

On a taxonomic position of the weasel (Carnivora, *Mustela*) from the Cheju Island (South Korea)

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ABSTRACT. The weasel from Cheju Island (formerly — Quelpart Island), which is situated in Korean Strait south of the coast of South Korea, was described as a separate species *Lutreola quelpartis* Thomas, 1908. The type specimens of *Lutreola quelpartis* were re-examined and compared with the Japanese weasel *Mustela itatsi* and the Siberian weasel *Mustela sibirica* from Korea, Japan, Siberia and China. The analysis of cranial and external characters has revealed that *L. quelpartis* is to be treated as a subspecies of *Mustela sibirica*.

KEY WORDS: *Mustela sibirica*, *Mustela itatsi*, Mustelidae, taxonomy, Cheju (Quelpart) Island.

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Таксономический статус колонка (Carnivora, *Mustela*) острова Чеджу (Южная Корея)

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РЕЗЮМЕ. Колонок острова Чеджу (прежнее название — Куэльпарт), расположенного в Корейском проливе, был описан как отдельный вид *Lutreola quelpartis* Thomas, 1908. Были исследованы типовые экземпляры *Lutreola quelpartis*. Результаты сравнительного анализа краниометрических и экстерьерных признаков итатси *Mustela itatsi* и колонок *Mustela sibirica* из популяций Кореи, Японии, Сибири и Китая свидетельствуют о принадлежности *quelpartis* к *Mustela sibirica*.

КЛЮЧЕВЫЕ СЛОВА: *Mustela sibirica*, *Mustela itatsi*, Mustelidae, таксономия, остров Чеджу (Куэльпарт).

Introduction

Mustela Linnaeus, 1758 is the largest genus of the family Mustelidae and is widespread worldwide. The taxonomy of *Mustela* has been studied many times (Heptner *et al.*, 1967; Youngman, 1982; Abramov, 1999, 2000a). Nevertheless, some of the controversial taxonomic matters have been solved just recently. One of them is a taxonomic revision of the *sibirica*–*itatsi* complex. The Japanese weasel was first described as a distinct species, *Mustela itatsi* Temminck, 1884, but later it was considered conspecific with the widespread Siberian weasel, or kolonok, *Mustela sibirica* Pallas, 1773. Many recent checklists mentioned *itatsi* as a synonym or a subspecies of *M. sibirica* (Ellerman & Morrison-Scott, 1951; Imaizumi, 1960; Heptner *et al.*, 1967; Corbet, 1978; Yudin, 1984; Corbet & Hill, 1992; Wosencraft, 1993).

Based on the mitochondrial DNA cytochrome *b* sequences, Masuda & Yoshida (1994a, 1994b) and Kurose *et al.* (2000) studied the phylogenetic relationships among the Eurasian *Mustela* species and revealed that there is a relatively larger genetic distance between *M. itatsi* and *M. sibirica*. Morphological evidences (morphotypic characters of the skull, body size, coloration, and the bacular

structure) support for the view that *M. itatsi* is an independent species (Abramov 2000a, b).

The Japanese weasel *M. itatsi* is an indigenous species of Japanese main islands (Honshu, Kyushu, and Shikoku) and adjacent islands (Tsushima, Yakushima, Tanegashima and Ohshima) except for Hokkaido (Abe *et al.*, 1997). In 1932, the Japanese weasel was introduced to Sakhalin, where it now occurs in the southern part of the island. The Siberian weasel, *M. sibirica*, is widespread in Asia from the Ural Mountains in the west to the Far East and Korea in the east, and is also recorded from some Pacific islands (Hokkaido, Tsushima and Taiwan). This species was also introduced to Honshu. A great number of different taxonomic forms of *Mustela sibirica* have been described (see Ellerman & Morrison-Scott, 1951). One of the doubtful forms was described from the Quelpart Island (recent name — Cheju or Cheju-do Island). Cheju-do is a large island, situated in Korean Strait south of the coast of South Korea (Fig. 1). The weasel of Quelpart Island was described by Oldfield Thomas as a separate species, *Lutreola quelpartis* (Thomas, 1908). Based on external and cranial characters, Thomas pointed out that this “Quelpart Mink” could be closer to the Japanese weasel (*M. itatsi*) than to the Siberian one (*M. sibirica*).



Figure 1. Geographic location of Cheju Island.

