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## Influences of Biological Invasion and Climate Change on Insular Animals: Cases in Terrestrial Vertebrates of the Ryukyu Archipelago, Japan

メタデータ	言語: 出版者: 琉球大学21世紀COEプログラム 公開日: 2008-10-07 キーワード (Ja): キーワード (En): 作成者: Ota, Hidetoshi メールアドレス: 所属:
URL	<a href="http://hdl.handle.net/20.500.12000/7378">http://hdl.handle.net/20.500.12000/7378</a>

Influences of Biological Invasion and Climate Change on Insular Animals:  
Cases in Terrestrial Vertebrates of the Ryukyu Archipelago, Japan

Hidetoshi Ota

Tropical Biosphere Research Center, University of the Ryukyus, Senbaru 1, Nishihara, Okinawa 903-0213, Japan

The Ryukyu Archipelago consists of an island chain extending from Kyushu of Japan to Taiwan (Ryukyu Arc), and two adjacent island assemblages (Senkaku Group on the continental shelf and Daito Group on the Philippine Plate). Islands composing the Ryukyu Arc are of continental origins, but most of these are considered to have been isolated from adjacent landmasses for relatively long periods ( $> 1.5$  MyBP for the central part, and  $> 0.3$  MyBP for the southern part). A far shorter isolation period ( $< 0.02$  MyBP) is postulated for islands of the Senkaku Group, whereas those composing the Daito Group are purely of oceanic origins. Such diverse geohistory of the Ryukyu Archipelago is more or less reflected by geographic patterns of endemism and lineage diversity in terrestrial organisms in this and surrounding regions. Recently, however, such patterns in native organisms have been substantially changing, and this issue is now a subject of serious conservational and biogeographical concern. Of the possible factors responsible for such changes, artificial introduction of organisms seems to be among the most crucial ones and is obviously common to many other insular regions of the world.

In this presentation, I review actual cases of artificial introduction of terrestrial vertebrates in the Ryukyus with reference to the type and extent of their impacts on indigenous organisms. I paid particular attention to those cases that have supposedly been enhanced by recent climatic change.

In the Ryukyu Archipelago, artificial introduction of terrestrial vertebrates to one or more island was once frequently attempted for some particular purposes, and some of these have led to establishment of their feral populations. Representatives of all major groups of terrestrial vertebrates (i.e., Amphibia, Reptilia, Aves, and Mammalia) were involved, and a few patterns may be recognizable: (1) on islands with no indigenous predatory mammals, introduction of a carnivore (cat, mongoose, or weasel) or predatory bird (peacock) has led to rapid population decline or even complete disappearance of small animals, scincid lizards in particular; (2) in reptiles, introduction of exotic taxa to an island from neighboring regions has frequently led to emergence of hybrids, predicting impact through introgression rather than through competition; (3) in tropical and subtropical animals that were involved in frequent intentional and unintentional transportations, northern extremity of the range may be determined by ambient temperature at habitat. This last issue is suggested by the fact that the common house gecko from tropical Asia (*Hemidactylus frenatus*), long confined to the southern two thirds of the archipelago, considerably extended its range to the north during the last two decades. Furthermore, the green tree lizard (*Japalura polygonata polygonata*), originally endemic to the central Ryukyus, recently established a feral population in temperate eastern Kyushu where winter temperature has been rising during the last four decades.

Present results altogether confirm the impact of exotic invasive species on the native Ryukyu organisms, although its type and extent appear highly variable, depending on the ecological and physiological characteristics of the former. The results also emphasize the importance of monitoring, besides eradication effort, for the nonnative populations in the archipelago to predict their further range extension and to put priority for controlling effort appropriately.