Morphological variation and zoogeography in Japanese shrew moles

Shinya OKABE

Abstract

Background

Several biogeographical studies have been conducted on small mammals on the main Japanese islands. These studies mainly conducted on the main Japanese islands and peripheral islands to reveal biogeographic pattern between the oceanic islands. These islands have been of interest in island biogeography. The field of island biogeography also covers mountain islands, which is a species composition or ecosystem within mountains that is distinct from the surrounding landscape. Sea and mountain islands are well known for their high endemism. Even though small mammals are highly endemic in the Japanese islands and complicated landscapes involve lower and higher land areas, island biogeographic studies of the main islands are lacking. Thus, it is necessary to reveal the biogeography of both the sea and mountain islands, compare divergence patterns between lower and higher land areas, and discuss the process of pattern formation on the main island of Japan.

Materials and Methods

I focused on the two Japanese shrew moles because of their segmented elevational distribution between alpine and lowland species in the same landmass. This is a good fit for the study model for

comparative zoogeographic variation. I examined the greater Japanese shrew mole, *Urotrichus talpoides*, which is distributed at lower elevations, and the lesser Japanese shrew mole, *Dymecodon pilirostris*, which is distributed at higher elevations. I examined skull specimens of these species and conducted surface observations and measurements of dentition and skull morphology.

Results

Dental anomalies in *U. talpoides* was studied, and the frequency (1.7%) was relatively low in talpid moles. These dental anomalies involved extra teeth posterior to C^1, posterior to P^2, or posterior to P^4 and a connate tooth on C_1, which were reported for the first time.

Geographic variation in skull morphology in *U. talpoides* was studied. Geographic differences were found between the main islands and between the peripheral islands of Japan, with differences in the overall skull size, distance from the fourth premolar to the third molar in the upper and lower jaws, and the slender–robust proportion of rostrum and braincase.

Geographic variation in skull morphology in *D. pilirostris* was studied, and it was found that skull morphology diverged between mountain ranges, with morphological differentiation due to overall size, teeth row length, and mandibular shape.

Discussion

The dental anomaly frequencies in Japanese shrew moles were not as high as expected. Even though the relationship between the frequency of dental anomalies and genetic drift has been discussed in the mole genus *Mogera*, which shows frequent dental anomalies, there was no geographical bias in the occurrence of dental anomalies of *U. talpoides*.

Geographic variation of the Japanese shrew mole *U. talpoides* suggested that the lowland shrew mole geographically diverged between sea islands due to isolation by sea and was less diverged within each island. The unique morphology of each peripheral island may have been formed by habitat shrinkage associated with climate change from glacial to interglacial periods.

Geographic variation of *D. pilirostris* indicated divergence between mountain ranges, supporting that this species is isolated in higher mountain ranges. This island biogeography suggests that Japanese mountain islands are recognized not in each mountain top but each mountain range. The combination of the range shift of *D. pilirostris* and interspecific competition with *U. talpoides* might have forced *D. pilirostris* to be distributed in a limited elevational range and enhanced its isolation.

Conclusion

The two Japanese shrew moles morphologically diverged on the Japanese islands. The lowland species of *U. talpoides* is diversified between populations of sea islands and mainland populations,

and the alpine species of *D. pilirostris* is diversified between populations of mountain ranges. Therefore, sea and mountain islands are considered insular systems promoting morphological divergence. This morphological divergence was caused by habitat shrinkage associated with climate change from glacial to interglacial periods. It is argued that insular systems in sea and mountain islands form different spatiotemporal isolations. However, this study explained the unique morphological divergence in sea and mountain islands and found that habitat shrinkage caused bottlenecks and promoted morphological divergence in animal populations.