The aim of the present study is to clarify the taxonomic status of *L. quelpartis* by comparing the type material with the specimens of *M. sibirica* and *M. itatsi*.

Materials and methods

The type specimens of *Lutreola quelpartis* from the Natural History Museum (London, UK) were re-examined: the holotype, NHM 6.12.6.1, adult male, skull, skin; paratypes NHM 6.12.6.2, subadult male, skull, skin; NHM 6.12.6.3, adult female, skull, skin; NHM 6.12.6.4, subadult female, skull, skin. The type specimens were compared with 38 specimens of *Mustela itatsi* and 165 specimens of *Mustela sibirica* from Korea, Japan, Siberia and China. Only adult males were used in the statistical analysis in order to minimize variations due to age differences and sexual size dimorphism. The adult specimens were classified on the basis

of the most common ageing criteria (obliteration of sutures, tooth wear, bone texture) used in mustelids.

The skulls were classified in following samples: (1) *Mustela itatsi* from Honshu, Kyushu and introduced populations (Sakhalin, Hokkaido), n=38; (2) *Mustela sibirica sibirica* from the Urals, Western Siberia, the Altai, Transbaikalia, Yakutia, n=97; (3) *Mustela sibirica manchurica* from the Russian Far East, North-East China (Manchuria), Korean Peninsula, n=51; *Mustela sibirica* ssp. from Tsushima Island, n=17. These samples are the representatives of morphologically distinct forms (see Abramov, 2000b).

The collections of the Zoological Institute, Russian Academy of Sciences (Saint Petersburg, Russia), the Institute of Animal Systematics and Ecology, the Siberian Branch of Russian Academy of Sciences (Novosibirsk, Russia), the Zoological Museum of Moscow State University (Moscow, Russia), The Museum, Faculty of

