral side of body; large pronotum; scutellum triangular and tarsi two or three segmented. Nymphs resemble the adults but lack wings. Most of the species have stink glands, which give off a foul order. On ventral side of head in Heteroptera, a distinct buccula is present which is mostly well developed, lying on each side of rostrum. It extends up to posterior side of head and can be open at apex or fused with rostral segment at apex. The thorax of Heteroptera is known as pronotum. In some families of Heteroptera, for example in Lygaeidae, a distinct collar is present. Pronotum can be divided in two lobes- i.e. anterior lobe and posterior lobe or can be undivided. Humeral angles of pronotum, also known as posterolateral angles, exhibit different forms. These can be rounded or subacute as in family Lygaeidae or may be projecting in an acute spine like projection in many families like Coreidae, Pentatomidae and Reduviidae. Mesothorax is in the form of scutellum, which is usually triangular in shape; in some families like Pentatomidae scutellum is very large, covering the most of abdomen. Ostiolar peritreme is present on metastrenum, associated with evaporative area, which is the area of release of fluid from metathoracic scent glands. The sternum in Heteroptera is covered by closely spaced coxae. The wings are folded over abdomen when these are not in use. The vein clavus lies adjacent to scutellum. Clavus is separated from corium by a furrow known as claval suture. Membrane venation varies among the families. There may be few veins in membrane for example in family Lygaeidae while there may be many in families like Coreidae and Pyrrhocoridae. Hind wing in Heteroptera is largely membranous and reduced. The abdomen is divided in to pregenital and genital segments. In females pregenital segments consist of terga 1-7 and sterna 2-7 and in males terga 1-8 and sterna 2-8. Lateral sides of terga are known as connexivum.


Abdominal spiracles are present on each segment and usually there are eight pairs of them. Spiracles may be located dorsally for example in family Lygaeidae, or located laterally as in several other families.

Segments eight and nine in female are modified as genitalia but in male only segment ninth is modified as genitalia. Segment ten in Heteroptera is modified as proctiger, containing anus, it also bears the remnants of segment eleven. The sternum ninth forms a distinct genital capsule known as pygophore in Heteroptera, that contains the phallus. The phallus is composed of a basal plate, which is also known as basal articulatory apparatus. To this basal plate are attached the aedeagus, intromittent organ and the parameres. The phallus is composed of two parts – phallotheca also called phallosoma and endosoma. Phallosoma is the basal part of aedeagus and the distal portion of aedeagus known as endosoma is drawn in this during repose. The endosoma is composed of proximal conjunctiva and distal tubular part, vesica. Conjunctiva may bear many processes such as lobes, spines and other appendages. The ductus ejaculatory passes through the basal foramen in the lumen of aedeagus, forms ductus seminis and terminates in the form of secondary gonopore. The ductus seminis may also terminate in the conjunctiva in Pentatomidae or in tubular vesica in Lygaeoidea.

Female genitalia of Heteroptera are composed of first gonocoxae and second gonocoxae. These are usually fused with first and second gonapophyses. The gonocoxae are formed from eighth and ninth abdominal segments. Ovipositor may encroach abdominal sternum VII, and can divide it completely or partially. Spermatheca is also present showing variations within families and can also differ from species to species. It is composed of a bulb and a tube of variable shape.

Heteroptera includes about 50,000 species of insects belonging to 73 families (Meyer, 2005), many of them have still not been described. It includes a diverse assemblage of insects that have become adapted to different types of habitats. Some are terrestrial, some are aquatic and some are semiaquatic. Terrestrial species live on plants and take the nutrition from them. Some of them are very important pests of many crop plants. For example, *Eurygaster integriceps* Puton, belonging to family Scutelleridae, is a serious pest of wheat. Some species feed on sap of plants and...
weakens them. Some species transmit plant pathogens. Few species of Heteroptera are predatory on other species including bugs while others feed on blood and transmit human diseases. For example, Chagas disease is transmitted by members belonging to family Reduviidae. Bed bugs belonging to family Cimicidae can inflict annoying bites. Some feed in vascular tissues and some are seed eaters.

