A REPORT ON THE POPULATION DISTRIBUTION AND HETEROCHROMATIN VARIATION OF *MUS BOODUGA* AND *MUS TERRICOLOR* IN SOME REGIONS OF NORTH BENGAL

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**ABSTRACT**

The sibling species, *Mus booduga* and *Mus terricolor* known as Indian Pygmy field mice co-exist occupying the same habitats. In an extensive survey, twelve sites of Terai and Dooars regions of North Bengal (West Bengal) were selected covering about 250 kilometres. Interestingly *M. booduga* was found in only three sites, viz. Rahimabad, Kumargram and Maynaguri though very few in numbers. *M. booduga* was not encountered in remaining nine sites; Cooch Behar, Nagrakata, Malbazar, Naxalbari, Chathat, Bidhan Nagar, Bagdogra and Garidhura. Such a skewed distribution of *M. booduga* suggests extreme population depletion due to some unknown environmental factors. C-band analysis done as species specific marker as Constitutive heterochromatin variation is well known between these two species. Quantitative and positional variation showed in our study is most likely related with qualitative variation.

**Key Words:** *Mus booduga, Mus terricolor*, C-band, Constitutive heterochromatin.

**INTRODUCTION**

The Indian pygmy field mice, *Mus booduga* (Gray, 1837) and *Mus terricolor* Blyth, 1851 are the indigenous common field mice of the Indian subcontinent. *M. terricolor* was known as *M. dunni* until Musser and Carleton (1993) replaced the nomenclature with the original one. Both have 2n=40 chromosomes as do all other species of the subgenus *Mus*. Compared to all acrocentric chromosomes of *M. booduga*, *M. terricolor* possesses large submetacentric X, large acrocentric Y and acrocentric autosomes in the complement (Matthey and Petter, 1968 ; Sharma and Garg, 1975; Markvong *et al.*, 1975). *Mus booduga* shows conservative karyotype but *M. terricolor* have three divergent karyotypes in different population. The divergent karyotypes of *M. terricolor* are due to heterochromatin variation established in homozygous condition as short arms (Sen and Sharma, 1983; Cheong 1986; Sharma *et al*., 1990). Both the species live in burrows and do not come to the human dwellings. They infest mainly paddy and wheat fields and coexist occupying the same habitat however differ in microhabitat (Cheong, 1986). Earlier they were considered as conspecific species due to their similar morphology but later in 1968 Matthey and Petter established these two species as sibling species primarily on the basis of their divergent karyotypes. They are morphologically only slightly different and can be distinguished on the basis of average characters. In contrast to the gray under parts of the *M. terricolor*, the under parts of *M. booduga* is white. There are also sharp differences in the first molar of the upper jaw in the two species (Marshall, 1977). Cytogenetic studies were carried out on the pygmy field mice collected mainly from Madras (Matthey and Petter, 1968), Varanasi (Sharma and Garg, 1975) and Mysore (Manjunatha and Aswathanarayana, 1975).
1979) and in some other places of Central, Western and Southern part of India. But places of West Bengal were not included in earlier studies. However few individuals of *M. terricolor* were studied from Alipurduar of North Bengal by Bahadur (1995). The Northern part of the West Bengal, popular as North Bengal is well known for its wild life diversity and diverse ecological features.

A study of *M. booduga* and *M. terricolor* from North Bengal (West Bengal) has been initiated and we report here the distribution pattern and heterochromatin variation of these two species from different places of Terai and Dooars.

**MATERIALS AND METHODS**

**Collection:** The collection of Indian pygmy field mice *M. booduga* and *M. terricolor* were carried out from 12 places covering three districts of North Bengal; Darjeeling, Jalpaiguri and Cooch Behar (Fig. 1 and Table1). A total of 1600 Indian pygmy field mice were captured alive by digging burrows in rice fields during harvesting season. The animals were kept in separate cages in the animal house at University of North Bengal with tags describing collection site, date and number of individuals till sacrifice.

**Chromosome Preparation:** The mitotic chromosomes were prepared from bone marrow of colchicine injected individuals by the usual flame dry method after hypotonic treatment and fixation as described by Bahadur (1995).

**C-Banding:** C-banding was done following the method of Sumner (1972) with slight modification. 2-3 days old air dried slides were treated in 0.2N HCl for 30 minutes and rinsed with distilled water followed by 5% barium hydroxide treatment at 50ºC for 4-7 minutes and immediately rinsed with distilled water. Thereafter the slides were incubated in 2xSSC at 60ºC for 2 to 3 hours. The slides were washed thoroughly in distilled water and stained in 3-5% giemsa for 30 minutes.

![Fig.1. Map showing collection sites of Indian Pygmy Field Mice (*M. terricolor* and *M. booduga*) in Terai and Dooars of West Bengal (not to scale).](image-url)
Table I. Table showing the collection sites, Number of individuals of *M. booduga* and *M. terricolor* and total number of individuals collected in North Bengal.

