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Ecology and Biodiversity of Crop Pest of Various Genera of Order Rodentia Inhabit District Dadu, Sindh, Pakistan

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Abstract
Rodents are mammals which belong to the order Rodentia, they are characterized by a single pair of continuously growing incisors in each of the upper and lower jaws. About 40% of all mammal species are rodents; they are found on all continents in vast number except Antarctica. They are the most diversified mammalian order and live in a variety of terrestrial habitats, including human-made environments. The information related to the existence of different species of order rodentia was collected from local community of District Dadu from March 2017 to February 2018 to All collected specimens were brought to vertebrate laboratory and were examined carefully. All specimens were identified with the help of identification key and relevant literature. The morphological characteristics included Body weight, Length of body, length of tail, length of hind limb, length of ear. This investigation recorded species 05 species *Rattus rattus Rattus norvegicus Mus booduga Sacista concolor* and *Apodemus sylvaticus* 02 Sub-species *Rattus Rattus Rattus and Rattus Rattus Fugivorous* belonging to different genera under order Rodentia from different localities of District Dadu. All together 284 specimens were collected, out of which 96 specimens were of *R. rattus* 41 males 55

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females 91 specimens were of *R. norvegicus* 40 males 51 females 14 specimens were of *M. booduga* 05 male 09 females 12 specimens were of *S. concolor* 5 female 7 males 71 specimens were of *A. Sylvaticus* 32 males 39 females and out of 96 specimens of *Rattus rattus* 08 specimens were subspecies of *R. r. rattus* 03 males 05 females and 09 specimens were of *R. r. fugivorous* 05 males 04 females.

Key words**:** rodents, biodiversity, ecology, dadu

Introduction

The contemporary research involves two main branches of zoology i.e. Taxonomy and ecology for the awareness of systematic, diversity and ecological circumstances of different group of Rabi and Kharif crop pest of order rodentia. The taxonomy of crop pest of order rodentia may systematically categorizes their biodiversity and orderly arrangement, whereas ecological conditions may discloses the state of apparent situations of their surroundings on which the crop pest rodents in subject are dependent to exist. Current classification as well as ecological studies will subsidize to scientific world a lot, it is revealing the realities of an area "DISTRICT DADU" which is not known to be surveyed in past for finding different species of crop pest of order rodentia.

Rodents are considered the greatest important mammalian agronomic pest globally. Cuong et al., 2002.

Order rodentia consist of many species out of them only 77 are crop damaging which are considered as crop pest and many of them are found at cereal crops that is largest part of agriculture field used for cultivation. (Manyingerew et al., 2006). Huge quantity of crop is effected by rodents that causes shortage of food in a few parts of the world. (Fayenuwo et al., 2007) Every year a tremendous amount of crop is lost during two periods as pre and post. Meerburg and Kijlstra, 2008. Rodents have many special characters as they can live in various situations of surrounding and are able to consume a variety of foods. (Mmetwaly et al., 2009).

Rodent related to class Mammalia are small in size, they belongs to Order Rodentia which comes in the subfamily Murinae of family Muridae. Various crops have been seen severely damaged by rodents through gnawing, spoilage, contamination and hoarding activities. Rodents settle themselves during initial stages of cropping, breed during growth period and migrate after harvest having increased their population rapidly. (Sarwar et al., 2011). It was found that rodents economically, ecologically, scientifically, social, are important (Witmer et al. 1995, Witmer and Singleton 2011). The members of order rodentia are widespread on islands where the number of predators is incredibly less. Their ability to feed on variety of food items has put certain bird species at the risk of extinction. (Moors and Atkinson 1984, Witmer et al. 1998, Veitch and Clout 2002, Engeman et al. 2006, Towns et al. 2011, Veitch et al. 2011). As rodents have greatly influence seabirds, non-indigenous rodents have affected different biotic components of

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ecosystem like seeds and seedlings, invertebrates, sea turtle eggs and hatchings, and other resources (Witmer et al. 2007a, Caut et al. 2008, Angel et al. 2009, Towns et al. 2009, Drake et al. 2011, St Clair 2011, Shiels et al. 2014). Rodents affect directly as well as indirectly on the many resources of island by competition and trophic cataract effects. (Russell 2011). Non-indigenous members of order rodentia have arrived around 80% island groups of world, where they have brought about destruction of local species (Atkinson 1985). It has resulted in the eradication of non-indigenous rodents from affected islands, globally. (Howald et al. 2007, Witmer et al. 2011)

Area of Study

Dadu is famous district of Sindh Pakistan which was previously a longest and largest district. Basically Dadu is a town which is also known as the capital of district. The district is situated on western bank of Indus River. Dadu town has three union councils administratively. During the Kalhora Dynasty village Khudabad was considered as the capital of district. After independence of Pakistan "HUNDI" was famous trade system.

