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Small mammals collected from Qinghai Province, China

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Abstract. We collected 78 specimens of small mammals from Qinghai Province, China, in the summers of 2007 and 2009. Nine species of the orders Rodentia and Lagomorpha were identified: *Allactaga sibirica*, *Dipus sagitta*, *Alticola stoliczkanus*, *Neodon irene*, *Phodopus roborovskii*, *Cricetulus longicaudatus*, *Meriones meridianus*, *Mus musculus*, and *Ochotona curzoniae*. Two distribution patterns were recognized for all species, except for the cosmopolitan species *Mus musculus*: restricted to the Qinghai–Tibetan Plateau (*Alticola stoliczkanus*, *Neodon irene*, and *Ochotona curzoniae*), or widely distributed in northern China, extending to Russia and neighboring countries (remaining species).

Key words: Qinghai Province, Qingzang Gaoyuan, Qinghai–Tibetan Plateau, Rodentia, Lagomorpha.

Introduction

Qinghai Province is located in the western part of China, surrounded by Gansu Province to the northeast, Sichuan Province to the southeast, Xinjiang Uygur Autonomous Region to the northwest, and Xizang (or Tibet) Autonomous Region to the southwest (Fig. 1). The province has an area of about 720,000 km^2 and the average elevation exceeds 3,000 m above sea level (a.s.l.). The capital, Xining City, and the area around Qinghai Lake, is a temperate steppe habitat, while the remaining areas are classified as semidesert, alpine meadow-steppe, or alpine desert (Zhang, 1997). Due to its high elevation, the province's fauna and flora have been the focus of much research. Still, the studies on fauna and biogeography of mammals of Qinghai Province are limited (Chang *et al.*, 1962; Chang & Wang, 1963, 1964; Chang *et al.*, 1964; Zhang, 1983, 1985; Li, 1989; Zhang, 1997).

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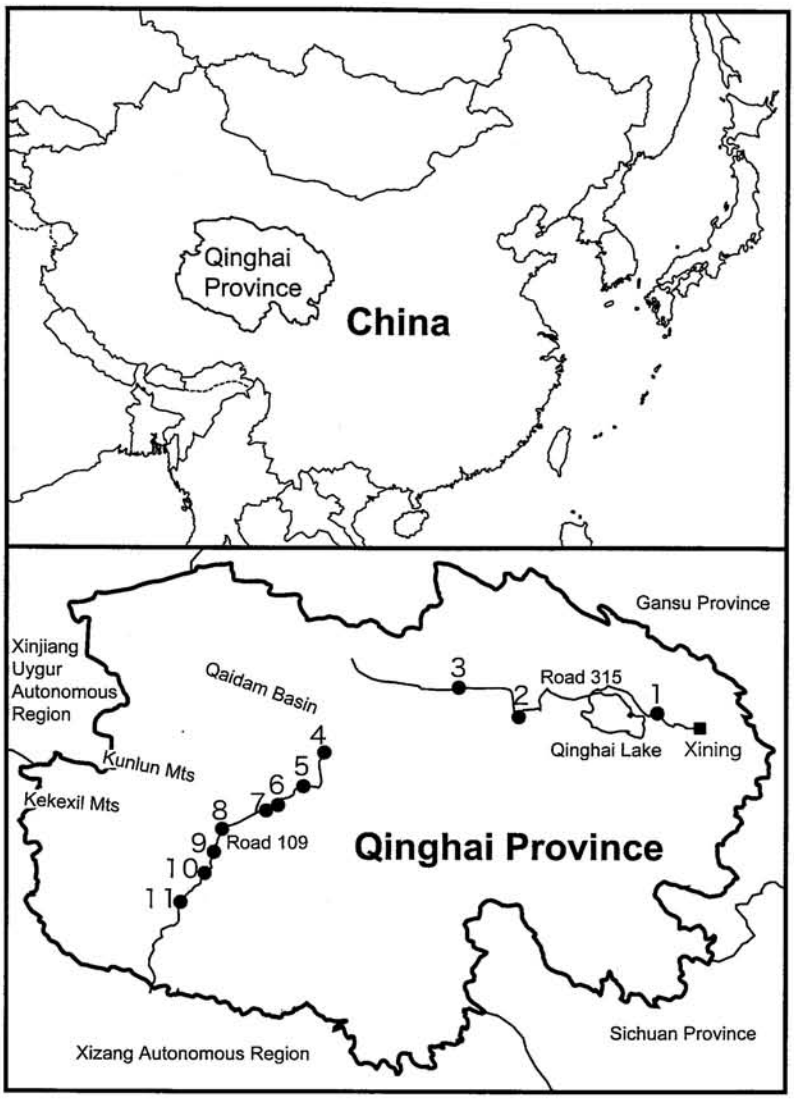

