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Research Article

A NEW RECORD OF THE *RATTUS NORVEGICUS* (BERKENHOUT, 1769) FROM MANIPUR, INDIA

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ABSTRACT
Manipur, the easternmost hilly state of the Union of India was known for her rich biodiversity and quite rightly included in the Indo-Burma biodiversity hotspots. Among the important criteria for hotspots the degree of endemism and degree of exploitation were exclusive; hence determination of the endemic and exotic species was much for accurate assessments of the endemic species. Live specimens of *Rattus norvegicus* were caught with live traps from different study sites of Imphal West District of Manipur and proceed to obtain the skull for taxonomic works. The Morphometric and skull measurements were taken for the study and found out the Manipur species shown certain variation from the typical model. The species was known as "Moreh rat" (Moreh-a name of town near Myanma or Burma) and might hitched ride to Manipur from mainland India as *Bandicota bengalensis*. More intensive work with larger population size and increase number of study sites might be necessary to ascertain the exact status of the species in relation to Manipur.

Key Words*: Manipur, First Record, Rattus Norvegicus, Imphal West*

INTRODUCTION
Manipur is the eastern most part of India neighboring Myanmar (now Myanma or Burma) and included in the biodiversity hotspots of the world as Indo-Burma hotspots (Myers *et al.*, 2000). Obviously there were many endemic as well as endangered species due to anthropogenic or invasion of exotic species of the both vertebrates and invertebrates and of course many plant species. Many exotic species had been reported like *Bandicota bengalensis* (Subiah and Singh, 1984), Congress grass recently, water hyacinth etc. all of which affect the biodiversity of Manipur. So there is a need for determination of the exotic and endemic species to ascertain the actual assessment of biodiversity of the state.
In this paper we report the occurrence of the urban menace *Rattus norvegicus* (Berkenhout, 1769) in Manipur for the first time. The study included the morphometrics, skull study and finally the cytotaxonomy. The study will be of great help to the young researcher in the area and to all biodiversity lovers as a whole.

MATERIALS AND METHODS
Twenty live specimens (12 males and 8 females) of *Rattus norvegicus* (Figure 1) from five different study sites were collected from different parts of Imphal West district (Table 1) of Manipur on 12 July-5 August, 2012, with help of live traps. Approval of the Institutional Ethics Committee (IEC) was obtained for using animals and protocols of the IEC were followed throughout the study. For comparative study we take two references: one albino *Rattus norvegicus* and the other measurements taken from Agrawal (2000) to validate our findings. The taxonomical book used in the study included Agrawal (2000), Aplin *et al.*, (2003), Corbet and Hill (1992).
The specimens were sacrificed by inhaling chloroform and taken morphological data and osteological data (Table 2). All the measurements were taken with help of the Fishers' digital callipers (mm).

Skull Preparation for Osteological Studies Had Followed Aplin et al., (2003)

Use a scalpel or scissors to cut the skull free from the body. Beware of cutting the hind part of the skull: it is better to cut a few vertebrae down the neck to be sure not to damage the skull.

Put the skull and its label in a plastic vial with screw cap and fill it with water.

Table 1: The numbers of study sites, location, specimens and sex, weight of the study materials of rattus norvegicus

S. No.	Study Site	Location	Sex	Average Weight (gm)	Speci-mens
1	Keishampat	N-24^{0}47.798' E-093^{0}55.932'	5males, 2females	280	7
2	Thangmeiband	N-24^{0}49.598' E-093^{0}56.327	1male, 1female	340	2
3	Singjamei	N-24^{0}49.196' E-093^{0}56.564'	3males	300	3
4	Paona Bazar	N-24^{0}48.285' E-093^{0}56.117'	3males, 1females	250	4
5	Kwakeithel	N-24^{0}47.403' E-093^{0}55.446'	4females	280	4

Table 2: External and cranial character measurements of R. norvegicus (albino), R. norvegicus (wild), and previous records of Ellerman, 1961