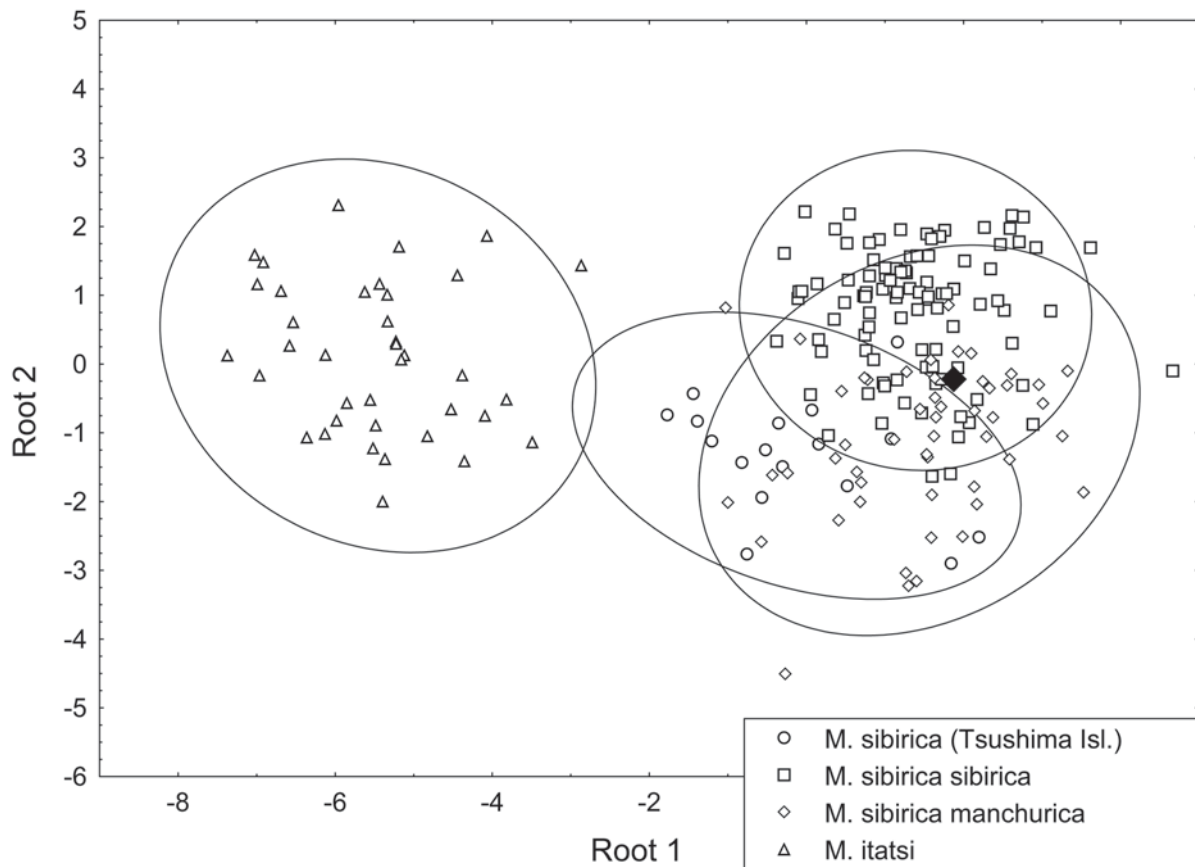


Figure 2. Distribution of the specimens of *M. itatsi* and *M. sibirica* in the space of two first canonical roots. Position of type specimens of *quelpartis* is shown in back square.

Agriculture, Hokkaido University (Sapporo, Japan), Tomakomai Research Forest, Hokkaido University (Tomakomai, Japan), National Science Museum (Tokyo, Japan), the Kitakyushu Museum and the Institute of Natural History (Kitakyushu, Japan), and Natural History Museum (London, UK) have been examined.

Twenty-two measurements were taken on each skull using sliding caliper with the accuracy of 0.1 mm. The measurements were as follows: 1 — condylobasal length, 2 — neurocranium length, 3 — viscerocranium length, 4 — braincase height, 5 — palatal length, 6 — maxillary tooth-row length, 7 — length of upper carnassial teeth P4, 8 — length of the auditory bulla, 9 — greatest length between oral border of the auditory bulla and aboral border of the occipital condyles, 10 — zygomatic breadth, 11 — mastoid width of skull, 12 — upper molar M1 breadth, 13 — interorbital width, 14 — breadth at the canine alveoli, 15 — greatest palatal breadth, 16 — width of the auditory bulla, 17 — minimal palatal breadth, 18 — total length of the mandible, 19 — length between the angular process and infradentale, 20 — mandibular toothrow length, 21 — length of lower carnassial tooth m1, 22 — vertical height of mandible. The scheme of measurements follows Abramov (2000b).

All statistical calculations were carried out using the STATISTICA 5.5 software.

Results

The results of the discriminant analysis over 22 cranial characters are shown in Fig. 2. In the space of the first two canonical axes all specimens were divided into two not overlapping clusters that exactly correspond to *itatsi* and *sibirica*. The holotype of *quelpartis* is located in the *sibirica* cluster.

Except for the size differences, there are morphotypical characters distinguished *M. sibirica* and *M. itatsi* (Abramov, 2000b). The frontal part of the *itatsi* skull is usually flat, but that in most of the *sibirica* specimens is convex. The auditory bullae of *itatsi* are slightly shorter and wider than those of *sibirica*. Anterior part of auditory bulla of *sibirica* is noticeably inflated, whereas the bullae of *itatsi* are more flattened, especially in their anterior parts. Choanal border of *itatsi* usually has a small medial projection. The tips of processus hamulares of *itatsi* are usually curved as hooks. Distal parts of the processes hamulares are usually slightly converged behind, so that the choanal notch is oval. Occasionally, there are also other notch's types: triangular or rectangular. The Siberian weasel has the choanal border lacking an acute ledge. The choanal notch of *sibirica* is triangular (tips of the processus hamulares are noticeably diverging behind) or rectangular (the pro-

cessus hamulares are almost parallel). Usually, the Siberian weasel has the second upper premolar P2 with two roots, the Japanese weasel with the one-rooted P2. The holotype and paratypes of *quelpartis* possess all the aforementioned morphotypic characters described for *M. sibirica*.

The weasel from Cheju Island is characterized by smaller size compared to the Siberian weasels from Korean Peninsula and Tsushima Island. In cranial measurements, *quelpartis* was closer to the nominative form, *Mustela sibirica sibirica*, from Western Siberia. Based on the result of multi-group discriminant analysis, the type specimen of *quelpartis* was placed in the *M. sibirica sibirica* cluster.

