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A NEW SPECIES OF VIPER (REPTILIA, VIPERIDAE) FROM THE ALTAY AND SAUR MOUNTAINS, KAZAKHSTAN

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Submitted September 24, 2009.

A new species of genus *Vipera* (Reptilia: Viperidae) belonging to the subgenus *Pelias* based on several specimens from the Altay and Saur mountain region in eastern Kazakhstan is described. It is a small species belonging to the *renardi* lineage.

Keywords: Viperidae, *Vipera*, subgenus *Pelias*, new species, Kazakhstan, Altay and Saur Mountains.

INTRODUCTION

During field work in eastern Kazakhstan for an INTAS project focusing on biodiversity and effects of nuclear waste in the polygon area close to Semipalatinsk and in a line towards the Altay mountain range, a series of populations of a hitherto unknown viper was found.

It is a foothill viper allopatric with the widespread *Vipera* (*Pelias*) *renardi*, characterized by having the morphological pholidosis typical for alpine and semi-alpine populations and taxa within this complex. It is a small species with whitish ventral side and scalation adaptations or modifications characteristic for mountain taxa. Despite its small size it has a very high ventral number in common with the much bigger *Vipera renardi*, and thereby separated from all mountain taxa, which all are characterized by lower number of ventrals. From the parapatric *renardi* it is further separated by cephalic scalation configurations and a different color pattern. We name this taxon after the Altay mountain range which is its main range and where it was discovered firstly.

Vipera (*Pelias*) *altaica* sp. nov.
(Figs. 1 – 4)

Holotype. Adult female GNM Re.ex. 6639. Altay, eastern Kazakhstan. 4 km N. Village Chernyaevka, at river Kalgyr (Kalgir), E. Kazakhstan (48°41′59″ N 85°2′24.6″ E), 218 – 327 m above sea level. Leg. Göran Nilson 1997-06-01.

Paratypes. 7 specimens from the type locality (GNM Re.ex. 6640 – 6646); one specimen from Saur mountains, S of Altay mountains (GNM Re.ex. 5668), 27 specimens from Slavyanka village, Southern Altay, Kazakhstan (48°49′20″ N 83°33′6″ E) (23 specimens, Zoological Institute, No. 21076a-x plus 4 specimens, Sochi National Park collection (SNP), No. 526a-d) Leg. Boris Tuniyev 1997-07-08; one specimen (SNP, No. 527) 4 km eastward Village Prirechnoye, at river Kalgyr (Kalgir), Southern Altay, Kazakhstan Leg. Tatiana Duysebaeva. 1997-07-06.

Definition. It is small sized (>40 cm) species with a very high number of ventral plates (average 146). It is a species probably within the *renardi* group, and in the same way living in foothill areas (200 – 1200 m a.s.l.). However, size and morphological characteristics developed as in alpine/subalpine taxa within the *ursinii* complex.

None of 38 examined specimen was 40 cm or smaller, and this general size was also observed in 40 to 50 additional specimens studied in Kazakhstan in 1997. *Vipera renardi* reaches 60 to 70 cm.

The belly is white or mixed white and black, where light colors predominate. *Vipera renardi* has a blackish belly.

It has a laterally pointed zigzag band, or transverse bands along its back (*renardi* has a typical undulating, brownish, and black edged dorsal band).

Upper labials are poorly painted, or not painted, while in *V. renardi* they are intensively painted, often with marked spots.

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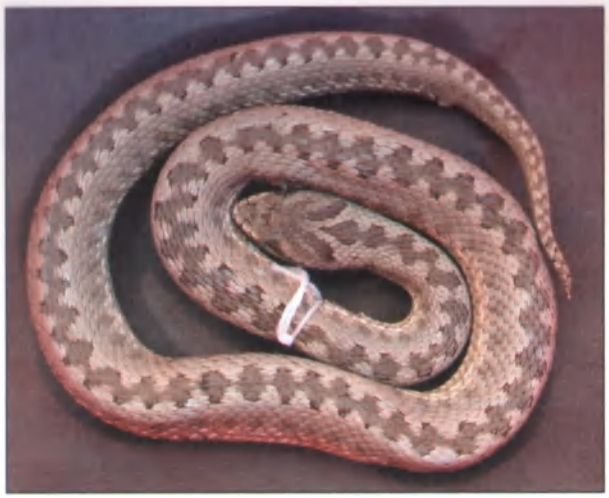

Fig. 1. Dorsal view of female holotype of *Vipera altaica* sp. nov. GNM Re.ex. 6639.

