

Morphological variation and evolution of the house mouse genus *Mus*

(Mammalia: Muridae) from Japan

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Abstract

Background

Variation is a central concept in biological research and thematic focus is crucial for understanding the broad perspectives of variation. The skull and dentition are fundamental in the study of the functional adaptation and evolution of mammalian species, reflecting the natural history of the animals. Rodents, including mice, are the most diverse and evolved groups of mammals, where the genus *Mus* constitutes small, nocturnal, and terrestrial rodents. Several species in the rodent genus *Mus* are used as model systems with respect to genetics, functional, developmental, and evolutionary aspects. In this dissertation, I used multiple indices of variation to study interspecific and geographic variations in the skull and dentition as well as dental abnormalities in the two species of genus *Mus* (*Mus musculus* and *M. caroli*).

Materials and Methods

I studied the two species of genus *Mus* in the Japanese and Ryukyu islands because of their complex morphology. This genus presents a suitable model for elucidating interspecific and geographic variations. I examined the Ryukyu mouse, *Mus caroli*, which is only found in Okinawajima Island and the house mouse, *Mus musculus*, found in most of the mainlands and peripheral islands of Japan. *M. caroli* coexisted with *M. musculus* in Okinawajima Island. I examined the skulls and dentitions of these specimens using both linear measurements and geometric morphometric methods and conducted surface observations of dentition.

Results

Morphological study of the house mouse *Mus musculus*, revealed the distinct features in specimens from Yonagunijima Island, similar to those of Miyakojima Island (my2). In addition, a morphometric similarity was identified between *M. musculus* from Yonagunijima Island and *M. caroli* from Okinawajima Island.

Morphological variation of dentition in two species of *Mus* (*Mus musculus* and *M. caroli*) showed differences in the size and shape of the upper first molar (UM1) in the sympatric species (*M. musculus* and *M. caroli* from Okinawajima Island). UM1 and LM1 indicated species differences between *M. musculus* and *M. caroli* populations. Moreover, *M.*

musculus from Yonagunijima Island showed a larger molar size in M3 than other *M.*

musculus populations and *M. caroli*.

Dental anomalies were observed in 13 specimens (12.75%) of the Ryukyu mouse, *M. caroli*. Observed dental anomalies were divided into three categories: absent tooth posterior to M2, interproximal space between molars, and abnormal position of M3, which were reported for the first time.

Discussion

Morphological variation of the house mouse *M. musculus* suggested that mice from Yonagunijima Island and those from other islands in the Ryukyu Archipelago might be the result of different origins among the populations. Morphometric similarities between the mandibles for *M. musculus* from Yonagunijima Island and *M. caroli* from Okinawajima Island might be related to the production of similar mechanical advantages and equivalent masticatory forces.

Morphological variation of dentition for two species of genus *Mus* (*Mus musculus* and *M. caroli*) indicated species differences, thereby supporting species identification. The unique morphology of the third molar in the Yonagunijima Island population may have been formed by dietary adaptation or a dietary shift, that is, the consumption of more herbivorous diets.

The dental anomalies in the Ryukyu mouse, *M. caroli*, indicated that missing of the third molar is the most common anomaly. Although the high incidences of dental anomalies are considered based on genetic effects, the interproximal space and abnormal molar position, such as those reported in this study, could be the cause of periodontal disease.

Conclusion

In this dissertation, the morphological variations of the skull and dentition in the genus *Mus* were observed in the Japanese and Ryukyu Archipelagos, suggesting that functional and evolutionary factors influence the variation trends. However, the trends in morphological variations of dentition are linked to their genetics and showed that dietary habits related to habitat utilization caused disease in animal populations. The results of this study suggest morphological adaptation related to dietary habits, reflecting the importance of variability and evolvability during the evolutionary processes.