The Late Pleistocene snake fauna (Reptilia: Squamata) of the Ryukyu Archipelago, Japan, as inferred from recently discovered fossils

Oral -15

Fossils of terrestrial turtles indicate the Late Pleistocene mass extinction in the East Asian Islands

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Extant terrestrial turtle fauna of the East Asian Islands consists of seven species (six geoemydids and one trionychid). Of these, *Geoemyda japonica* and *Mauremys japonica* are endemic to the Okinawa Group of the Ryukyu Archipelago and Japan mainland, respectively, whereas *Cuora flavomarginata* and *M. mutica* are distributed in the Yaeyama Group of the southern Ryukyus, Taiwan, and the eastern part of the continent. The southern Ryukyu populations of the latter two species are distinguished from their conspecific Taiwanese and continental populations as endemic subspecies (*C. f. evelynae* and *M. m. kami*). *Chinemys reevesii* and *Pelodiscus sinensis* occur in Japan mainland, Taiwan, and the continent. The remaining species, *Ocadia sinensis*, ranges from southeastern continent to Taiwan. Based on the zoogeographic and physical information, it is very likely that Taiwan was connected to the continent in the Last Glacial Maximum in the Late Pleistocene, whereas the other islands remained isolated from the continent, as well as from each other during this period. Terrestrial turtles do not seem to be tolerant to seawater for oversea dispersals, because their natural ranges do not include oceanic islands at all. Thus, it is obvious that the ancestors of the current terrestrial turtles of the East Asian Islands had colonized from the continent to these islands through landbridges.

Recently, taxonomic studies on terrestrial turtle fossils from the Quaternary of the East Asian Islands have been rapidly progressing, showing that the turtle fauna in this region was much more diverse in the Pleistocene than in the present. For example, from the Upper Pleistocene of the central Ryukyus (i.e., the Amami and Okinawa Groups, and a few southern islands of the Tokara Group), two extinct geoemydids (i.e., *Cuora* sp., obviously different from *C. flavomarginata*; *G. amamiensis*, endemic to the Amami Group and closest to *G. japonica*) have recently been found. Besides these, one more geoemydid species, for which generic status has not yet been determined with certainty, but obviously different from extant turtles of the archipelago, was also found from one island (Kumejima) of the central Ryukyus. From the southern Ryukyus, one extinct geoemydid, *Mauremys* sp. has been discovered from comparable deposits on Miyakojima Island. Moreover, an endemic testudinid (*Manouria oyamai*) was recently described from both the southern and central Ryukyus. In Japan mainland, three extinct endemic geoemydids, *C. miyatai*, *M. yabei*, and *O. nipponica*, have been recorded from the Middle to Late Pleistocene deposits. These Pleistocene turtles of Japan mainland and the Ryukyus had probably been differentiated through insular isolation mainly caused by sea level changes during the Pleistocene. Majority of such terrestrial turtles of the East Asian Islands had gone extinct in the latest Pleistocene, leaving only a few species surviving to the present. The abrupt extinction of those turtles is most likely a part of the mass extinction of terrestrial vertebrates during this period, which seems to have been caused by prominent climate change, or human activities, or both.

Oral -16

The Late Pleistocene snake fauna (Reptilia: Squamata) of the Ryukyu Archipelago, Japan, as inferred from recently discovered fossils

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The Ryukyu Archipelago is a chain of continental islands located in the subtropical East Asia between Japan mainland and Taiwan. This archipelago is usually divided into three regions, the northern Ryukyus, the central Ryukyus, and the southern Ryukyus, by the Tokara Tectonic Strait in northeast and the

Kerama Gap in southwest. These regions show sets of extant terrestrial animals distinct from each other. Formation process of such distinct geographic pattern in the current Ryukyu fauna yields a number of questions to be answered. Fossil studies often offer good clues to such questions. Indeed, a number of fossil vertebrae of snakes has been collected from the Upper Pleistocene cave and fissure filling deposits on several islands of the Ryukyus (Tokunoshima, Okinawajima, Miyakojima, Ishigakijima, and Yonagunijima Islands), and these may possibly contribute to the solution of some of these questions. However, due to the difficulties in their reliable identifications, many of these fossil snake vertebrae have been left unidentified, or were identified but without any concrete justifications, offering little biogeographical information. Keeping this problem in mind, I have been working to establish a reliable identification system of snake vertebrae on the basis of extant snake specimens from East and Southeast Asia. I have also attempted to apply this system to the identification of fossil snake vertebrae excavated from the Ryukyu Archipelago.

As a result, fossil snake vertebrae excavated from each island of the Ryukyus were identified to four genera of three families, such as the genus *Dinodon* of the family Colubridae and the genus *Protobothrops* of the family Viperidae. These fossils suggest that Late Pleistocene snake fauna on each of Tokunoshima, Okinawajima, Ishigakijima, and Yonagunijima Islands is very similar to that at present, and these fossil snakes are therefore considered as the ancestor forms of the extant snakes on each island. In contrast, the Late Pleistocene snake fauna of Miyakojima Island was considerably different from the extant snake fauna of the same island: some fossil vertebrae of the Colubridae, for example, clearly differ in size and several other morphological characters as compared with extant colubrids of Miyakojima and other islands of the Ryukyu Archipelago. Moreover, fossil vertebrae of the viperid taxa, such as *Protobothrops* cf. *P. elegans*, were also excavated from Miyakojima Island, but not a single viperid species currently occurs on this island. These and other fossil evidences clearly indicate that on Miyakojima Island a number of snake taxa has gone extinct since the Late Pleistocene.

The vertebrae found from those Ryukyu islands as the Pleistocene fossils were distinctly larger in size than those of their extant putative descendants of the same islands (see above). Such prominent size differences between fossil and extant snake vertebrae suggest that in each lineage of snakes, the body size has rapidly reduced during the last few hundred thousand years, probably due to the reduction in size and density of available prey, such as the frogs and birds.

Oral -17

Cynocephalus variegatus (Dermoptera) and *Manis javanica* (Pholidota): examples of neglected mammalian orders

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Even though most biologists feel that mammals is the most well-studied group of animals, there is still a great gap in our knowledge on the basic ecology of many tropical nocturnal species. For instance, what we know of the biology of the 37 species of cats is far from being complete. The *Cynocephalus variegatus* and *Manis javanica* are two examples of such animals, which belong to very unique mammalian orders and still exist on the largely urbanized island of Singapore. I will present on the natural history of these two very different animals and also discuss the characters that render them and others species being neglected in mammalogy