Fig. 2. Ventral view of female holotype of *Vipera altaica* sp. nov. GNM Re.ex. 6639.

It is a small taxon of the *Vipera ursinii* complex, and closest affinity with the *renardi* lineage. Maximum total length in our material is 38.8 cm for males (of which tail length is 5.0 cm), and 39.9 cm for females (tail 3.6 cm).

Head pattern and lateral body pattern present in most specimens. Belly-pattern whitish. Dark labial sutures developed in males, absent or weakly developed in females; occipital stripes of head present; ground color not bilineated; dorsal pattern consists of a pronouncedly developed zigzag band with pointed or slightly rounded corners of windings, or occasionally transverse stripes. Lateral spots present being single, squarish and tilted. Ground colors uniform brownish, with a denser staining

Fig. 3. Dorsal view of head of female holotype of *Vipera altaica* sp. nov. GNM Re.ex. 6639.

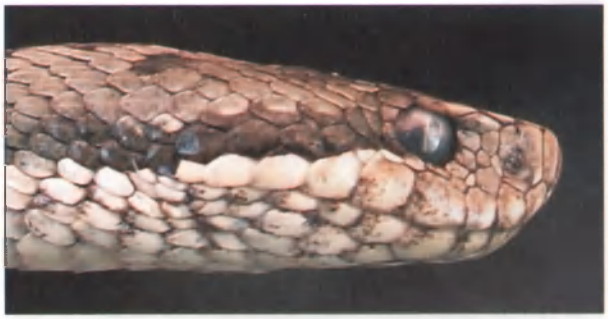

Fig. 4. Lateral view of head of female holotype of *Vipera altaica* sp. nov. GNM Re.ex. 6639.

at lower lateral parts of body. Very often there are gray and bluish-gray ground colors.

On average nine supralabials on each side (occasionally ten) and with the fourth under orbit. Two to six loreals on each side. Nasal normal without an upper nasal split; upper preocular mostly in contact with the nasal; parietals fragmented, divided or undivided (Fig. 3).

Reduction of dorsal scale rows from 21 to 19 rows at an average position between ventrals 73 to 98, i.e., 21 dorsal scale rows from neck to midbody, and 17 anterior to anal plate. A high numbers of ventrals, which makes the dorsal scale row reduction comparatively early — two out of three specimens have only 20 scale rows at midbody.

Diagnosis. Thus a species within the *ursinii* complex that differs from all other taxa in the complex by the combination of characteristics. It has a small to medium size; non-bilineate ground color; white belly; small lateral blotches and spots present; dark sutures on labials

in males; dorsal zigzag band with pointed corners of windings, or with transverse bars; high number of dorsal windings; upper nasal split absent; a squarish rostral; variable loreal number; many circumoculars; upper preocular in contact with nasal; medium number of crown scales; parietals fragmented or not; nine supralabials on each side; posterior supralabials of the same size as anterior ones; fourth supralabial below orbit; ten sublabials on each side; normally four mental scales; somewhat early dorsal scale row reduction compared to *renardi*; 21 rows on neck and at midbody; a high ventral number; no pronounced exposed intersquamose area; a high number of subcaudals and being a foothill valleys steppe inhabitant.

A low mountain species of the *ursinii* complex characterized by an external morphology normally evolved as typical for mountain taxa of the *ursinii* complex; similar to European mountain populations (*ursinii*, *macrops*) in some characters and to *renardi* and Asian mountain populations (*eriwanensis*) in others but unique to both in combination of characters.

It is special in being the smallest taxon, and having the highest number of ventrals within the entire complex; in being a lowland dweller with a color and scalation characteristics typical for mountain taxa, and in having a sharp sexual dimorphism in labial pattern and loreal number.