By gathering Mahal Kohistan and Kotri then with the addition of Jamshoro as of Karachi and Dadu, Johi, Khairpur Nathan Shah, Mehar and Sehwan tehsils belonging to district Larkana Dadu had organized. Later District Dadu was divided into two halves and another District Jamshoro were made in 2004. Jamshoro, Naushahro Feroze, Shaheed Benazirabad and Kamber Shahdadkot are known as present from different four sides of Dadu. It is connected with Hyderabad and Karachi through Indus Highway. In all talukas few languages are spoken but Sindhi is dominant which is noted as 98.3 percent people speak Sindhi as their native language.

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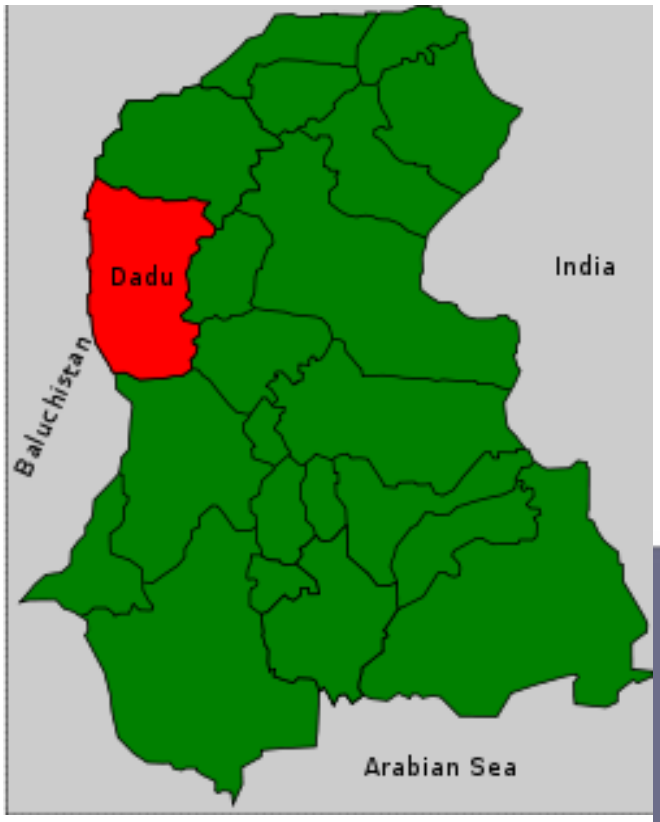
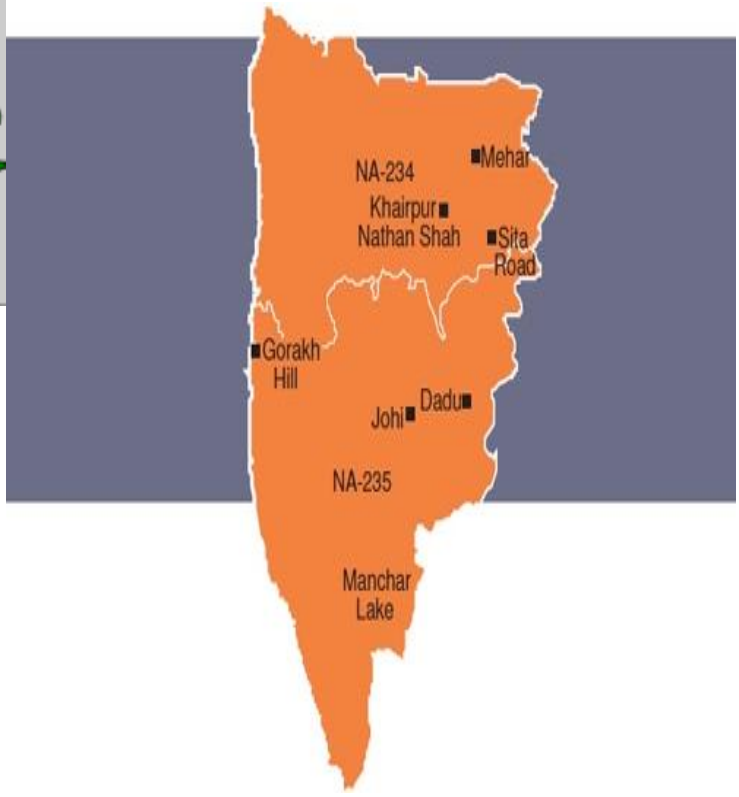


- DADU
- JOHI
- K.N SHAH
- MEHAR



Material and Methods

During study following materials were used for research as Mouse trapper, Foot scale, Compass , Weight machine, Chloroform, Gloves, Mask, Arsenic powder and rodents were being attracted by using following baits Raw wheat, Olive, Tomato, Bread, Wheat

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flour. Traps were placed near the burrows of rodents in different crops of various localities of district including four examination regions.