Fig. 1. Map of Qinghai Province, China, and collecting localities of small mammals. 1 Haian, 2 Wulan, 3 Delingha, 4 Geermu, 5 Xidatang, 6 Kunlunshankou, 7 Butongquan, 8 Wudaoliang, 9 Xiushuihe, 10 Fenghuoshan, and 11 Tuotuohe.

In the summers of 2007 and 2009, we surveyed the small mammals in Qinghai Province at elevations from about 2,800 m up to 5,000 m a.s.l., including temperate steppe habitat in the northeastern part of the province close to Qinghai Lake, as well as alpine habitat around and south of the Kunlun Mountains in an area called the Qinghai–Tibetan Plateau or Qingzang Gaoyuan. Here, we report our results.

Materials and methods

We collected small mammals in August 2007 and July–August 2009 in Qinghai Province, China (Fig. 1). We collected specimens around Xidatang (5 in Fig. 1), Kunlunshankou (6), Butongquan (7), Wudaoliang (8), and Xiushuihe (9) in 2007, and Haian (1), Wulan

(2), Delingha (3), Geermu (4), Xidatang (5), Kunlunshankou (6), Wudaoliang (8), Xiushuihe (9), Fenghuoshan (10), and Tuotuohe (11) in 2009. Collecting localities were close to Road 315 (localities 1–3) and Road 109 (4–11; Fig. 1). We recorded the closest road mark, which is usually given for every kilometer, and indicated the road marks for localities other than those mentioned above. Latitude, longitude, and elevation (to the nearest 10 m) were recorded with GPS.

We mainly used snap traps baited with sweet potatoes, peanuts, and sunflower seeds in the field, but also used cage traps in the field and glue board for mice in and around human residents. Traps were set around the entrances of underground burrows or runways. In addition to mammals, nine birds were obtained accidentally: *Emberiza cioides* Brandt, 1843 (n = 1, Butongquan), *Montifringilla ruficollis* Blanford, 1871 (n = 1, Butongquan), *Montifringilla adamsi* Adams, 1859 (n = 4, Kekexili Di-2-hao-qiao with road mark 2,987 km between Butongquan and Wudaoliang, Xiushuihe, Fenghuoshan, Xiushuihe-Fenghuoshan with road mark 3,060 km), and *Melanocorypha maxima* Blyth, 1867 (n = 3, Wudaoliang, Kunlunshankuo).

The following standard external measurements were recorded from captured mammals: body weight (BW) in grams, total length (TL) in mm, tail length (T), head and body length (HB) calculated as TL- T, ear length (E), and hind foot length without claw (HF). TL and T were measured using a stainless steel scale to the nearest 0.5 mm, and E and HF were determined with Mitsutoyo digital calipers to the nearest 0.1 mm. Specimens were then dissected and voucher specimens were fixed and kept in 75% ethanol. Intestine and liver samples were kept in ethanol separately for helminthological and DNA examination. The voucher specimens of the mammals and birds were deposited at the Shaanxi Institute of Zoology, Xian. The registration numbers of the Kyoto University Museum, Kyoto, Japan (KUZ), were also provided for each specimen. In the present paper, we refer to the KUZ number. The skulls of all specimens were cleaned in the laboratory at Shaanxi Institute of Zoology. Each specimen was identified based on a combination of external, cranial, and dental characteristics. We followed Wilson & Reeder (2005) and Smith & Xie (2005) for species taxonomy. For identification, we referred to the morphological information provided by Feng *et al.* (1986), Li (1989), Huang *et al.* (1995), Luo *et al.* (2000), and Smith & Xie (2005).

Results and Discussion

We collected a total of 78 small mammal specimens classified into two orders, four families, and nine species as follows.