The body size of Siberian weasel is larger than that of the Japanese weasel. Body length of adult males of the nominative subspecies of *M. sibirica* varies from 210 to 390 mm (in average, 360 mm), and the tail length varies from 160 to 210 mm (in average, 175 mm). The Far Eastern *manchurica* is larger; the male body length is 387 mm in average, and tail length is 183 mm (Yudin, 1984). According to Abramov (2000b), the body length of adult males of *M. itatsi* varies from 300 to 360 mm (in average, 331.3 mm), tail length from 125 to 157 mm (in average, 137.9 mm). Females' body length varies from 215 to 247 mm (in average, 230.4 mm), tail length from 70 to 98 mm (in average, 86.8 mm). One of the main exterior characters to distinguish *sibirica* and *itatsi* is the relative length of tail (Imaizumi, 1960; Abe *et al.*, 1997). That of the Japanese (Korean) population of *M. sibirica* makes more than 50% of the length of body and head. The Siberian weasel from the Russian Far East also has relatively long tail, reaching 45.6–47.2% of the body length (Yudin, 1984). In *M. itatsi*, the relative length of tail varies from 32 to 46% (the mean for males is 41.6, for females — 38.5%). The body length of adult male of *quelpartis* is 309 mm, tail length is 153 mm, the body length of adult female is 265 mm, and the tail length is 130 mm. Thus, by external characters, *quelpartis* is also closer to *M. sibirica sibirica* than to other forms of the Siberian weasel or to *M. itatsi*.

Discussion

Reasoning from the results of this study, the weasel from the Cheju Island is to be placed in *Mustela sibirica*. According to results of the previous study (Abramov, 2000b), the Siberian weasel from the northern part of its distribution range is divided into three well-differentiated forms: *Mustela sibirica sibirica*, widely distributed from the Urals throughout Siberia eastward to Zeya River basin; *M. sibirica manchurica*, distributed in the Russian Far East, North-East China (Manchuria) and Korean Peninsula, and a separate form *Mustela sibirica* ssp., inhabiting Tsushima Island. *M. sibirica quelpartis* is clearly distinct from the Siberian weasel of Korean Peninsula and Tsushima Island by smaller size.

The Cheju Island is known to have a high level of mammal endemism. Six of the seventeen mammals

inhabiting this island present separate subspecies: *Crocidura dsinezumi quelpartis*, *Sorex caecutiens hallamontanus*, *Rhinolophus ferrumequinum quelpartis*, *Apodemus agrarius chejuensis*, *Micromys minutus gertigi*, *Mustela sibirica quelpartis* (Won & Smith, 1999; Ohdachi *et al.*, 2005).

The Cheju Island was formed by a series of volcanic activities at the end of the Neogene (Park, 1985) and later it was connected to the mainland during the Pleistocene and then separated again ca. 10000 years ago. Koh *et al.* (2000) analyzed the mitochondrial control region of two subspecies of striped field mice, *Apodemus agrarius coreae* and *Apodemus agrarius chejuensis*, to determine the level of genetic divergence between these morphologically distinct taxa. The authors revealed the significant difference between mainland populations of the field mice and that of the Cheju Island. Based on the molecular clock estimate, they suspected that the two subspecies of the field mice might have been isolated at the time of separation of the island from the mainland. The same difference was also found between Korean populations of *Sorex caecutiens* and the specimens from Cheju Island based on full nucleotide sequences of mitochondrial cytochrome *b* gene (Ohdachi *et al.*, 2003).

One of most interesting problem in the *sibirica-itatsi* complex is a migration history and the origin of *Mustela itatsi* as an endemic species of Japanese Islands. It is possible to hypothesize two ways of the *M. itatsi* origin. First, the Japanese weasel evolved in continental Asia from the ancestor common to *M. sibirica*. Then it penetrated to Japanese Islands and evolved independently of continental populations. The second idea is that *itatsi* might have evolved from *M. sibirica* in Japanese Islands.

Based on the considerable morphological differences among eastern populations of *M. sibirica* (Russian Far East, Cheju, Tsushima, Taiwan), it is possible to suspect that ancestral form of *M. sibirica* can evolve rapidly under insular or confined conditions. The Japanese weasel, *M. itatsi*, might reach a species level under the long insular isolation. On the contrary, the low morphological diversity of the Siberian weasels from the Urals to Eastern Siberia (Zeya River) can be the evidence of rapid colonization of this vast territory.

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