Characters (mm)	*Rattus Norvegicus* (Albino) n-1	*Rattus Norvegicus* (wild) n-5 (Average)	*Rattus Norvegicus* (Ellerman, 1961)
Length of head & body length	201	215	250
Length of tail	192	195	200
Length of hind foot	42	43	43
Length of ear	20	21	16
Length of occipitonasal	42.07	42.41	51
Condylobasal	42.22	40.26	-
Height of rostrum	9.80	8.95	-
Tympanic bulla	7.05	5.74	7.5
Length of diastema	13.24	12.23	14.75
Length of molar	5.76	6.21	7.00
Length of rostrum	14.44	13.62	-
Length of palate	25.34	23.19	28.25
Anterior palatal foramen	7.66	7.23	8.75
Length of nasal	16.15	15.39	-
Nasal width	4.59	4.61	-
Frontal width	6.58	6.55	-
Length of orbit	15.55	14.89	-
Greatest zygomatic width	21.88	20.25	-
Cranial width	15.21	15.40	12.5
Inclination of incisor	Opisthodont	Opisthodont	-
Tail colour	White	Unicoloured	-

Then, leave the plastic vial into a boiler for 15 to 30 minutes depending on the skull size and fragility (beware that the plastic vial does not melt down). Boiling does little to remove material inside the nasal and other cavities. Slow cooking is preferable to make meat tender. Add some herbs if smells bother the neighbourhood…
Take the skull out of the vial and put it in cool water.
Peel the skin off the skull, scrape away most of the meat and pull out the eye balls (Beware of breaking the zygomatic arch).
Remove the brain by using a syringe or long-end dropper filled with water: inject water through the spinal whole (foramen magnum) with pressure.
Delicately remove the jaw from the skull in water. Make sure to save all teeth that may have come loose, since jaws are delicate.
Clean the skull and jaws from all tissue. Scrub the skull with liquid detergent (washing liquid) and a toothbrush, making sure all tissue is removed.
Skull should be whitened with very dilute hydrogen peroxide. If the skull is badly stained, it cannot be completely whitened.
Carefully label with a permanent pen or with a pencil. Always label Figure 74: Skull preparation both the container and the specimen for avoiding mix-up in the collection.
Store skulls in a plastic or glass vial, with desiccant.

Cytological Study

The cytological works were carried out from the bone marrow cells of 4 (2males, 2females). Chromosome number and morphology were recorded from 50 Giemsa – stained metaphases from each specimen directly under 100X bright field optics of microscope- Olympus as well as from photographs of selected cells. The types of chromosome structures and karyotypes were done according to Yosida (1983)**.** The snaps were taken under oil immersion with zoom (not digital) at 100 ASA of Olympus digital cameras attached to the microscope. Karyotypes were prepared in accordance with Yosida, (1983).
The skins, skulls and microscopic slides were deposited in the University museum under giving Accession numbers.

RESULTS

1769. *Mus norvegicus* Berkenhout, *Outlines Nat. Hist. Gt. Britain and Ireland,* 1; 5 (Great Britain)
Keys to mainland species of Rattus
6. Maxillary tooth rows less than 7.5 mm in length; palate extending posteriorly behind third upper molars……..***Rattus norvegicus***

Distinguishing Characters

A bandicoot –like large rat, having an obscurely bicolored tail, shorter than head and body length (80-95%) and relatively smaller ears (16-23). Fur coarse and spiny. Dorsum dark brown and venter gray. Skull large, occipitonasal length 45-55 mm; supraorbital ridges powerful, extending backwards fairly straight up to occiput; palate long, more than one half of occipitonasal length (*onl)*, extending posteriorly far behind third upper molars; maxillary tooth rows less than 15% of *onl* and its width ranges from 2.0-2.3 mm; anterior palatal foramina, on average, 17 % of *onl* and broad (3.0-4.6), ending far ahead of first upper molars; braincase narrow, cranial width less than 28% of *onl* Mammae 5 or 6 (Agrawal, 2000).