***Allactaga sibirica* (Forster, 1778)**

Mongolian five-toed Jerboa (Fig. 2A)

Order Rodentia, Family Dipodidae, Subfamily Allactaginae

Two specimens were collected from Delingha (M11018, M11019: 37°21.5′ N, 97°18.3′ E, 2,990 m a.s.l.) in desert habitat. Of the two, one specimen (M11018) was found as a dried carcass. Measurements of M11019 were as follows: BW 120.0, HB 154.0, T 206.0, E 46.1, and HF 71.4. M11019 was female, collected on 29 July 2009, and had five pairs of nipples. This species is widely distributed throughout northern China as well as Kazakhstan, Russia, Turkmenistan, and Mongolia (Holden & Musser, 2005; Smith, 2008*a*).

***Dipus sagitta* (Pallas, 1773)**

Northern three-toed Jerboa (Fig. 2B)

Order Rodentia, Family Dipodidae, Subfamily Dipodinae

Three female specimens were collected from Geermu (M11027–M11029: 36°22.2′ N, 95°00.5′ E, 2,830 m a.s.l.) in desert habitat. Measurements were as follows: BW 83.5, 66.0, 93.5, HB 131.0, 125.0, 153.0, T 179.0, 175.0, 175.0, E 20.3, 20.6, 19.3, and HF 64.6, 65.1, 64.6. This species is widely distributed throughout northern China, and extends into Iran and the Caucasus in the west (Smith, 2008*a*). Smith (2008*a*) commented that this species generally inhabits elevations of 1,000 to 1,300 m a.s.l. but can be found as high as 3,000 m a.s.l. (in the Altai). Geermu is considered another high-elevation location for this species.