<table>
<thead>
<tr>
<th>Sites</th>
<th>No. of <em>M. booduga</em></th>
<th>No. of <em>M. terricolor</em></th>
<th>No. of individuals collected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Darjeeling District</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Naxalbari</td>
<td>0</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>Bagdogra</td>
<td>0</td>
<td>70</td>
<td>70</td>
</tr>
<tr>
<td>Garidhura</td>
<td>0</td>
<td>90</td>
<td>90</td>
</tr>
<tr>
<td>Bidhan Nagar</td>
<td>0</td>
<td>180</td>
<td>180</td>
</tr>
<tr>
<td>Chathat</td>
<td>0</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>Jalpaiguri District</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alipurduar</td>
<td>0</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Rahimabad</td>
<td>2</td>
<td>78</td>
<td>80</td>
</tr>
<tr>
<td>Kumargram</td>
<td>9</td>
<td>81</td>
<td>90</td>
</tr>
<tr>
<td>Maynaguri</td>
<td>1</td>
<td>79</td>
<td>80</td>
</tr>
<tr>
<td>Nagrakata</td>
<td>0</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Malbazar</td>
<td>0</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>Cooch Behar</td>
<td>0</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>12</strong></td>
<td><strong>1588</strong></td>
<td><strong>1600</strong></td>
</tr>
</tbody>
</table>

RESULTS AND DISCUSSION

A total of 1600 Indian pygmy field mice were collected from 12 sites of Dooars and Terai regions of North Bengal covering a distance of about 250 km with varying ecological features. The Table1 shows the collection pattern of the pygmy field mice. *M. terricolor* were found abundantly in all sites while *M. booduga* were found only in three sites. Out of 1600 individuals, 1588 were *M. terricolor* and only 12 were *M. booduga*. Out of 12 *booduga* individuals, 2 were found in Rahimabad (Hatipotha), 1 in Maynaguri and 9 were found in Kumargram near Bhutan border.

C-banding technique was used for localizing constitutive heterochromatin and its variation in population by many workers (Sharma and Raman, 1973; Baverstock *et al.*, 1977; Oshida and Obara, 1993; Bauchan and Hossain, 1999 and references therein). Chromosomal studies using C-banding revealed that the chromosomes of *M. booduga* were all acrocentric with C-band positive centromere showing large block of heterochromatic region (Fig.2 A and B). In *M. terricolor*, autosomes were acrocentric with feeble C-band positive region around centromere. The large submetacentric X chromosome was with C-band positive short arm and the large acrocentric Y chromosome was entirely heterochromatic. However, the telomeres of long arm of X and Y chromosomes were also C-band positive (Fig.2 C and D). Autosomes of *M. terricolor* revealed interstitial C-band positive regions which were found to be absent in *M. booduga* chromosomes.

Chromosomal studies carried out by Sharma and workers over a long span of time established the presence of three chromosomal types of *M. terricolor*, viz. Type I having all acrocentric autosomes, Type II with biarmed autosome pairs 1 and 3 and Type III possessing biarmed autosome pairs 1, 3 and 6. The short arms of biarmed autosomes were C-band positive (Sen and Sharma,
Fig. 2. C-banded mitotic chromosomes of Indian pygmy field mice *M. booduga*, showing all acrocentric chromosomes with large blocks of heterochromatin at centromeres (A and B) and *M. terricolor* with distinct metacentric X and large acrocentric Y chromosomes (C and D). Short arm of the X (broken arrows) and entire Y are heterochromatic. Note the telomere of X and Y in *M. terricolor* is strongly C-band positive (arrow heads). Many autosomes in *M. terricolor* show interstitial heterochromatin (C and D, arrows).
Indian pygmy field mice identified as *M. terricolor* by chromosome analysis in our laboratory is in exact agreement with the karyotypic feature of *M. terricolor* type I reported from Varanasi (Sen and Sharma, 1983; Cheong, 1986; Bahadur, 1995; Sharma, 1996). In contrast to karyotypic divergence in *M. terricolor* shown by Sharma and workers, the karyotype of *M. booduga* from different places is highly conserved with all acrocentric chromosomes.

The survey carried out by our laboratory in a span of 2-3 years in different places of Terai and Dooars showed that most of the pygmy mice collected were *M. terricolor* (1588) and *M. booduga* appeared very rare and was found only in three isolated regions of Dooars in very low frequency (Table 1). As both the species are major rodent pest and reported to coexist in the same field, the depletion of *M. booduga* population only is very puzzling. Various environmental factors may be responsible for reduced fecundity of *M. booduga*. However the exact reasons of sporadic and rare occurrence of *M. booduga* in North Bengal needs further investigations.

The C banding pattern of *M. booduga* is very different from that of *M. terricolor*. All acrocentric chromosomes are heavily C-band positive in their centromeric region. The amount of constitutive heterochromatin is very high in *M. booduga*. Presence of interstitial constitutive heterochromatin is evident in *M. terricolor* from our study and other studies (Sharma and Garg, 1975) whereas in *M. booduga* there is no trace of constitutive heterochromatin in interstitial position which is very interesting from the point of evolutionary sequence variation. In quantitative and positional aspect these two sibling species clearly show C-band positive variation. Various investigators have shown that *M. terricolor* possess ‘*Mus musculus* like’ AT-rich heterochromatin only in a confined region of X chromosome whereas *M. booduga* share substantial homology in all but five autosomes (Sen and Sharma, 1980; 1983; Balajee and Sharma, 1994) and also differences in repetitive elements (Chatterjee et al., 2003). This clearly indicates that these two species evolved separately in course of time at least in respect of heterochromatin.

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REFERENCES


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Population distribution and heterochromatin variation of Mus