Morphological Characters

This species is robust and heavily built. The tail is always less than head and body length in adult specimens. The ear is short and when drawn forward, does not reach the eyes. External measurements are given in Table 2. Dorsal fur colour varies slightly from dark brownish to ochre (particularly in old specimens) and the dorsal hair bases are grayish. Tail is slightly is bicoloured and covered with short, sparse, dirty, whitish hairs. The soles of the fore and hind feet are completely naked (Figure 2 d). The upper surface of both the fore and hind feet are covered with tiny whitish hairs but the base of the hind

Upper surface has patches of grayish hairs (Figure 2 e). The hairs on ventral fur are dirty white but bases are grayish. The line of demarcation is quite distinct. The species has six pairs of mammae (2 pair's pectoral, 1 pair abdominal and 3 pairs inguinal).

Cranial Characteristics

The skull of the *Rattus norvegicus* is considerably robust, the braincase is narrow and elongated (Figure 2 a). The rostrum is moderately long and the nasals are rounded off posteriorly. The cranial measurements are given in Table 2. The parietals and interparietals are bordered by ridges which are straight an almost Parallel (Figure 2 an arrowed). The squamosal and maxillary process of the zygomatic arc is laterally widened. The supraoccipital is nearly vertical and exoccipital condyles form the most posteriorly projecting point of the skull in this species. Incisive foramina is of moderate size, just reaching the front of M^1, and the post-palatal foramina is point size. The posterior margin of the palate is situated considerably posterior margin of M^3 (Figure 2 b).

Figure legends

Figure 1a: The typical model of albino *Rattus norvegicus* (Winstar breed). Its accession number was RN 1234.

Figure 1b: The wild *Rattus norvegicus* from Singjamei. Its accession number was DH 1001.

Figure 2a: The dorsal view of the cranial bones of albino rat (RN 1234) and wild rat (DH 1001) with their respective mandibles at their sides.

Figure 2b: The ventral view of the cranial bones of albino rat (RN 1234) and wild rat (DH 1001) with their respective mandibles at their sides.

Figure 2c: The lateral view of the cranial bones of albino rat (RN 1234) and wild rat (DH 1001) with their respective mandibles at their sides.

Figure 2d: The sole of hind foot.

Figure 2e: The upper surface of the hind foot.

Figure 3: The metaphase plate 2n=42, #1, 9 and 13 being subtelocentrics. Bar represent 1 cm.

The tip of the pterygoid process does not touch the anterior parts of tympanic bullae (Figure 2 c). The mandible is also robust and its coronoid process is markedly separated from the condyloid process. Incisor teeth is straight (Opisthdont) and the anterior surfaces are smooth without any grooves and coloured orange. The molars lobes in M^1 are 3; M_1 - 4; M^2 and M_2 - 3; M^3 - 3; M_3 – 2.

Cytological Study

The diploid count of the metaphase plate is 42 and karyotype comprises of chromosome numbers(#) 1, 9 and 13 subtelocentrics, #2, 3, 4, 5, 6, 7, 8, 10, 11, and 12 acrocentrics, #14-20 are small metacentrics and XY are acrocentrics (Figure 3).

DISCUSSION

The species in th**e** present study is confirmed to be *Rattus norvegicus* (Berkenhout, 1769) for its morphological characters and cranial characters are consistent with Agrawal (2000), Aplin *et al.,* (2003), Corbet and Hill (1992) and karyological findings is quite identical with the albino rats. Harrison (1972) stated that the exoccipital condyles form the most posteriorly projecting point of the skull. This feature was similarly found in the Manipur specimens. The species is found in homesteads, drainages, market places, storages, godowns, fields, lakes abundantly in Imphal West and Imphal east Districts of Manipur, yet this species is not reported in the state fauna series of Zoological Survey of India (Alfred, 2005).