During study live traps were used for collection because alive specimens were required for observing and measuring their all body parameters along with skull. Cages are as arranged as medium size and large rodents can enter easily inside the cage.

Some cages are made up of perforated sheets which were no safe for smallest individuals as of Mus. That's why smaller live traps were also used. Sometimes snap traps were also used instead of live traps in emergency where ever live were not arranged. In this conditions, killed animals were quickly fetched towards laboratory. Every sampling site were kept in mind to collect same individuals from everywhere as those sites could be compared according to their habitat and localities.

Different baits were used and sometimes different types of food were placed in same cage. Rodent pest were attracted by different baits according to the suggestions of local community, food having smell are better to attract rodents in crop of rice. Olive were observed as most attractive that's why it was used most of the time which proves that smelly food are good to attract them. Few types of food were beneficial because these are long lasting, which were used for many days in cages. According to the aims and objectives of research methods were well planned for trapping. Variations were noted from one collection site to another site. For getting good results always tried to collect equally specimens from different collection sites and analyzed them in vertebrate laboratory Department of Zoology University of Sindh Jamshoro.

Two tasks were kept in mind while capturing rodent pest.

1. Trapping areas for survey of their ecology.
2. Support of local people for information of those areas where rodents were captured.

5 to 6 cages were paced in every collection site near the burrows during day and night time. Cages were moved if they found empty on a line.

Traps were placed away from houses inside the various crops or water course site where burrows were observed. Some rodent individual were observed in field as they were only baits from outside but they were not coming inside. Many specimens were collected in the live traps at the night time. Keeping traps at night time was proved very supportive to collect a good diversity of crop pest of order rodentia.

Most of the traps were settled in those crops where human were working who were also guiding me. Those traps in which specimens were captured were labelled immediately for showing their place from where those actually were captured. Label was as attached as it cannot be destroyed by individuals. While handling traps thick gloves was been putted on hand. Gloves were always remained major materials during research, hand wash was also kept for washing hand after every visit in various crops at different localities. Captured rodents were brought to Vertebrate Biology laboratory, wherever I carried my further research and stuffed over there for future record.

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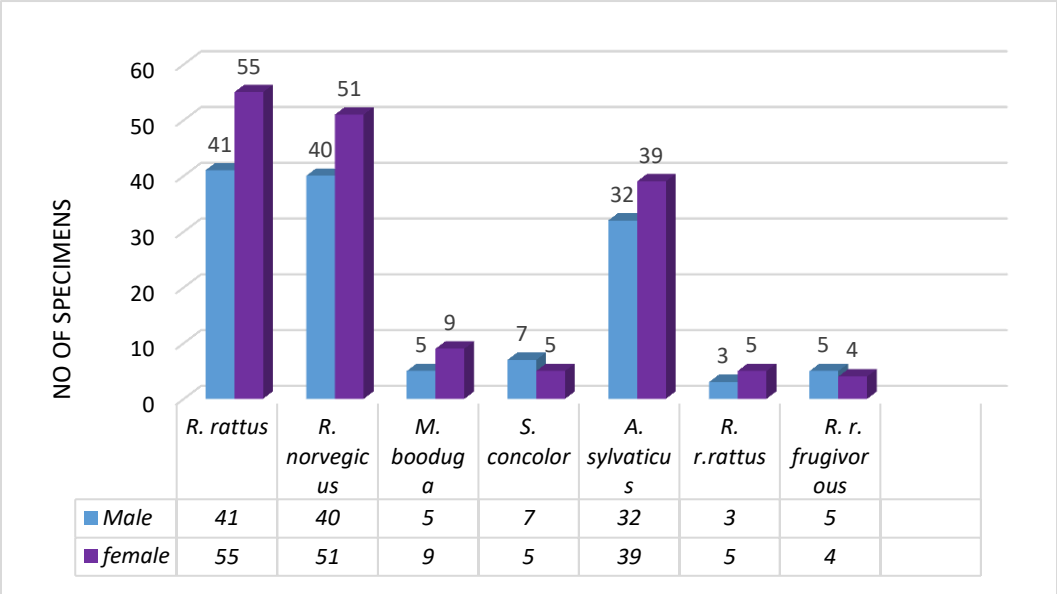
Results

