

## Species and subspecies of *Alticola* s.str. (Rodentia: Arvicolidae)

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**Abstract:** Classification of vole subgenus *Alticola* s.str. is revised. The following species are recognized: *roylei*, *montosus*, *albicaudus* (all monotypic), *argentatus* (with 9 subspecies), *tuvincus* (with 3 subspecies), *semicanus* (with 2 subspecies), *barakshin* (monotypic), *stoliczkanus* (with 3 subspecies). Species and subspecies recognized by the authors are characterised morphologically, geographically, taxonomically. A new subspecies of *A. argentatus* from S Kirgizia is described. A phylogenetic hypothesis is outlined to explain similarity and distribution patterns of recent species, and unclear points in *Alticola* taxonomy are briefly reviewed.

The taxonomic situation in the nominative subgenus *Alticola* s. str. did not gain close attention of vole experts during several decades. Apart from its appearance in a number of faunistic monographs, which was self-evident but did not mean any radical advancement in the taxonomy of *Alticola*, there were very few papers where this group was specially investigated.

The first to be mentioned here was the outstanding Hinton's (1926) revision; but this author was a great "splitter" (from the modern viewpoint) and his system of 12 species is now outdated. Another was the more recent extensive paper written in the framework of "populationistic" tradition (Geptner & Rossolimo 1968). The senior author of that publication was a great "lumper", so subgenus *Alticola* s.str. was established as monotypic. These opposite solutions were compromised by those "moderate" systems in which the subgenus in question contained two to three species (e.g. Ellerman & Morrison-Scott 1951; Gromov & Poljakov 1977; Corbet 1978; Honacki *et al.* 1982).

But these solutions remained more or less formal because they were not based on direct investigation of comparative material good enough to allow discriminating species differences from within-species variation.

Taking into account all these facts, we made an attempt to revise the taxonomy of *Alticola* s. str. on the basis of as extensive material as possible processed by modern multivariate techniques. We were lucky to gather, in one place at one time, very large sample from the whole range of this subgenus, almost all forms described in it were represented by type material. And this made it possible to understand more clearly the nature of taxonomic differentiation of these voles.

Some results of our work have already been published elsewhere (Rossolimo & Pavlinov 1986; Rossolimo *et al.* 1988; Rossolimo 1989a,b). Here we shall try to put them all together with previously unpublished data, to present formal classification of

subgenus *Alticola* s. str., and to show those problems which we were unable to resolve.

We would like to thank here deeply all those persons who made our investigation possible by having lent us morphological material under their care. These are (alphabetically): R. Angermann (Natural History Museum, Berlin, Germany), M. Anděra (National Museum, Praha, ČSFR), G. Baranova (Zoo-

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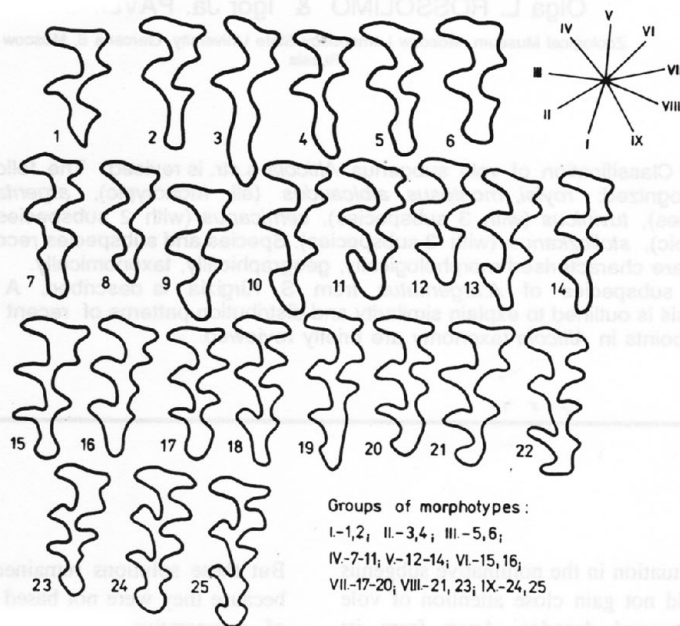


Fig. 1. Diversity of crown pattern of third upper molar in *Alticola* s.str. (very schematically). 1-25 morphotypes. Circle in the upper right corner is to show arrows identification in Fig. 2. Figure at each arrow designates a group of morphotypes.