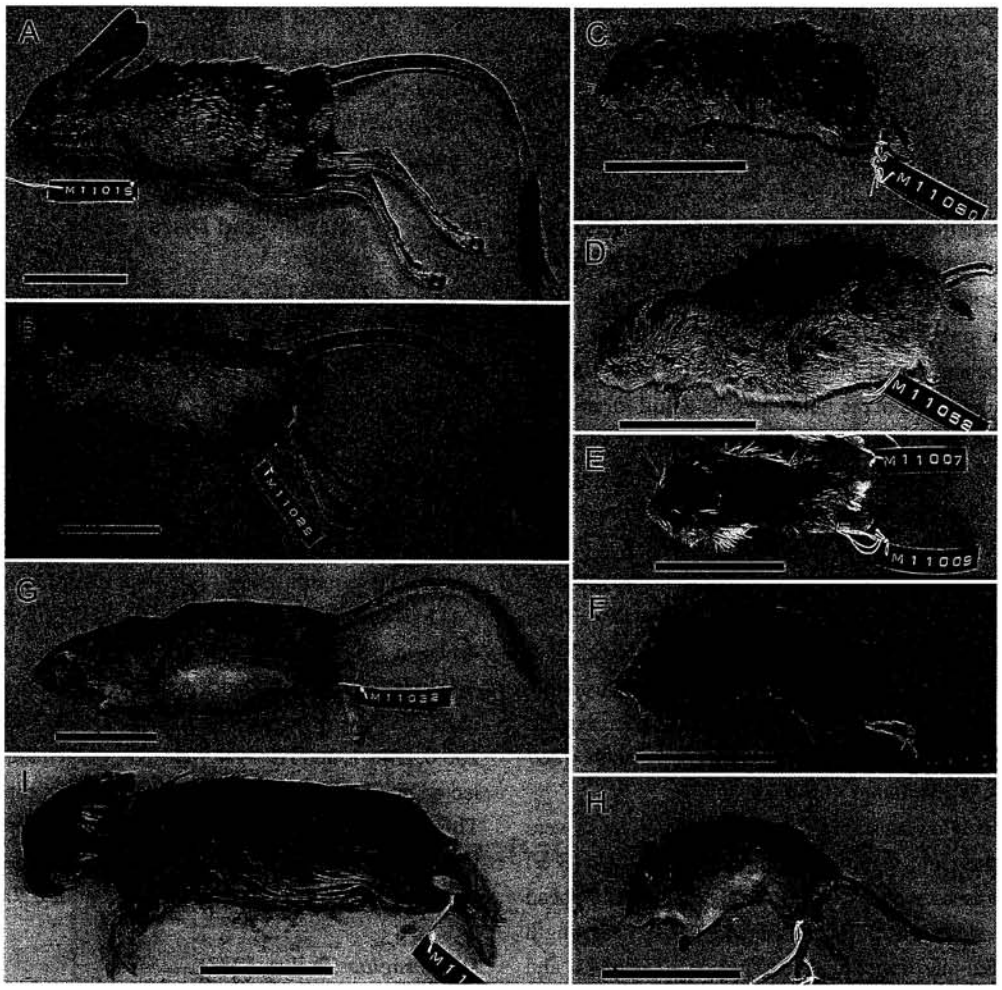

Fig. 2. Small mammals collected in Qinghai Province, China. A: *Allactaga sibirica* (M11019), B: *Dipus sagitta* (M11029), C: *Alticola stoliczkanus* (M11080), D: *Neodon irene* (M11058), E: *Phodopus roborovskii* (M11009), F: *Cricetulus longicaudatus* (M11011), G: *Meriones meridianus* (M11032), H: *Mus musculus* (M11056), and I: *Ochotona curzoniae* (M11050). Scale bars indicate 50 mm.

***Alticola stoliczkanus* (Blanford, 1875)**

Stoliczka's mountain vole (Fig. 2C)

Order Rodentia, Family Cricetidae, Subfamily Arvicolinae

Only one male specimen was collected from Wudaoliang (M11080: 35°11.5′ N, 93°04.3′ E, 4,630 m a.s.l., near Wudaoliang Station of Qingzang Railway or Qinghai–Tibetan Railway). Dental characters agreed with the previous descriptions (Feng *et al.*, 1986; Li, 1989; Huang *et al.*, 1995; Luo *et al.*, 2000) in that M^3 character is the most important. As shown in Fig. 3A, M^3 of the specimen has two salient folds on the lingual side (a and b), and three salient folds (c, d, and e) on the labial side (c, d, and e), and developed posterior heel (arrow); the distance between the anterior two salient folds on the labial side (c and d) is very small, so that the first reentrant fold between them becomes very narrow and shallow. In this specimen, the third salient fold (e) on the labial side is less developed than previously reported and this may be related to the

considerable variation in length and shape of the posterior heel (Zheng, 1979; Feng *et al.*, 1986). Measurements were as follows: BW 36.2, HB 103.0, tail broken, E 14.8, and HF 17.6. This species is distributed in the Qinghai–Tibetan Plateau (Xizang and south Xinjiang) and adjoining high mountain regions of Qinghai and Gansu, extending into north India and Nepal (Lunde, 2008).

***Neodon irene* (Thomas, 1911)**

Irene's mountain vole (Fig. 2D)

Order Rodentia, Family Cricetidae, Subfamily Arvicolinae

Twenty specimens were collected from Butongquan (M11003: 35°30.1′ N, 93°54.0′ E, 4,590 m a.s.l.), Xidatang (M11054, M11057, M11058: 35°44.4′ N, 94°17.5′ E, 4,140 m a.s.l.), and Wudaoliang (M11064–M11079: 35°13.0′ N, 93°04.2′ E, 4,220 m a.s.l.). The enamel patterns of the molars are shown in Fig. 3B. The third upper molar has three salient folds on the lingual side (a, b, and arrow) and the third (arrow) is well developed; it is different from *N. sikimensis* with four salient folds, a congeneric species previously confused with *N. irene* (Luo *et al.*, 2000). The first lower molar has five salient folds on the lingual side (c, d, e, f, g) different from *N. sikimensis* with six salient folds (Luo *et al.*, 2000). Tail was very small and bicolored in our *N. irene* (Fig. 2) different from monocolored *Phaiomys leucurus*, a vole species with similar morphology and overlapping distribution with *N. irene* (Luo *et al.*, 2000; Lunde, 2008). Measurements (means and ranges) were as follows: BW 34.5 (22.8–63.6), HB 108.5 (95.0–134.0), T 27.4 (24.0–33.0), E 11.5 (9.3–15.3), and HF 18.7 (17.3–19.9). One female specimen collected from Wudaoliang on 7 August 2009 had four embryos, each measuring 5.7 x 5.6 mm. This species is distributed in the high mountains of east Qinghai, south Gansu, west Sichuan, northeast Xizang, and northwest Yunnan (Lunde, 2008).