During present investigation it was observed that there were four seasons where two times in the year crops were being cultivated specially in summer and winter. During study we recorded 05 species of order rodentia *R. rattus, R. norvegicus, M. booduga, S. concolor and A. sylvaticus* and 02 sub-species *R. r. rattus and R. r. frugivorous* belonging to different genera and families under the order Rodentia from different localities of District Dadu. All together 284 specimens of different species under order Rodentia were studied which were identified as 125 males and 159 females. Out of which 96 41 males, 55 females specimens were of *R. rattus* 91 specimens were of *R. norvegicus* 40 males 51 females 14 were of *M. booduga* 5 males 9 females 12 were of *S. concolor* 7males 5 females and 71 were of *A. sylvaticus* 32 male and 39 female.Out of 96 specimens of *Rattus rattus* only 17 specimens of sub-species were declared, from which 8 were of *R. r. rattus* 3 males, 5 females and 9 were of *R. r. frugivorous*.



Graph 1 Number of specimens of different species and sub-species of order Rodentia

In Dadu Sindh, temperature was noted very high during summer, common crop pest rodents thrive in crop fields, buds and storage areas. Good conditions were provided for rapid population by irrigation for fast breeding and growth of rodents. In winter for avoiding cold temperature rodents also seek shelter in crop fields, buds and human habitation.

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Table 1: Number of specimens recorded from different study sites of district Dadu

	Dadu		Johi		K.N Shah		Mehar	
Species	Male	Female	Male	Female	Male	Female	Male	Female
Rattus rattus	09	13	08	09	11	17	13	16
Rattus norvegicus	09	13	10	11	9	13	12	14
Mus booduga	01	02	02	04	01	03	01	00
Sacista concolor	01	01	01	02	02	00	03	02
Apodemus sylvaticus	07	11	05	07	08	12	12	09

TABLE 2: Number of specimens recorded from study site Dadu

Localities	*Rattus rattus*		*Rattus norvegicus*		*Mus booduga*		*Sacista concolor*		*Apodemus Sylvaticus*	
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
Dadu	01	01	02	01	00	00	00	01	00	01
M. Bilawal	02	04	01	03	00	00	01	00	01	02
A. Sharif	03	05	04	05	01	01	00	00	03	03
Vill. H.Ismail Teevno	03	03	02	04	00	01	00	00	03	05

TABLE 3: Number of specimens recorded from study site Johi

Localities	*Rattus rattus*		*Rattus norvegicus*		*Mus booduga*		*Sacista concolor*		*Apodemus Sylvaticus*	
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
Johi	01	01	03	01	01	00	00	00	01	02
Vill. H. khan	02	03	04	05	00	01	00	01	02	03
Vill. H. Khan	03	04	02	02	01	02	01	01	00	02

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Wahi Pandhi	02	01	01	03	00	01	00	00	02	00

TABLE 4: Number of specimens recorded from study site K.N Shah

Localities	*Rattus rattus*		*Rattus norvegicus*		*Mus booduga*		*Sacista concolor*		*Apodemus sylvaticus*	
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
K.N Shah	02	03	03	03	00	00	00	00	01	02
Gozo	02	04	01	03	00	00	00	00	02	01
Kandi Chokhi	03	04	02	03	00	01	01	00	04	05
Village BahadurPur	04	06	03	04	01	02	01	00	01	04

Table 5: Number of specimens recorded from study site Mehar

Localities	*Rattus rattus*		*Rattus norvegicus*		*Mus booduga*		*Sacista concolor*		*Apodemus Sylvaticus*	
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
Mehar	02	02	02	03	00	00	00	01	02	00
Faridabad	04	03	03	02	00	00	01	00	03	04
Radhan	03	05	03	04	00	00	02	01	04	03
Sojhro Gorar	04	06	04	05	01	00	00	00	03	02

The data given in graph 1 and table 1-5 about species is proved. All the specimens were studied and species were identified with the help of international key of identification of rodents.