## Material and methods

The study is based on using standard museum skin and skull specimens. In total, we studied more than 350 specimens which were grouped in 63 samples (see Appendix). In numerical analysis we used 37 measurements, of which 4 are external, 19 are cranial and 14 are dental. Standard statistics was used and principal component analysis was conducted using character mean values calculated for the samples. Visual analysis of body color was also used. Original numerical data are not shown here because of limits and aims of the paper (they are available from the authors).

The following protocol was accepted in our analysis. First we analysed samples on regional basis - those from Mongolia and S Siberia, from Tien Shan and Pamir, and those from Hindukush, Himalayas and Tibet. Thereafter we made pairwise comparisons of forms identified at first step as separate entities. As a result, we obtained a number of groups of samples which were separable from each other by measurable characters with more or less significant gaps. Then this classification was compared with that obtained on the basis of body color analysis, which resulted into further separating our material into morphologically uniform groups.

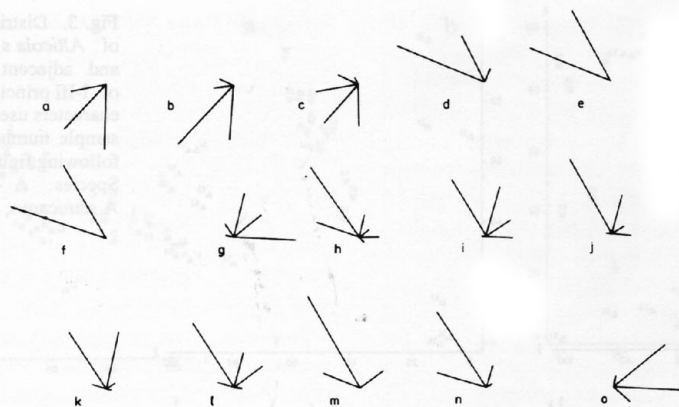


Fig. 2. Morphotype frequencies of third upper molar in selected taxa of *Alticola* s.str.: (a) *A.stoliczkanus*, (b) *A.barakshin* from Trans-Altai Gobi Desert, (c) *A.barakshin* from Mongol Altai Mts, (d) *A.semicanus alleni*, (e) *A.s.semicanus* from Khangai Mts, (f) *A.s.semicanus* from Tuva, Khan-huhei, Tarbagatai, (g) *A.tuvanicus olchonensis*, (h) *A.t.tuvanicus*, (i) *A.argentatus subluteus*, (j) *A.a.severtzovi*, (k) *A.a.tarasovi*, (l) *A.a.argentatus*, (m) *A.a.glacialis*, (n) *A.a.parvidens*, (o) *A.montosus*. For arrow identification, see Fig. 1. Arrow length: 1 mm = 1%.

From the above it becomes clear that, strictly speaking, these are not "species" that we defined in our study, but just morphologically identifiable groups of samples. They were treated as species if there were gaps, or as subspecies if there were no gaps. Of course, this is a standard classical morpho-taxonomical procedure. But we should like to stress here this point, so that it would be completely clear: we have got only morphological background for future biological investigations.

## GENERAL LOOK AT TAXONOMY OF *Alticola* s.str..

Here we describe in short those morphological features which appeared to be most useful for recognising species groups, species and subspecies of *Alticola*. Also some principal results and unclear questions to be studied more actively in the future are outlined.

### The characters

General size of body and skull, although quite variable, does not give any discrete differences. The smallest are some Himalayan species (*A.albicaudus*, *A.roylei*, *A.stoliczkanus*), the largest are *A.semicanus* and *A.tuvanicus* from Mongolia and adjacent regions

of Siberia. There are two species, *A.argentatus* and *A.semicanus*, in which geographical variation is expressed conspicuously enough to serve as one of the bases for subspecies identification.

In body proportions the most variable is tail length, which allowed to divide subgenus into two groups of taxa, long-tailed and short-tailed. However, they are not discrete, but form a continuous morphocline, where the longest tail is in *A.roylei*, *A.montosus*, *A.tuvanicus* and *A.argentatus*, followed by *A.semicanus*, while the shortest tail is characteristic of *A.stoliczkanus*, *A.barakshin* and *A.albicaudus*. In regional framework these groups are more discrete, long- and short-tailed are readily identifiable in Mongolia and in Hindukush. Within *A.argentatus* and *A.tuvanicus* tail length is of use in discriminating at least some subspecies.