***Phodopus roborovskii* (Satunin, 1903)**

Desert hamster (Fig. 2E)

Order Rodentia, Family Cricetidae, Subfamily Cricetinae

Two female specimens were collected from Butongquan (M11007, M11009: 35°30.1′ N, 93°54.0′ E, 4,580 m a.s.l.). This is probably the first record of this species from the Qinghai–Tibetan Plateau, south of the Kunlun Mountains. Measurements were BW 18.6, 21.2, HB 77.0, 79.5, T 8.0, 10.5, E 12.5, 12.1, and HF 11.7, 12.9. One specimen (M11009) collected on 23 August 2007 had two embryos. Cheek pouches of both specimens contained plant seeds (Fig. 4). This species is distributed across northern China, extending to Mongolia, Russia, and Kazakhstan (Smith & Hoffmann, 2008). The genus *Phodopus* includes two species, and another species *P. campbelli* is distinguished from *P. roborovskii* in having larger body size and not distributed in Qinghai Province (Smith & Hoffmann, 2008).

***Cricetulus longicaudatus* (Milne-Edwards, 1867)**

Long-tailed dwarf hamster (Fig. 2F)

Order Rodentia, Family Cricetidae, Subfamily Cricetinae

Two specimens were collected from Fenghuoshan (M11011: 34°51.3′ N, 92°57.0′ E, 4,600 m a.s.l.) and Xiushuihe (M11014: 34°58.5′ N, 92°58.3′ E, 4,590 m a.s.l.). In Qinghai Province, *C. longicaudatus* has been confused with *C. kamensis*, but it is distinguished from the latter in having shorter tail (*e.g.*, Li, 1989). Measurements were as follows: BW 23.6, 23.6, HB 91.0, 99.0, T 29.0, 28.0, E 14.2, 15.1, and HF 16.0, 15.1. This species is distributed in north-central China, extending to Kazakhstan and Russia (Smith & Hoffmann, 2008). The cheek pouches of both specimens contained carabid beetles (*Pterostichus gebleri* Dejean, 1828) and unidentified invertebrate remains (the arrow in the figure indicates a peanut used as bait) in the former and plant seeds in the latter (Fig. 4).

***Meriones meridianus* (Pallas, 1773)**

Mid-day gerbil (Fig. 2G)

Order Rodentia, Family Muridae, Subfamily Gerbillinae

Ten specimens were collected from Delingha (M11020: 36°25.0′ N, 94°25.2′ E, 2,790 m a.s.l.) and Geermu (M11021–M11025: 36°25.5′ N, 94°22.0′ E, 2,800 m a.s.l.; M11030–M11033: 36°22.2′ N, 95°00.5′

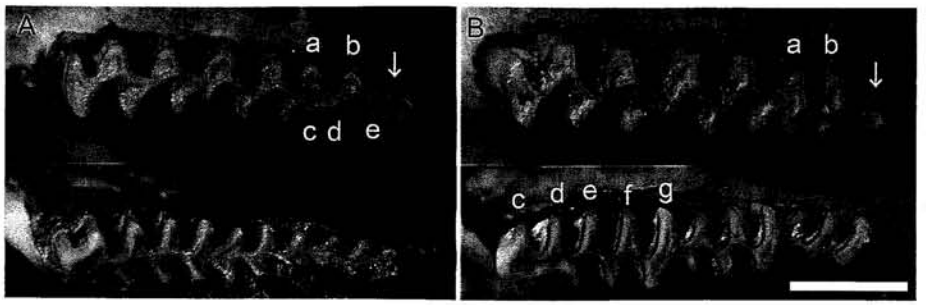

Fig. 3. Upper molars (above) and lower molars (below) of *Alticola stoliczkanus* (A: M11080) and *Neodon irene* (B: M11068). Scale bars indicate 2 mm.

E, 2,830 m a.s.l.) in desert habitat. Measurements (means and ranges) were as follows: BW 72.7 (27.0–104.0), HB 139.6 (90.0–156.0), T 116.2 (95.0–126.0), E 16.0 (12.2–20.2), and HF 32.0 (29.7–33.7). This species is distributed in north-central and northwest China, extending to Mongolia, Afghanistan, Iran, and the Caucasus region (Smith & Lunde, 2008).

