
SHORT COMMUNICATIONS

Spatial Distribution of *Marmota baibacina* and *M. sibirica* (*Marmota*, Sciuridae, Rodentia) in a Zone of Sympatry in Mongolian Altai: Bioacoustic Analysis

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Abstract—The spatial distribution of two marmot species *Marmota baibacina* and *M. sibirica* in a zone of coexistence was studied by using their alarm call as a diagnostic trait. It was found that *M. baibacina* prefers to inhabit bouldery screes, whereas *M. sibirica* inhabits all suitable biotopes. The difference in biotopic distribution of these species could be explained by *M. sibirica* forcing *M. baibacina* out of optimum habitats. Cases of coexistence of both species in one family group sites were registered, which might contribute to the appearance of hybrids.

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The gray or Altai marmot (*Marmota baibacina* Kastschenko, 1899) and the tarbagan or Mongolian marmot (*M. sibirica* Radde, 1862) both have extensive natural habitats, which overlap in the Mongolian Altai. Earlier studies delineated the area of coexistence of these two species in the upper reaches of the Buyant River and the Bulgan River basin and found traces of their hybridization (Smirin et al., 1985; Formosov, Nikol'sky, 1986). The mechanisms responsible for the preservation of these two species in spite of their hybridization are of interest. As was shown with the ground squirrels of the *Spermophilus* genus, the spatial distribution of different species governed by the biotope characteristics determines the degree of segregation of sympatric species (Titov et al., 2006). The biotopic distribution of the gray and Mongolian marmots in the zone of overlapping of their habitats was studied earlier (Smirin et al., 1985; Rogovin, 1992). The alarm call was used in these studies for identification of the species apart from the morphological traits (Smirin et al., 1985; Formosov, Nikol'sky, 1986). Taking into account the fact that the external differences between *M. baibacina* and *M. sibirica* are not sufficiently distinct, the use of the alarm call allows us to determine reliably the species of a large number of animals without taking them out of their natural habitat. This paper gives the preliminary results of studying the spatial distribution of two species of marmots in a sympatry zone. The study was based on determining the specific characteristics of the alarm calls of the two species, recorded during the Joint Russian–Mongolian Complex Biological Expedition of the Russian

Academy of Sciences and the Mongolian Academy of Sciences devoted to the study of marmots.

EXPERIMENTAL

The alarm call of marmots was recorded in the field conditions using a Marantz-PMD660 digital tape-recorder (Japan) and an Audio-Technica AT897 condenser microphone (Japan) in the noncompressed digital format Wave (WAV) with the discredit frequency 48 kHz. The acoustic reaction was provoked by a man standing at a distance from the animal or moving slowly towards him. The coordinates of the whereabouts of the animals were determined using a GPS-navigator (JJ-connect, Russia). The main criterion for including the recording into the analysis was the quality of the phonogram. The total number of analyzed recordings was from 69 marmots from the sympatry zone of *M. baibacina* and *M. sibirica* in the Mongolian Altai in the upper reaches of the Ulagchin-Gol River (the left tributary of the Bulgan River), which were made from June 20 to July 7, 2008, over an area of 25 km² with the coordinates of the central point 47°27'31" n.l. 90°52'40" e.l.

The acoustic characteristics of the alarm call were analyzed using the SpectraLab 4.32.17 program. Time and frequency characteristics were used as species-specific indicators of *M. baibacina* and *M. sibirica*, which were described earlier (Nicol'sky, 1976, 1984): the presence or absence of a pause between the low- and high-frequency components of the alarm call and

the character of the high-frequency component modulation.

The spatial distribution of marmots in the sympatry zone was analyzed using an satellite images of 30 Mpixels provided in open access by Google (United States) and topographic maps of the 1 : 20000 and 1 : 10000 scale on which points were plotted of the whereabouts of animals with indication of the species identified by their alarm call.

RESULTS AND DISCUSSION

The alarm call of the gray marmot differs from that of the tarbagan by a pause between the low- and high-frequency components. The characteristics of the frequency modulation of the high-frequency component of the tarbagan's call are usually symmetrical while for the gray marmot the final frequency of this element is significantly higher than the initial one. In addition, in most cases, there are lateral frequencies in the spectrum of the Mongolian marmot alarm call, higher and lower than the carrier frequency, caused by the amplitude modulation of the carrier frequency (Nikol'sky, 1976, 1984, 2007).