Body color is also variable and is of use in many cases, at both species and subspecies level. The most evident cases where it "works" are: dividing long-tailed *Alticola* of Kashmir, with their very similar cranial characters, into three species; discriminating *A.argentatus* from *A.tuvanicus* and *A.semicanus* from other species in Mongolia; additional discrimination of short- and long-tailed groups in Hindukush. At

characters between typical *argentatus* from Pamir and representatives of Hindukush group of subspecies.

Includes *argurus* (wrongly listed under *severtzovi* previously, see Rossolimo 1989a), *alaica* and *rosanovi*. The two last forms were described from the same type locality, and it remains unclear why Ognev (1940, 1950) decided to apply another name to the already described form. To us, the original description of Rozanov (1935) seems to be valid, although the subspecies name and formal characters appeared on different and distant pages of his publication.

#### *A.a.phasma* Miller, 1912

TYPE LOCALITY. "Eastern side of Kara Korum Mts", Sin Kiang, China.

DESCRIPTION. One of the smallest, but large-headed subspecies: body length 94.50 mm (the least average value for *A. argentatus*), skull length 26.80 mm. Body color is pallid and dull above, generally gray olive on the back, with but small addition of brownish tint entirely lacking on the sides. Pale rusty tone is well expressed along borderline between dark and light coloration on body side. Belly is white. Tail moderately long (about 41 per cent of body length), densely covered with white hairs; although the body is light colored, white tail contrasts with brownish back.

The skull is smoothly outlined, rather specific in having wide interorbital constriction, long both orbit and braincase, long and narrow auditory bulla (similarly to that of *A.a.worthingtoni*). Third upper molar is rather characteristic: it is longest for the species, with talon even longest for entire subgenus because of quite elongated posterior loop (about 54 per cent of total tooth length). However, the tooth is not especially complicated: fourth labial angle, though present, not strongly prominent, while lingual one is absent or expressed only as a plane curvature of inner side of posterior loop.

Known from type locality only.

COMMENTS ON TAXONOMY. Well defined subspecies, most similar to *A.a.worthingtoni* in external and cranial characters, but third upper molar specific. Geographical neighbour of subspecies belonging to Pamir group, but morphologically (especially cranially) more resembles those of Tien Shan group. More material is needed for more detailed discussion of both taxonomic status and geographic limits.

#### *A.a.tarasovi* subsp. nov.

MATERIAL INVESTIGATED. More than 35 specimens from 5 localities in SE and E Kirghizia (USSR).

HOLOTYPE. Skin and skull male specimen No S-78278 in collection of Zoological Museum of Moscow Lomonosov University, collected by Dr. Tarasov (field number 599, May 31, 1955).

TYPE LOCALITY. Banks of Inylchek River, system of Inylchek and Sary Dzhaz Ridges, E Kirghizia, USSR.

DESCRIPTION. Size rather large: body length 103.0-111.8

mm, skull length 26.40-27.13 mm. Body color principally as in *A.a. argentatus*: it is dull pale-rusty with addition of brownish on the back, tail uniformly whitish. Skull rather angled, with relatively wide interorbital constriction but narrow braincase (a condition separating this subspecies from the nominotypical one). Auditory bulla rather short and wide (its width is 80-88 per cent of its length). Third upper molar without peculiarities, absolutely predominating are moderately complex morphotypes.

Occupies southern part of the range of Tien Shan group of subspecies: specimens are known from Alai Ridge, vicinity of Osh City, system of Inylchek - Sary Dzhaz Ridges.

COMMENTS ON TAXONOMY. In our previous publication we indicated that *A. argentatus* from southern Tien Shan could be separate subspecies, but did not formally nominate it because of inadequate material. After that time we got more specimens which confirm our supposition.

By body color this new subspecies is hardly separable from the nominotypical one. But cranially it belongs to the Tien Shan group of subspecies in which it is the largest. There is certain similarity in skull size and proportions between *A.a.tarasovi* and *A.a.subluteus* which are probably in contact in a region just east of Lake Issyk Kul. From *A.a.severtzovi* it differs in larger size and paler body color, but they probably widely intergrade in the region of Naryn Ridge in the south of Lake Issyk Kul.

#### *A.a.severtzovi* (Tikhomirov et Korchagin, 1889)

TYPE LOCALITY. Mashat, Karatau Ridge, S Kazakhstan, USSR.

DESCRIPTION. Size small to medium: body length 100.2-110.7 mm, skull length 25.87-26.72 mm. Body color generally dark, rather bright brownish, specimens from Terskei Alatau with addition of pale-rusty, in those from westernmost parts of Tien Shan mouse-gray is added. Tail moderately long to rather short for species (33-44 per cent of body length), weakly haired, dirty white entirely or slightly bicolored.