***Mus musculus* Linnaeus, 1758**

House mouse (Fig. 2H)

Order Rodentia, Family Muridae, Subfamily Murinae

Seven specimens were collected from Wulan (M11017: 36°55.4′ N, 98°28.1′ E, 2,970 m a.s.l.) and Xidatang (M11002, M11036, M11055, M11056, M11060, M11061: 35°44.4′ N, 94°18.0′ E, 4,190 m a.s.l.). All specimens were collected within or near human houses. Only one specimen (M11002) could be weighed and was 26.2 g including embryos (see below), while the remaining six specimens were caught using glue board traps and could not be weighed. Measurements (mean and range) were as follows: HB 91.4 (80.0–102.0), T 69.7 (63.0–76.5), E 13.1 (11.7–14.7), and HF 16.6 (14.9–17.7). Two female specimens collected from Xidatang on 23 August 2007 (M11002) and 5 August 2009 (M11055) had four and five embryos, respectively; embryos in the latter measured 20.6 × 12.4 mm each. This species is currently distributed worldwide through its close association with humans (Musser & Carleton, 2005). Five subspecies are recognized (Musser & Carleton, 2005) based on morphological and genetic characteristics. Specimens collected from Wulan and Xidatang were identified as *M. musculus musculus* based on coloration and external measurements, but further genetic studies are required to confirm the subspecies identification.

***Ochotona curzoniae* (Hodgson, 1858)**

Plateau pika (Fig. 2I)

Order Lagomorpha, Family Ochotonidae

Thirty-four specimens were collected from Haian at road mark 126 km (M11016: 37°03.5′ N, 100°41.0′ E, 3,430 m a.s.l.), Xidatang (M11037–M11040: 35°45.0′ E, 94°18.0′ E, 4,170 m a.s.l.; M11053: 35°44.4′ N, 94°17.5′ E, 4,140 m a.s.l.; M11059: 35°44.4′ N, 94°18.0′ E, 4,130 m a.s.l.), Kunlunshankou (M11001: 35°40.5′ N, 94°03.0′ E, 4,670 m a.s.l.; M11042–M11048, M11062: 35°42.4′ N, 94°03.0′ E, 4,560 m a.s.l.; M11050–M11052: 35°42.4′ N, 94°02.5′ E, 4,570 m a.s.l.), Butongquan (M11004, M11006: 35°30.1′ N, 93°54.0′ E, 4,590 m a.s.l.), Kekexili No. 2 Bridge at road mark 2,987 km (Butongquan–Wudaoliang, M11094–M11097: 35°17.2′ N, 93°15.3′ E, 4,570 m a.s.l.), Xiushuihe (M11012: 34°58.5′ N, 92°58.3′ E, 4,600 m a.s.l.), Xiushuihe–Fenghuoshan at road mark 3,060 km (M11083–M11085: 34°48.1′ N, 92°34.1′ E, 4,660 m a.s.l.), Fenghuoshan (M11081, M11086: 34°41.1′ N, 92°54.0′ E, 4,900 m a.s.l.), near Tuotuohe at road mark 3,143 km (M11087–M11089: 34°17.3′N, 92°30.0′ E, 4,580 m a.s.l.). Measurements for 32 specimens were BW 120.0 (30.0–180.0), TL 172.9 (111.0–213.0), E 18.4 (13.3–29.3), and HF 28.8 (21.6–36.3). This species is distributed in the Qinghai–Tibetan Plateau of south Xinjiang, Qinghai, Xizang, and west Sichuan, extending into north Nepal and north India