An analysis of the spectral components of the marmot alarm calls in the sympatry zone (the upper reaches of the Ulagchin-Gol River) allowed us to identify the species of 66 animals, from which 52 were classified as *M. sibirica* and 14 as *M. baibacina*. The alarm calls of these animals do not differ in the structure of the spectrum from individuals from other populations living outside the contact zone (Fig. 1). The calls of three animals were excluded from the analysis because difficulties arose in their identification associated with the uncertainty of the characteristics of their calls. The difference of these specimens can be explained by individual variability or possible hybrid descent of the individuals and might require additional research.

An analysis of the spatial distribution of the identified individuals showed that most calls of gray marmots were registered in rock outcrops with bouldery screes (Fig. 2). The calls of tarbagans, on the contrary, were registered in all biotopes of the studied area. The height distribution of gray marmots is characterized by their localization in the upper half of the slopes. Most probably, it reflects the pattern of the bouldery screes. It should be noted that one of the two gray marmots registered at the foot of the slope (Fig. 2a) was situated in a similar biotope. We encountered the calls of tarbagans in all mountainous areas, from a valley bottom to the crests of mountain ridges.

The biotopic and height distribution of *M. baibacina* and *M. sibirica* in the contact zone, namely, in the upper reaches of the Ulagchin-Gol River, was discussed by other authors (Smirin et al., 1985; Formosov, Nikol'sky, 1986; Rogovin, 1992). The distribution pattern of these two species described by them differs slightly from the one we discovered.

They also note that bouldery screes are the preferential habitat of *M. baibacina*. The tarbagan was found by them to inhabit mostly bottoms of valleys and not venture onto the slopes of mountain ridges (Smirin et al., 1985). Our observations showed that in the upper reaches of the Ulagchin-Gol River, the tarbagan occupies almost all suitable stations, including the bouldery screes and plateaus, climbing higher than 3000 m above sea level (Fig. 2a). It should be noted that such eurytopicity is characteristic of the tarbagan from the Gobi Altai and other parts of the Mongolian Altai, outside the zone of contact with the gray marmot. This fact was mentioned by both Smirin et al. (1985), who referred to previous studies and their own observations, and Rogovin (Rogovin, 1992). We also observed tarbagan stations in bouldery screes on the slopes of Mount Ih-Bogdo (Gobi Altai). On the other hand, it is difficult to agree that the gray marmot inhabits the same stations in the sympatry zone as in the zones where it is the only species in the Mongolian Altai (Smirin et al., 1985), i.e., the crests and slopes of dividing ridges with preference given to bouldery screes. We observed stations of gray marmots 22 km to the north of Ulguii (the center of the Bayak-Ulguii aimak, Mongolia) on sandy and pebbly slopes, covered with caragana, on the slopes of Mount Galan (25 km to the south of the Tsagaanuur settlement in the Bayan-Ulguii aimak) situated both at the foot of the mountain and on the dividing plateaus with fine (melkozem) and pebbly soils, and at the bottom of river valleys on the Sailugem ridge in the vicinity of the Kosh-Agach settlement. Apparently, the opportunities for occupying various biotopes outside the sympatry zone do not differ significantly for *M. sibirica* and *M. baibacina*. The biotopic separation of these two species in the zone where their habitats overlap allows us to presume the existence of competition between them. Smirin et al. (1985) and Rogovin (Rogovin, 1992) believe that the gray marmot possesses a higher degree of competitiveness and restricts the habitation of the tarbagan in the sympatry zone to the bottom of river valleys. Our study, on the contrary, revealed that the tarbagan ousts the gray marmot, rather than vice versa, and limits its expansion to bouldery screes.

Based on the results of previous studies, the possibility of contacts between individuals of *M. sibirica* and *M. baibacina* (Smirin et al., 1985; Formosov, Nikol'sky, 1986) had not been excluded but no coexistence of the two species had been registered previously. However, we found areas of coexistence of tarbagans and gray marmots within the confines of the studied area (Fig. 2b). Animals of both species were noted to live on the territory belonging to one family. In our case, such territories are situated in recesses of mountain slopes, covered with bouldery screes. A marmot with the alarm call of *M. baibacina* was registered at the foot of the slope on the bank of a stream next to family groups of *M. sibirica* (Fig. 2b). It is known that marmots do not