Discussion

In this current study District Dadu is explored in which exploration of Ecology and Biodiversity of various genera of order rodentia inhabit in District Dadu where different

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Genera were captured and identified at different study areas which are shown and described in results.
Many aspects of research was described worldwide including Phylogeny, Taxonomy Biodiversity and Vector Biology.
In various districts, Rodent fauna research has been conducted by many researchers and cleared that there was no any research ever accompanied in district Dadu for altered features of crop pest Rodent like their external appearance of body characters including variation in Body Colour, belly colour, food habits, habitat selection, habitat, breeding season, mating strategies, parental behavior, burrowing nature of different Genera and species under order rodentia therefore the present study is being carried for highlighting the Ecology and Biodiversity of crop pest of order rodentia, which describes two families, four genera, five species and two subspecies for the first time in district Dadu, Sindh, Pakistan.
During study period two families Muridae and Dipodidae, four genera *Rattus, Mus, Apodemus, Sacista* five species *Rattus rattus, Rattus norvegicus, Mus Booduga, Apodemus sylvaticus, Sacista concolor* and two subspecies *Rattus rattus rattus, Rattus rattus frugivorous* were recorded which are mentioned in tables and graph given in results. The crop pest of Order rodentia was found most diversed in various localities of district Dadu. Altogether 284 specimens of two families, four genera, five species and two subspecies were studied and those were identified as male and female which are mentioned shown in results out of which 96 specimens were of *R. rattus* 41 males 55 females 91 specimens were of *R. norvegicus*, 40 males 51 females 14 specimens were of *M. booduga* 05 male 09 females 7 specimens were of *S. concolor* 5 female 2 males 71 specimens were of *A. Sylvaticus* 32 males 39 females and out of 96 specimens *of Rattus rattus* only *08 specimens* were subspecies of *R. r. rattus* 03 males 05 females and 09 specimens were *of R. r. fugivorous 05 males 04 females*. Variable number of different five species of crop pest of order rodentia was recorded from the study area mentioned in (Table: 1-5).
*Rattus rattus (*Black rat) belongs to the family muridae of order rodentia it is the one of greatest rodent. Black rat is 12.75 – 18.25 long excluding 15 – 22 cm tail. Schwartz, Charles Walsh and Schwartz, Elizabeth Reeder (2001). It looks like Rattus norvegicus, these can be differentiated by comparing shape of their upper molar and a finer covering of hair. (Allen, 1938; Corbet and Southern, 1977; Grzimek, 2003.
Rattus norvegicus brown and grey crop pest rodent having 28 cm long body with head, considerably shorter tail considered as larges murid. It is weighted about to 140 g to 500 g. The have originated from northern China, now it is diversified in almost all continents excluding Antarctica continent, but its dominancy it observed in North America and Europe, this has made them most successful mammal found on the earth along with humans. Fragaszy, Dorothy Munkenbeck; Perry, Susan (2003). Norway rats was found asomnivorous also. (Yabe 1979).

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Mus booduga Little Indian field mouse belongs to Muridae family of rodent. It is present in India, Nepal Myanmar, Sri Lanka and Bangladesh. Its Body and Head is measured as 7 cm with 6 to 8 cm tail. Its ventral surface is white and it has light brown vanishing to grayish white upper parts, light brown bands are present around their chest. They possess round large ears. Pointed muzzle are also found. Tail has two distinct colour as paler bellow and dark above. Their incisors are curved backside. Aplin, K.; Molur, S.; Nameer, P.O. (2008).

Sacista Concolor Chinese Brich Mouse like all members of the genus is extremely hardly and capable of living in cold regions. They are mainly nocturnal in activity but will also forage during day light hours according to Russian observers (Bobrinskii et al., 1965)

The wood mouse *Apodemus sylvaticus* is a crop pest of order rodentia that belongs to muridae family of rodent that is native to northwestern Africa and Europe. It is almost similar to *Apodemus flavicollis* but it has no any yellow band surrounding its neck that made it different from this species. Ears of wood mouse are smaller and considerably it is also smaller in size. It is found throughout the Europe and is widespread and common species that is commensal with humans. Occasionally it is considered as crop pest. Schlitter & Van der Straeten (2004). It is commonly called with different names like European wood mouse, Long-tailed field mouse and common field mouse. Wrobel, Murray. (2006). European wood mouse is inhabitant of grasslands, cultivated fields and forests trying to search for more wooded areas in the season of winter. J. L. Tellería; T. Santos; M. Alcántara (1991). This mouse also lives in northwestern Africa as well as on many Mediterranean islands. Encyclopædia Britannica. 2008 Wood mice are primarily seed eaters, Fedriani, J. M. (2005).

This study recorded number of specimens of order rodentia collected from various localities of sub-divisions of District Dadu. District Dadu is divided into four talukas, those were designated for field including Dadu, Khairpur Nathan shah, Johi and Mehar.

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