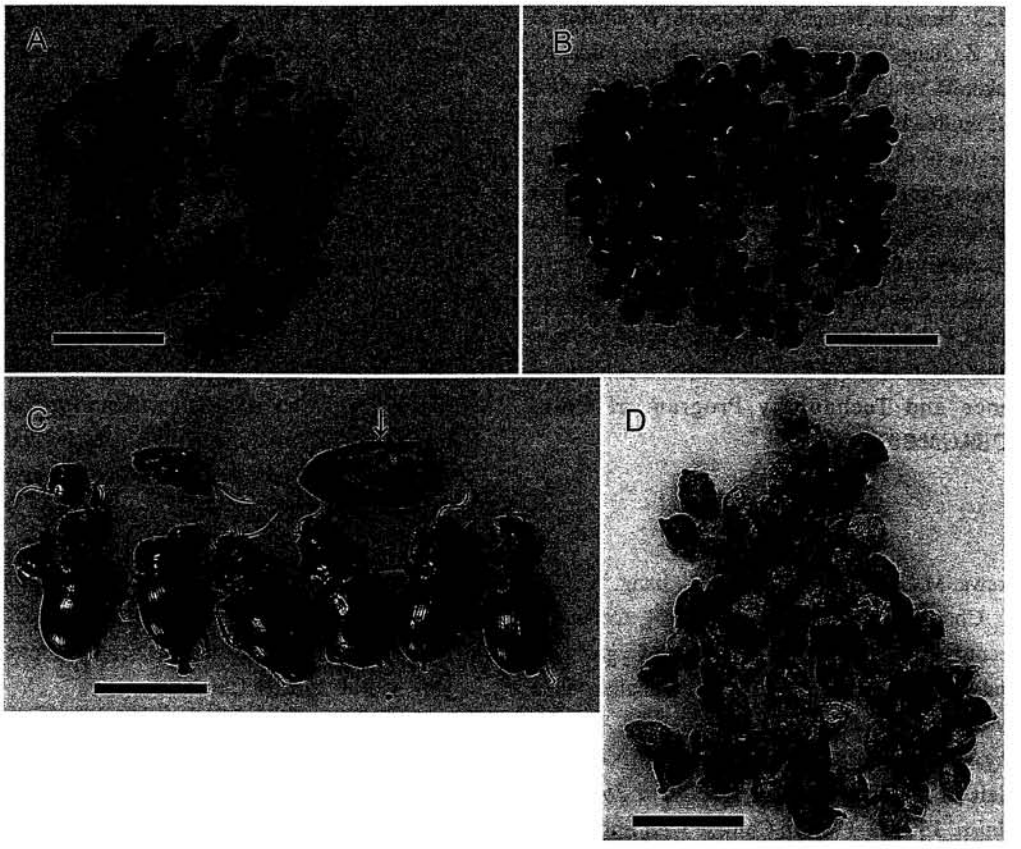

Fig. 4. Contents of the cheek pouches of *Phodopus roborovskii* (A: M11007, B: M11009) and *Cricetulus longicaudatus* (C: M11011, D: M11014). Scale bars indicate 10 mm. The arrow indicates a peanut used as bait.

(Smith, 2008*b*).

Biogeography

All species collected in Qinghai Province, with the exception of the cosmopolitan species *Mus musculus*, showed roughly two distribution patterns: restricted to the Qinghai–Tibetan Plateau, sometimes extending to the border of Sichuan and Yunnan provinces and the Himalayan region (*Alticola stoliczkanus*, *Neodon irene*, and *Ochotona curzoniae*), and a wide distribution throughout northern China, extending into Russia and neighboring countries (*Allactaga sibirica*, *Dipus sagitta*, *Phodopus roborovskii*, *Cricetulus longicaudatus*, and *Meriones meridianus*). It is interesting that the localities of this study had a combination of fauna endemic to the plateau and northern China fauna, but number of collected species is not enough to further discuss the biogeography and origin of Qinghai fauna. Future fieldwork for collecting more species and specimens and detailed phylogeographic, systematic and molecular studies are required. Published faunal and distribution data of small mammals from the related areas, such as Xinjiang Uygur Autonomous Region, Xizang Autonomous Region, and Gansu Province (*e.g.*, Zheng, 1979; Wang & Yang, 1983; Feng *et al.*, 1986; Ma *et al.*, 1987; Li, 1989; Wang, 1991; Asakawa *et al.*, 2001), should also be reevaluated and synthesized with re-identification of voucher specimens.

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References

Asakawa, M., Hagiwara, K., Liao, L., Jiang, W., Yan, S., Chai, J., Oku, Y. & Ito, M., 2001. Collection record of small mammals in Xinjiang-Uygur, 1998 and 1999 with brief review of its mammalian fauna. *Biogeography*, **3**: 13–31.

Chang, C. & Wang, T., 1963. Faunistic studies of mammals of the Chinghai Province. *Acta Zoologica Sinica*, **15**: 125–138. (In Chinese with English abstract).

Chang, C. & Wang, T., 1964. Taxonomic study of mammals in Qinghai–Gansu area. *In* Chinese Academy of Science Qinghai Gansu General Survey Team (Ed), *Report of the Mammal Survey in Qinghai and Gansu*: 1–7. Science Press, Beijing, P. R. China. (In Chinese).

Chang, C., Wang, T., Chen, X., Lin, Y. & Ye, X., 1962. Faunistic study of mammals and birds from Huangshui He Gu, Qinghai Province. *Acta Zoologica Sinica*, **14**: 63–73. (In Chinese with Russian abstract).