The Norway rat (*Rattus* norvegicus) and the black rat (*Rattus Rattus*) originated in Asia. Norway rats originated on the plains of Asia, probably in what is now northern China and Mongolia, where wild rats still live in burrows today. Black rats originated further south in the Indo-Malayan region (Krinke, 2000; Welker, 1964). Murids (Muridae), the family that gave rise to present-day Norway rats, house mice, hamsters, voles, and gerbils, first appeared during the late Eocene (around 34 million years ago). Modern murids had evolved by the Miocene (23.8-5 mya) and radiated during the Pliocene (5.3-1.8 mya). The genus *Rattus* first emerged within the Muridae family about 3.5 (Furano and Usdin, 1995) to 5-6 mya (Verneau *et al.,* 1998). The genus *Rattus* was native to the Mediterranean countries, the Middle east, India, China, Japan, and Southeast Asia (including the Philipines, New Guinea and Australia) (Krinke, 2000). After it arose, the *Rattus* genus underwent two episodes of intense speciation, one about 2.7 mya, and another began about 1.2 mya and may still be ongoing (Verneau *et al.,* 1998). The closest relative of *Rattus norvegicus* is *Rattus cf moluccarius* (Verneau *et al.,* 1998; Cabot *et al.,* 1997; Usdin *et al.,* 1995). The split between these two species occurred around 0.5 mya (Verneau *et al.,* 1998). Today, there are 51 species within the genus *Rattus*. *Rattus norvegicus* is thought to be native to the Hondo region of Japan because it is represented there by Holocene and late Pleistocene fossils along with a form identified as *R.* aff. *Norvegicus* from the middle Pleistocene that may have been ancestral to *R. norvegicus* in the Japanese Isls; the rest of the endemic Japanese rodent fauna is also represented by Pleistocene and Holocene fossils. Late Pleistocene-Holocene records of *R. norvegicus* come from cave deposits in the Sichuan-Guizhou region of China , which adds credance to the conventional view that the original range probably also included N China (particularly in Heilongjiang Province) and SE Siberia (Wilson and Reeder online).

How the species is come to Manipur is still a good question to be answered. In 1980s the *Bandicota bengalensis* reported by Subiah and Singh (1984) from Manipur and the route was through introduction of the food Lorries and trucks from Kolkata (than Culcutta) and Assam. It is possible their identity might be mistaken with *Rattus norvegicus*. *Rattus norvegicus* is sometimes mistaken for species of *Bandicota*. However, Bandicoot rats have large ears, a darker manus and pes, and broader incisors (Aplin *et al.,* 2003). Another possible route was the introduction of the species through the British troops during Anglo-British War in 1891 (*The Last war of Independence of Manipur*) in which the British troops attacked the Khongjom (a hillock in the way of Indo-Burma road) from Burma. Last one is during the Second World War II in which either the British troops or the Japanese troops entered Manipur for the War. The troops were entered Manipur from Burma (today Myanma) along the trucks weapons, heavy

vehicles and all requirements for human survival. There is still a iron bridge that was built by the British troops near Khudengthabi.

After all the discussions it is hard to come to the conclusive that when this urban menace in Manipur came and what are the effects of this species to the endemic species till date is uncertain but this rodent might had replace many unknown species in Manipur particularly in the valleys where there is direct transportation system. Many holes in mud and bamboo houses even in the wooden houses are made by this species and in fields as well as in the storage houses the menace has been causing many damages at an alarming rate. As a conclusive point we like to put up some points: a) the species *Rattus norvegicus* (local people called this species as Moreh rat) is present in Manipur and it is not an endemic species; b) the exact timing of arrival of this species in Manipur is still yet to be ascertained, c) the species is causing damages to houses as well as in fields, in market places they look horribly unhygienic, d) the menace should be controlled before it is too late, e) there is urgent need for enlarging the scope of the study in order to understand the route of the invasion and threat to the endemic

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