**COREIDAE**

Members of family Coreidae are commonly known as leaffooted bugs and squash bugs. It includes some of the largest members of Heteroptera, length of the species varying from 2mm to 40mm. General characters of the family include medium to large sized bugs; darker in color; head narrower than pronotum; antennae four segmented; ocelli two; beak or rostrum four segmented; front wing having many veins; tarsi three segmented; hind tibiae in some species expanded giving leaf like appearance. Scent glands are present on the thorax between mesocoxae and metacoxal and are highly modified and well developed. Coreids often give off foul odour. Hind legs in this family are often modified, incrassated. In some species males use their hind legs in combat over territories. All members in the family are exclusively phytophagous. In family Coreidae all abdominal spiracles are ventral in position.

Gonocoxae of female genitalia are usually flattened and plate like. Abdominal sternite VII is usually cleft, sometimes half of its length, sometimes fully. Spermatheca is with a bulb of varied shape and with a flange alongwith a long spermathecal tube. Male genitalia consists of pygophore usually ovoid shape, paramere with a blade and a stem. Aedeagus has dorsal and ventral membranous conjuctival appendages.

The family Coreidae was established by Leach (1815). He also included the families Alydidae and Rhopalidae in this. There are over 1,802 species under 252 genera in the world (Schuh and Slater, 1995). According to the fauna of British India (Distant, 1902, 1908, 1910), there are available 143 species under 45 genera in India belonging to this family. Schuh and Slater (1995) divided family Coreidae in to four subfamilies: Agriopocorinae, Meropachydinae, Coreinae and Pseudophloeinae. The collection being studied for the present work belongs to subfamilies Coreinae and Pseudophloeinae.
This subfamily Coreinae includes medium to very large sized bugs. Head near central lobe is distinctly and longitudinally depressed between lateral lobes. In this subfamily interocellar distance is greater than that from eye to ocellus. Bucculae are generally long and they extend up to near insertion of antennae. Pronotum at the posterior margin is usually three times or more than twice the breadth of head. Scutellum is sometimes reaching or passing base of metanotum. Metathoracic scent glands have well developed anterolateral opening. Peritreme and evaporative area is usually well developed. Costal margin of corium is usually straight or little sinuate. Hind tibiae are sulcated or dilated. Hemelytral membranes have many veins. Membranal veins of forewing arise from a transverse vein, touching the corial margin. This subfamily is worldwide in distribution containing the vast majority of coreid bugs.

The subfamily Pseudophloeinae is different from Coreinae in not having head centrally depressed. It includes small to medium sized coreids. Antennae are present on sides of head and antenniferous tubercles have deflexed processes. In this subfamily tibiae are rounded and not sulcated. The hemelytral membrane has a compound vein at the base and this vein is parallel with apical margin of corium. Posterior coxae are far from each other, femora are mostly clavate and posterior femora have two or more large spines on outer side. Tibiae in this subfamily are never sulcated. The female paratergite eight is without a functional spiracle.

Many species in family Coreidae posses strongly expanded femora and tibiae, which are often leaflike, that’s why these bugs are known as leaf-footed bugs. In many species spines and tubercles are also present. Humeral angles of the pronotum are sometimes produced in to long, acute projections. Coreids are all phytophagous and majority of them live on plants above the ground feeding on plant vascular system (Kumar, 1966). Many coreid bugs show definite associations with particular plant groups, while others feed on unrelated plant taxa. Globally, members of family Coreidae are of considerable economic importance because they cause significant loss of grain legumes, different types of crops such as cucurbits, soft fruits and nuts.
LYGAEIDAE

Members of this family are commonly known as chinch bugs and seed bugs. Most of the Lygaeidae are phytophagous and feed on plant juices. A few species feed on seeds, some are predators of other insects (for example subfamily Geocorinae), a few species feed on sap (this phenomenon is known as mucivory) and some feed on blood. The family includes small to medium sized bugs (usually 2-18mm long). The insects are usually drab, but many show yellow, red, orange and other bright color also. Antennae are four segmented and located below a line drawn through center of an eye. A pair of ocelli are present between the eyes. Rostrum is four segmented and bucculae are well developed. Front wing in lygaeids have only four to five veins. Tarsi are three segmented and a pad is present at the base of each claw. Position of the abdominal spiracles in family Lygaeidae is extremely variable. Usually there are three trichobothria on middle of abdominal sternites III and IV, on lateral side between sternites V and VI and two on sternite VII present laterally.