Chang, Y., Chang, C. & Wang, Z., 1964. On the dividing of zoogeographical regions based on studies of the mammalian fauna of the Ching-Kan region. *Acta Zoologica Sinica*, **16**: 315–321. (In Chinese with English abstract).

Feng, Z., Cai, G. & Zheng, C., 1986. *The Mammals of Xizang*. Science Press, Beijing, China. (In Chinese).

Holden, M. E. & Musser, G. G., 2005. Family Dipodidae. In Wilson, D. E. & Reeder, D. M. (Eds), *Mammal Species of the World: A Taxonomic and Geographic Reference, Third Edition*: 871–893. Johns Hopkins University Press, Baltimore, U.S.A.

Huang, W.-J., Chen, Y.-X. & Wen, Y.-X., 1995. *Glires of China*. Fudan University Press, Shanghai, China. (In Chinese).

Luo, Z., Chen, W. & Gao, W., 2000. *Fauna Sinica Mammalia Vol. 6 Rodentia Part III: Cricetidae*. Science Press, Beijing, China. (In Chinese).

Li, D. H. (Ed.), 1989. *Qinghai Fauna Economica*. Qinghai People's Press, Xining, China. (In Chinese).

Lunde, D., 2008. Subfamily Arvicolinae. In Smith, A. T. & Xie, Y. (Eds), *A Guide to the Mammals of China*: 214–239. Princeton University Press, Princeton, U.S.A.

Ma, Y., Wang, F., Jin, S. & Li, S., 1987. *Glires (Rodents and Lagomorphs) of Northern Xinjiang and Their Zoogeographical Distribution*. Science Press, Beijing, P. R. China (In Chinese).

Musser, G. G. & Carleton, M. D., 2005. Superfamily Muroidea. In Wilson, D. E. & Reeder, D. M. (Eds), *Mammal Species of the World: A Taxonomic and Geographic Reference, Third Edition*: 894–1531. Johns Hopkins University Press, Baltimore, U.S.A.

Smith, A. T., 2008*a*. Family Dipodidae. In Smith, A. T. & Xie, Y. (Eds), *A Guide to the Mammals of China*: 198–207. Princeton University Press, Princeton, U.S.A.

Smith, A. T., 2008*b*. Order Lagomorpha. In Smith, A. T. & Xie, Y. (Eds), *A Guide to the Mammals of China*: 275–292. Princeton University Press, Princeton, U.S.A.

Smith, A. T. & Hoffmann, R. S., 2008. Subfamily Cricetinae. In Smith, A. T. & Xie, Y. (Eds), *A Guide to the Mammals of China*: 239–247. Princeton University Press, Princeton, U.S.A.

Smith, A. T. & Lunde D., 2008. Subfamily Gerbillinae. In Smith, A. T. & Xie, Y. (Eds), *A Guide to the Mammals of China*: 247–252. Princeton University Press, Princeton, U.S.A.

Smith, A. T. & Xie, Y., 2008. *A Guide to the Mammals of China*. Princeton University Press, Princeton, U.S.A.

Wang, S. & yang, G., 1983. *Rodent Fauna of Xinjiang*. Xinjiang People's Publishing House, Wulumuqi, P. R. China. (In Chinese).

Wang, X., 1991. *Vertebrate Fauna of Gansu*. Gansu Science and Technology Publishing House, Lanzhou, P. R. China (In Chinese).

Wilson, D. E. & Reeder, D. M., 2005. *Mammal Species of the World: A Taxonomic and Geographic Reference. Third Edition*. The Johns Hopkins University Press, Baltimore, U.S.A.

Zhang, G., 1983. The rodent of Hainan District Qinghai Province. Acta Theriologica Sinica, **3**: 195–196. (In Chinese).

Zhang, G., 1985. Mammal survey of Hainan Area, Qinghai Province. *Zoological Magazine*, **20** (4): 13–16. (In Chinese)

Zhang, Y. (Ed.), 1997. *Distribution of Mammalian Species in China*. China Forestry Publishing House, Beijing, China.

Zheng, C., 1979. Xizang Ali mammalian faunal research and preliminary discussion on the Qingzang Gaoyuan mammalian faunal changes. In Institute of Biology, Qinghai Province (Ed), *Survey Report of animals and plants from Xizang Ali Area*: 191–227. Science Press, Beijing, P. R. China. (In Chinese).

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