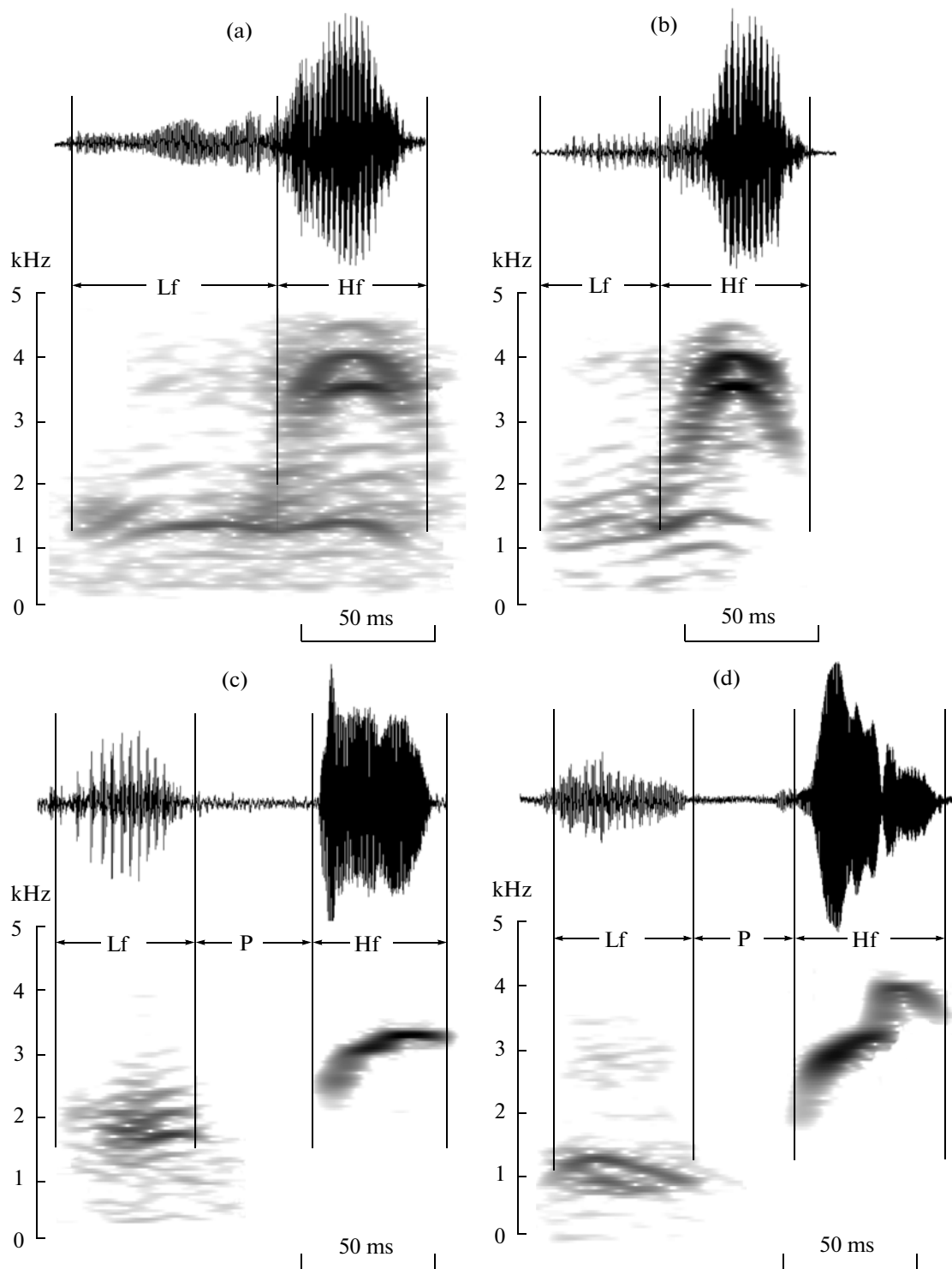


Fig. 1. The main characteristics of the alarm call: (a)- *Marmota sibirica* from a population outside the zone of sympatry (Tarbagatai crest, Hangai, Arhangai aimak, Mongolia), (b) *M. sibirica* from the sympatry zone (Ulagchin-Gol, Mongolia), (c) *M. baibacina* from outside the sympatry zone (Altaiiskii Krai, Krasnogorskii district, the outskirts of the village of Berezovka), (d) *M. baibacina* from the sympatry zone (Ulagchin-Gol). Lf—low-frequency component of the call, Hf—high-frequency component, P—pause between them.