Skull with plain outlines, with short and narrow braincase (35-38 and 44-48 per cent of skull length, respectively), rather narrow auditory bulla (its width is 76-80 per cent of its length). Third upper molar long, with moderately both lengthened and complicated posterior loop which is usually elongated and evidently, though not sharply, isolated from third lingual angle by enamel curvature.

Distributed in northern, western and central parts of Tien Shan from Karatau and Zailiiski Alatau Ridges to Talass Tau and Naryn Tau Ridges. Terskei Alatau Ridge is transitional between this and the preceding subspecies.

COMMENTS ON TAXONOMY. A well defined subspecies of the Tien Shan group. From other subspecies known from Tien Shan Mts (*tarasovi*, *worthingtoni*, *subluteus*) it differs in darker body color, from *tarasovi* and *worthingtoni* also in smaller size.

Includes *leucura*, *gracilis*, *longicauda*, *villosa*, *shnitnikovi*.

DESCRIPTION OF SAMPLES OF *Alticola* s.str. USED IN NUMERICAL ANALYSIS

The below description is arranged taxonomically. Sample numeration is used in text and figures. For each sample is indicated the number of skulls (+ numbers of additional dentitions in parentheses); number of skins, as a rule, is equal to number of skulls in the samples.

*A. roylei*: 1. India, Kashmir: Kishtwar - 3; 2. India, Kashmir: Burzil - 2.

*A. montosus*: 3. India, Kashmir: Min Nai - 14(+3); 4. India, Kashmir: Palawar, Bonar Nullah, Vij Nullah - 5(+3).

*A. albicaudus*: 5. India, Ladak: Phyang Nullah - 4.

*A. argentatus blandfordi*: 6. Pakistan, Gilgit: Naltar - 3(+2). [out of sample: India, Ladak: Nun Kun - (+3)]

*A. a. parvidens*: 7. Pakistan, Dir: 16 mi N of Dir, and Swat: 6 mi SW of Utror - 8; 8. Pakistan, Dir: Tirich Mir - 11(+7).

*A. a. glacialis*: 9. India, Baltistan: Tormik, Chogo Lungma, Basha - 10(+9).

*A. a. argentatus*: 10. Afghanistan: Salang - 17; 11. Afghanistan: Wakhan - 10(+8); 12. USSR, Tadzhikistan, Pamir Mts: Kyzyl Rabot, mouth of Murgab River, Alichur, Ishkashim, Djilandy, Maz, upper flow of Vanch River, Ghurumda River, Shah Dara - 14; 13. USSR, Tadzhikistan, Pamir Mts: Sarez Lake, Pshart River - 6; 14. USSR, Tadzhikistan, Trans-Alai Ridge: Bor Dobe - 9; 15. China, Xinjiang, northwestern part of Kuen Lun: Tash Kurgan - 2 [out of samples in Pamir and Pamiro-Alai Mts: Kugitangtau Ridge, Turkestan Ridge - 2(+5)].

*A. a. phasma*: 16. China, Xinjiang, "eastern side of Karakorum Mts" - 2.

*A. a. tarasovi*: 17. USSR, Kirgizia, Alai Ridge: Sary Tash, Taldyk, Kichik River, Kashkasu, Archa Bulak, Tuz-ashu - 7(+13); 18. USSR, Kirgizia, Aksai Plateau: Kyzyl River - 2; 19. USSR, Kirgizia: vic. of Osh City - 15(+8); 20. USSR, Kirgizia: Sary Djaz A. Inylchek Ridges - 10(+4).

*A. a. severtovi*: 21. USSR, Kirgizia, Talastau Ridge: Aksu Dzhebagly, Terek Pass, Parkent, Besh Tash, Kara Bura - 14; 22. USSR, Kirgizia, Terskei Alatau Ridge: Chon Kyzylsu - 8(+12); 23. USSR, Kirgizia, Naryntau Ridge: 50-70 km E of Naryn City, Kaindy; A. Dzhumgoltai Ridge - 11(+2); 24. USSR, Kazakhstan, Kirgizski Ridge: Touyuk, Kara Balta - 7(+3); 25. USSR, Kazakhstan, Zailiyski Alatau Ridge: 10 km S of Alma Ata City - 27, [out of samples: Chatkal A. Kuramin Ridges - 2; Karatau Ridge - 1].

*A. a. worthingtoni*: 26. China, Xinjiang, Khalyktai Ridge: Muzart - 2.