It differs from parapatric *renardi* by having an earlier dorsal scale row reduction (19 – 21, mean at 90th ventral number) (21 in *renardi*, with mean scale reduction at 95th ventral number) and a high number of ventrals, which are whitish in color.

It differs from European mountain *ursinii* by having a high number of supralabials. It is separated from most taxa by having partly fragmented parietals (replaced by a mean number of eight scales), banded black suture on supralabials weakly developed or absent, lateral body pattern reduced to squarish rhombic spots that are tilted, dorsal scales are pronouncedly keeled. No interparietalia.

Description of holotype. An adult female (Figs. 1 – 4), total length 363 mm, tail 37 mm, latter equal to 10.2% of total length. Length of head (from posterior corner of mouth to tip of snout) 15.9 mm, breadth of head at position of eyes 9.0 mm, breadth of head at posterior position 11.4 mm. Anterior head concave with a pronounced canthus rostralis, and covered with scales or plates. Two large supraoculars and a transversely divided frontal plate on top of head; parietals fragmented into two slightly larger and several smaller plates, frontal separated from supraoculars by four smaller scales on right and three on left side, 1 canthal and 1 supranasal scale on each canthus rostralis, and a single apical; 4 intercanthals and 9 intersupraoculars (including the two frontals). Height/depth of rostral 3.3/2.9 mm, it is bordering 2 supralabials, 2 internasals and the apical; eye surrounded by 10 circumoculars on right side and 9 on left, 6 loreals on each side, upper preocular in contact with nasal on both sides, nasal with a small notch at upper edge, 9 supralabials, with forth and part of fifth below eye, and 10 sublabials on each side, anterior and posterior supralabials of equal size, middle ones (below eye) slightly larger, 4 second chinshields bordering anterior ones and 4 scales in the mental row.

Two preventrals and 150 ventrals, 28/29 + 1 subcaudals, 20 dorsal scale rows at midbody, 21 on neck one head-length behind the head, 17 dorsal scale rows one head-length anterior to anal, scale reduction from 21 to 19 dorsal scale rows at ventrals 97 and 73 on right and left side respectively.

Dorsal body pattern consisting of a zigzag band with 79 sharp windings, lateral body pattern reduced and consists of single squarish spots which are tilted, and corresponds to the bars of the dorsal band. Head pattern consists of 2 dark oblique bands which do not unite, and a posterior band from eye to corner of mouth, labial pattern consisting of very weakly bands on labial sutures, ground color light brown with dorsal pattern dark brown, ventral side whitish, throat light. No dorsoventral longitudinal lines on outer edge of ventrals.

Morphology. Some information was published earlier (Nilson and Andrén, 2001) but with the additional material further and more detailed analyses could be achieved for understanding of the variation in morphology in this taxon. *Vipera altaica* sp. nov. belongs to the *renardi* lineage and the morphological variations are described in comparison with the other taxa within this lineage. For more precise descriptions of these taxa, see Nilson and Andrén (2001). The comparison data can be seen in Tables 1 – 9.

The high number of ventrals is one character that distinguishes *altaica* from surrounding taxa. The average number is 145.9 and with a range between 142 and 155. This is the highest numbers of ventrals within the entire *ursinii* complex (Table 2).

The number of subcaudals is one of the few characters that express sexual dimorphism where males have more subcaudals than females. Both the female and the male values are similar to the surrounding taxa within the complex. Females have 27.2 and males 35.4 on average (Table 3). In this character all the mountain populations as well as lowland *renardi* are similar. The only exception is the Iranian *V. ebneri* which has much lower average numbers.