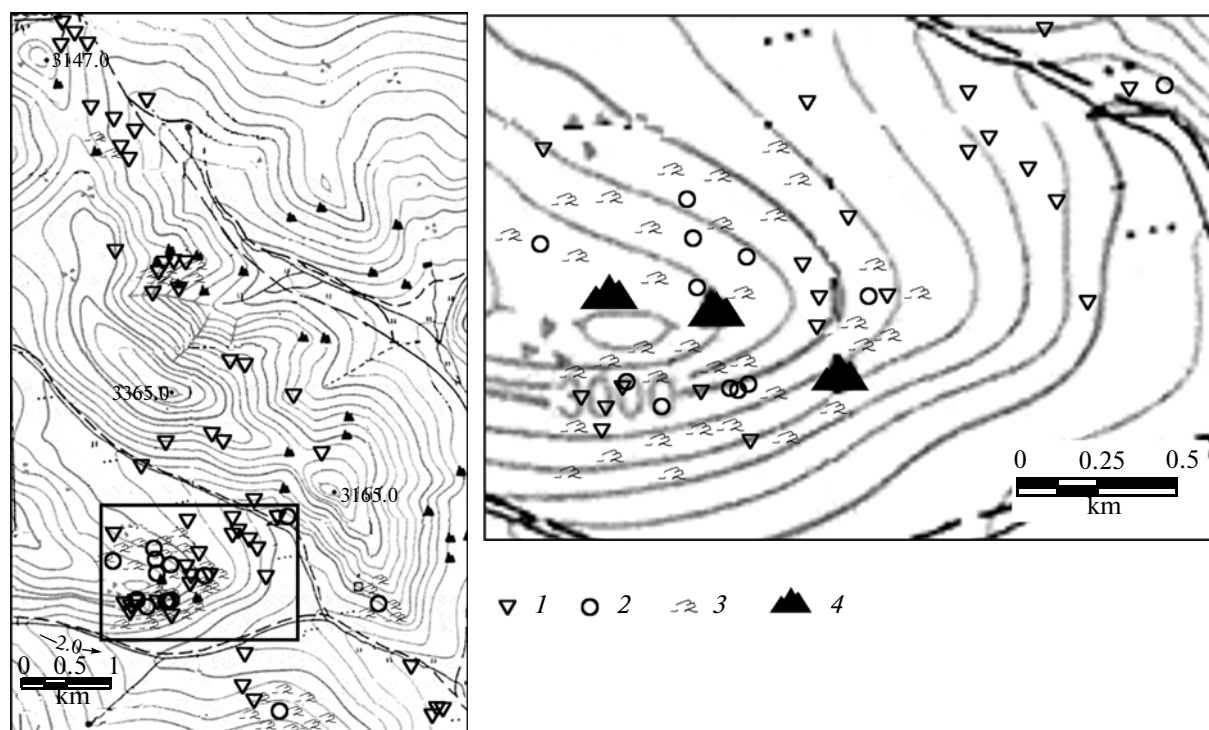


Fig. 2. The places where the alarm call of the two species of marmot was recorded in the upper reaches of the Ulagchin-Gol River: (a) the area studied (the framed area shows the area of the coexistence of the two marmot species), (b) the area of coexistence of gray marmots and tarbagans. (1) *M. sibirica*, (2) *M. baibacina*, (3) bouldery screes, (4) rocks.

tolerate individuals that do not belong to their family group and yet venture into their territory (Mashkin, Baturin, 1993; Mashkin, 1997). We did not observe any aggressive behavior between gray marmots and tarbagans inhabiting one territory. It can be conjectured that individuals of different species coexisting on one territory belong to mixed family groups, which increases considerably the possibility of hybridization.

In conclusion, it should be noted that despite the fact that the described area of overlapping habitats of the gray and Mongolian marmots is relatively large, the character of the coexistence of these two species and their hybridization has been studied on a limited area in the upper reaches of the Ulagchin-Gol River. Evidently, in the future, it would be expedient to conduct similar research in other areas of the sympatry zone in order to reveal the processes that take place in it. Taking into account considerable difficulties of identifying these two species of marmots by the coloring and structure of their fur during the summer molt, which lasts here on average from the end of May to mid-July, the alarm call seems a promising diagnostic tool.

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