Ovipositor is reduced. Spermatheca has a bulb of variable shape and a tube may be long or short. Aedeagus consists of phallobase and endosoma. Conjunctival lobes are present and many other processes are also there. Vesica in this family is very distinct in the form of long coiling tube, known as gonoporal process. Sperm reservoir is also there. Parameres are variable in shape in different species i.e. elongated, broadened or may be cylindrical. Lygaeidae comprises of 101 genera and 972 species in the world (Slater and O’Donnel, 1995). According to fauna of British India (Distant, 1902, 1908, 1910 and 1918), the family is represented by 93 species under 72 genera in India. Schuh and Slater (1995) divided the family Lygaeidae in to sixteen subfamilies i.e. Rhyparochrominae, Psamminae, Ischnorrhynchinae, Lygaeinae, Orsillinae, Blissinae, Cyminae, Cryptorrhaphinae, Bledionotinae, Henestarinae, Geocorinae, Henococorinae, Artheneinae, Oxycareninae, Heterogastrinae and Pachygronthinae. The collection under the present study belongs to five subfamilies-Lygaeinae, Rhyparochrominae, Orsillinae, Oxycareninae and Blissinae.

The subfamily Lygaeinae is characterized by impunctate hemelytra, subcostal vein and most of the insects are brightly colored. In India this subfamily is found in abundance and is the second largest subfamily on the basis of number of species.
Most of the species are large in size, show bright coloration- red, orange, and a mixture of red and black, orange and black. Most of the members feed above the ground, some may feed upon the seeds in the ground litter. Some members of this subfamily are flightless and cryptically colored.

The subfamily Orsillinae consists of relatively small size bugs which are dull and gray brown with impunctate hemelytra and dorsal abdominal spiracles. Only one genus i.e. *Nysius* is found in India.

Members of subfamily Oxycareninae are very small, flattened and usually myrmecomorphic. Head in these species is usually porrect, hemelytra is with explanate margins, abdominal spiracles on abdominal sternites 3-7 are ventral and only a single trichobothria is present on abdominal sternite V toward posterior side.

The subfamily Rhyparochrominae includes insects which are usually dull colored, black and white, mostly myrmecomorphic. Fore femora are incrassated usually with spines. Main identifying feature of this subfamily is that abdominal suture between stenites IV and V is curved forward not reaching up to lateral margin. This subfamily is very large and diverse.

The subfamily Blissinae has hemelytra not, or only weakly, punctuate. Spiracles are dorsal on abdominal segments 2-6 and ventral on segment 7. Body shape ranges from very elongate and slender to short and stout. The bugs of this subfamily are known as chinch bugs. According to Schuh and Slater (1985) there are 50 genera and 385 species belonging to this subfamily.

**RAPD studies**

Although identification is usually done on the basis of morphology, sometimes it may be very difficult to make proper identification on the basis of morphology only. It becomes more difficult in case of immature stages, damaged and preserved specimens. The detection of polymorphism in naturally occurring DNA sequences is a recent development in molecular biology. Large numbers of highly informative DNA markers have been developed, one of which is RAPD based on PCR. This technique is used to obtain DNA fragments of discrete sizes that are analyzed through agarose
gel electrophoresis. The fragments produced by this technique are usually distinctive of a particular species and these fragments may vary among the species, populations and strains. RAPD technique has been one of the most commonly used molecular techniques for comparison of closely related species. Even a minute quantity of the DNA can be used for RAPD with the help of PCR.

RAPD markers are amplified products of DNA sequences using single, short and arbitrary oligonucleotide primers and it does not require prior knowledge of DNA sequences. The technique of RAPD utilizes short synthetic oligonucleotides (10 bases long) of random sequences so that primers can amplify nanogram amounts of total genomic DNA. This technique reveals considerable polymorphism in genomic DNA. For this reason, it has been extensively used as a genetic marker for estimating genetic, taxonomic and phylogenetic relationships in plants and animals. It can be used for many areas like genetic mapping, for developing genetic markers, for population and evolutionary genetics, for plant and animal breeding. Many insects like aphids, moths, bees, bugs and flies have been subjected to RAPD studies and it has become an important tool for molecular level studies. It can help in solving problems especially where morphological characters do not work.

The objective during the present work was to study intraspecific variations among the populations of the same species collected from different localities such as one collected from Punjab and other from Himachal Pradesh or Uttarakhand. In addition to this RAPD analysis has also been tried interspecific level.