TABLE 1. Number of Preventrals, Apicals, Circumoculars, and Loreals Counted as Sum of Both Sides

Taxa	*N*	Preventrals		Apicals		Circumoculars		Loreals	
		mean ± S.E.	range	mean ± S.E.	% of specimens with two plates	mean ± S.E.	range	mean ± S.E.	range
renardi	57	2.14 ± 0.08	1 – 3	1.05 ± 0.03	5.4	18.55 ± 0.19	16 – 21	8.56 ± 0.27	4 – 12
'west-*renardi*'	26	2.20 ± 0.14	1 – 3	1.04 ± 0.04	7.7	18.03 ± 0.26	16 – 20	8.64 ± 0.40	6 – 12
'east-*renardi*'	30	2.07 ± 0.11	1 – 3	1.07 ± 0.05	6.9	19.04 ± 0.27	16 – 21	8.48 ± 0.41	4 – 12
eriwanensis	44	2.00 ± 0.10	1 – 3	1.27 ± 0.07	27.3	18.61 ± 0.35	15 – 22	10.18 ± 0.42	5 – 18
ebneri	16	1.87 ± 0.15	1 – 3	1.00 ± 0.00	0	17.69 ± 0.22	16 – 19	7.94 ± 0.36	6 – 11
lotievi	16	2.43 ± 0.14	2 – 3	1.00 ± 0.00	0	18.50 ± 0.56	14 – 22	7.93 ± 0.52	5 – 12
altaica	38	2.20 ± 0.10	1 – 4	1.00 ± 0.00	0	19.44 ± 0.2	17 – 22	8.45 ± 0.78	5 – 12
tienshanica	15	2.20 ± 0.22	1 – 4	1.06 ± 0.07	6.7	19.53 ± 0.27	18 – 22	8.86 ± 0.56	4 – 12
parursinii	31	2.26 ± 0.11	1 – 3	1.00 ± 0.00	0	20.07 ± 0.13	18 – 21	10.63 ± 0.21	7 – 12

The average midbody scal row number is close to 21 and the corresponding posterior number is close to 17. The number of scale rows on neck is close to 21. In these characters *altaica* is similar to other taxa within the complex (Table 4). Average scale row reduction is also rather posterior, near the position of the 90th ventral plate. The only related taxon that differs in this characteristic is *V. parursinii* in China.

There is a certain variation in the shape of the rostral but in general it has a rather squarish general shape.

The dorsal head scales are rather fragmented with an average number of 12.1 crown scales (intercanthals + intersupraoculars). The number of intercanthal and intersupraocular scales spans from 7 to 19. The largest variation is found between the different populations of *tienshanica* where the number spans over 15 scales (from 8 to 22) (Table 5). All mountain taxa plus *altaica* show a higher degree of fragmentation in this character (as in several other characters).

The degree of fragmentation of the parietals in the entire complex varies between 14.3% in *lotievi* up to 93.3 in the *tienshanica* and 100% in *parursinii*. In *altaica* the corresponding figure is 54.5. Most mountain taxa have a high division of parietals which is also the case for the frontal. In the eastern mountain taxa (*tienshanica*, *parursinii* and *altaica*) more that 50% have fragmented parietals, in which they differ from most western mountain taxa (*ebneri* has high values in the western group). In lowland taxa fragmentation is fixed at a lower level.

TABLE 2. Number of Ventrals

Taxa	*N*	Mean ± S.E.	Range
renardi	57	142.67 ± 0.45	135 – 150
'west-*renardi*'	26	141.85 ± 0.60	135 – 148
'east-*renardi*'	29	143.52 ± 0.66	135 – 150
eriwanensis	44	137.66 ± 0.34	133 – 143
ebneri	16	129.88 ± 0.98	123 – 134
lotievi	14	141.29 ± 0.54	138 – 144
altaica	38	145.86 ± 0.91	142 – 155
tienshanica	15	135.00 ± 0.76	129 – 138
parursinii	31	135.80 ± 0.43	132 – 141

TABLE 3. Number of Subcaudals

Taxa	Males			Females		
	mean ± S.E.	range	*N*	mean ± S.E.	range	*N*
renardi	34.5 ± 0.4	28 – 38	33	27.0 ± 0.4	24 – 29	19
'west-*renardi*'	34.9 ± 0.6	31 – 38	16	26.7 ± 0.5	24 – 29	10
'east-*renardi*'	34.5 ± 0.5	28 – 38	19	27.6 ± 0.5	24 – 30	11
eriwanensis	35.0 ± 0.4	32 – 39	25	26.6 ± 0.4	23 – 30	19
ebneri	30.4 ± 1.4	23 – 34	8	23.4 ± 0.7	19 – 25	8
lotievi	35.5 ± 0.7	33 – 38	6	25.3 ± 0.6	23 – 27	8
altaica	35.4 ± 0.3	33 – 38	16	27.2 ± 0.3	24 – 29	21
tienshanica	35.0 ± 0.7	30 – 38	11	27.8 ± 0.5	27 – 29	4
parursinii	33.4 ± 0.3	32 – 35	15	25.7 ± 0.5	23 – 30	16