*A. a. subluteus*: 27. USSR, Kirgizia, Kungei Alatau Ridge: Kar Kara - 10(+27); 28. USSR, Kazakhstan, Dzungar Alatau Ridge: Bizhe River, Koksus River, Koktal River, Panfilov, Chandala River - 25(+19); 29. USSR Kazakhstan: Saur A. Monrak Ridges - 3(+7), [out of samples: Tarbagatai Mts: Chagan-obo - 1].

*A. tuvinicus tuvinicus*: 30. USSR, Tuva: Kyzyl-Mozhakyk,

Kyzyl, Eleghest, Barun-Kemtchik, W Tannu Ola Mts, Mongun-Taiga; A. Mongolia, northeastern part of Mongol Altai Mts - 8(+2); 31. USSR, Khakassia: Azyrtal, Uchum, Efremkino, Bogradsk - 7(+4), [out of samples: Tuva, Obrutchev Ridge - 1(+2)].

*A. t. kosogol*: 32. Mongolia: northern shore of Khubsugul Lake - 6.

*A. t. olchonensis*: 33. USSR, Baikal Lake: Olkhon isl. - 22; 34. USSR, Baikal Lake: Barakchin isl. - 6; 35. USSR, Baikal Lake, southwestern shore: Ulan Anga - 2.

*A. semicanus semicanus*: 36. USSR, Tuva: Samagaltai, Terekhol Lake, E Tannu Ola Mts - 17; 37. Mongolia, Khan-huhei - 17; 38. Mongolia, Tarbagatai Mts: Toson Tsengel - 4; 39. Mongolia, western Khangai Mts: Otghon, Tsagan Chulut - 11; 40. Mongolia, southwestern Khangai Mts: Dzag, Khure Maral, Dzhangalan, Gurvan Bulak - 6; 41. Mongolia, southeastern Khangai Mts: "Sain Noin Khan", Bat-ulzii, Arvai Khure - 11; Mongolia, northeastern Khangai Mts: 30 km S of Towshruleh - 5; 43. Mongolia, northeastern Khangai Mts: Towshruleh to 30 km N of Towshruleh - 23; 44. Mongolia, SE of Khangai Mts: Tsakhryndzhas, Arts Bogdo - 3, [out of samples: Shurkhein Khure - 1, Usghehin Nuru - 1, Serkh Ula - 1, 60 km S of Bayan Khongor - 1].

*A. s. allenii*: 45. Mongolia (eastern): Munh Khan - 10; 46. Mongolia (eastern): Tumen Tsogt A. Idermegh - 5; 47. Mongolia (eastern): Erdene Tsagan - 3; 48. Mongolia, Khentei Mts: Uldzya, Urygin Gol, Mungen Mord, Bindurya, 40 km E of Ulan Bator - 4(+2).

*A. barakshin*: 49. USSR, Tuva: Mugur-aksy - 7; 50. Mongolia, Achit Nur Valley: Tsagan Nur, Achit Nur - 5; 51. Mongolia (northwestern): Ureg Nur Lake - 3; 52. Mongolia, northeastern Mongol Altai Mts: Indert, Must, Khudzhirt, Tsast Ula, Yolt, Ulegei - 10(+4); 53. Mongolia, central to eastern Mongol Altai Mts: Bayan Under, Wenchi, Erdeneh, Ikh Daba - 4(+2); 54. Mongolia: Darwyin Nuru Ridge - 4; 55. Mongolia: Taishirin Ula Ridge - 4; 56. Mongolia, Gobi Altai Mts: Dzun Saikhan, Ikh Bogdo Ula - 6; 57. Mongolia, eastern Trans-Altai Gobi Desert: Shara Khulsuin Bulak - 10; 58. Mongolia, southern Trans-Altai Gobi Desert: Tsagan Bogdo Ula - 10, [out of samples: Barun Khurai Valley: Gun Tamga Bulak - 1].

*A. stoliczkanus*: 59. India, Ladak: Rupshu, Nubra, Leh, Golung, Shushul, Durgu - 8(+3); 60. India, Lahul: Kimlung, Tsarup Valley, Kyinlung, Khardong, Lingti - 6(+4); 61. Nepal: Barun, N of Dawlaghiri; A. Sikkim: "Gyakong", "Gyamtsen" - 8(+2); 62. China, Tibet Plateau: Arucho, Bangong, Turi, Qinghai, Sharagol-djin Gol Raskem Ridge - 9; 63. China, Nan Shan: upper flow of Yantzy River, Ostyn Tag Ridge - 2.