TABLE 4. Number of Dorsal Scale Rows one Head Length Posterior of Head, at Midbody, and One Head Length Anterior to Anal

Taxa	*N*	Neck		Midbody		Posteriorly	
		mean ± S.E.	range	mean ± S.E.	range	mean ± S.E.	range
renardi	57	21.25 ± 0.08	21 – 23	20.91 ± 0.05	20 – 21	17.05 ± 0.03	17 – 18
'west-*renardi*'	26	21.38 ± 0.10	21 – 23	20.96 ± 0.10	20 – 21	17.00 ± 0.05	17
'east-*renardi*'	30	21.14 ± 0.10	21 – 23	20.86 ± 0.10	19 – 21	17.11 ± 0.06	17 – 18
eriwanensis	44	21.07 ± 0.05	21 – 23	21.02 ± 0.02	21 – 22	17.00 ± 0.02	16 – 18
ebneri	16	21.00 ± 0.00	21	20.75 ± 0.17	19 – 21	17.06 ± 0.06	17 – 18
lotievi	14	21.00 ± 0.00	21	20.64 ± 0.20	19 – 21	17.00 ± 0.00	17
altaica	38	21.08 ± 0.06	21 – 23	20.92 ± 0.07	19 – 22	17.00 ± 0.00	17
tienshanica	15	21.00 ± 0.00	21	20.70 ± 0.15	19 – 21	16.93 ± 0.07	16 – 17
parursinii	31	19.13 ± 0.08	19 – 21	19.26 ± 0.11	19 – 21	16.97 ± 0.03	16 – 17

TABLE 5. Level of Reduction of 21 to 19 Dorsal Scale Rows (at Ventral Number), Rostral Index (Height/Width), Number of Crown Scales (Intersupraoculars + Intercanthals), and Number of Windings or Blotches in the Dorsal Zigzag Band

Taxa	*N*	Scale reduction		Rostral index		Crown scales		Zigzag windings	
		mean ± S.E.	range	mean ± S.E.	range	mean ± S.E.	range	mean ± S.E.	range
renardi	57	95.19 ± 1.37	65 – 127	1.04 ± 0.01	0.91 – 1.32	10.95 ± 0.37	6 – 18	59.30 ± 0.77	50 – 73
'west-*renardi*'	26	96.35 ± 1.80	71 – 113	1.04 ± 0.01	0.95 – 1.20	9.92 ± 0.46	6 – 15	57.42 ± 0.69	51 – 67
'east-*renardi*'	30	94.03 ± 2.18	65 – 127	1.04 ± 0.02	0.91 – 1.32	11.66 ± 0.56	7 – 18	60.86 ± 1.10	50 – 75
eriwanensis	44	94.70 ± 0.94	82 – 109	1.23 ± 0.02	0.79 – 1.67	13.07 ± 0.36	9 – 19	65.77 ± 0.80	56 – 79
ebneri	16	77.19 ± 4.50	18 – 96	1.18 ± 0.02	1.05 – 1.40	12.06 ± 0.39	9 – 16	60.19 ± 0.89	54 – 65
lotievi	16	87.50 ± 6.49	17 – 106	1.11 ± 0.03	0.92 – 1.27	10.93 ± 0.68	7 – 16	65.50 ± 2.88	50 – 81
altaica	38	90.57 ± 3.18	73 – 98	1.02 ± 0.06	0.90 – 1.33	12.1 ± 1.88	7 – 19	65.82 ± 1.71	54 – 76
tienshanica	15	80.27 ± 2.79	63 – 93	1.04 ± 0.16	1.00 – 1.20	12.80 ± 0.96	8 – 22	48.20 ± 1.05	41 – 58
parursinii	31	8.81 ± 0.74	5 – 27	1.03 ± 0.01	1.00 – 1.16	12.26 ± 0.35	10 – 17	54.77 ± 0.55	50 – 64

TABLE 6. Number of Supralabials and Sublabials (counted as sum of both sides), Second Chinshields, and Mental Scales

Taxa	*N*	Supralabials		Sublabials		2nd Chinshields		Mental scales	
		mean ± S.E.	range	mean ± S.E.	range	mean ± S.E.	range	mean ± S.E.	range
renardi	57	17.98 ± 0.06	14 – 19	20.05 ± 0.16	17 – 24	4.19 ± 0.09	4 – 8	4.33 ± 0.09	3 – 6
'west-*renardi*'	26	17.92 ± 0.08	17 – 19	20.42 ± 0.24	18 – 24	4.27 ± 0.16	4 – 8	4.35 ± 0.12	3 – 6
'east-*renardi*'	30	18.03 ± 0.10	17 – 19	19.75 ± 0.23	17 – 22	4.13 ± 0.10	4 – 6	4.34 ± 0.13	3 – 6
eriwanensis	44	18.02 ± 0.08	17 – 20	19.93 ± 0.22	17 – 25	4.07 ± 0.05	4 – 6	4.50 ± 0.11	3 – 6
ebneri	16	18.0 ± 0.13	17 – 19	20.25 ± 0.30	18 – 22	4.06 ± 0.06	4 – 5	4.87 ± 0.18	4 – 6
lotievi	16	17.36 ± 0.29	16 – 20	19.64 ± 0.49	15 – 22	4.64 ± 0.25	4 – 6	3.71 ± 0.13	3 – 4
altaica	38	18.11 ± 0.05	18 – 19	19.52 ± 0.15	19 – 22	4.00 ± 0.00	4	4.24 ± 0.09	3 – 6
tienshanica	15	17.33 ± 0.23	16 – 18	20.80 ± 0.22	20 – 22	4.73 ± 0.30	4 – 7	3.77 ± 0.19	3 – 5
parursinii	31	17.67 ± 0.19	16 – 22	19.32 ± 0.19	17 – 22	4.00 ± 0.00	4	3.34 ± 0.17	3 – 5

The degree of fragmentation or division of the frontal is normally lower than corresponding situation for the parietals, but in *altaica* it is comparatively high. In the entire complex the lowest degree of fragmentation (actually no fragmentation) is seen in *parursinii*.

The size of the upper preocular varies in the complex, but normally it is large and in contact with the nasal plate. This character has traditionally been given (together with the single rostral) as the characteristic feature for *Vipera ursinii* sensu lato. However, the degree of snakes in the different taxa with the upper preocular in contact with nasal on one or both sides of head varies from the low value of 22.7% in *eriwanensis* to 96.8% (in *parursinii*). Thus this character holds comparatively well for the entire *ursinii* complex except for *eriwanensis* where only about one fifth of the snakes express this

Fig. 5. A female *Vipera altaica* sp. nov. from Kalgir valley in the Altay mountains, 4 km N. Village Chernyaevka, at river Kalgir (Kalgyr) (48°41′59″ N 85°2′24.6″ E) 218 – 327 m a.s.l. in early July 1999. Topotype.

Fig. 7. A female *Vipera altaica* sp. nov. from east of Kaznakovka in the Altay mountains, at the village Slavyanka (48°49′20″ N 83°33′6″ E) at 425 m a.s.l. in late June 1999.

TABLE 7. Frequencies of Certain Characteristics in the Populations (in)

Taxa	*N*	Divided parietals, %	Divided frontal, %	Preocular(s) in contact with nasal, %
renardi	57	49.1	14.0	82.4
'west-*renardi*'	26	42.3	11.5	76.9
'east-*renardi*'	30	51.7	17.2	82.8
eriwanensis	44	20.5	4.5	22.7
ebneri	16	68.8	12.5	62.5
lotievi	14	14.3	14.3	78.6
altaica	38	54.5	54.5	59.6
tienshanica	15	93.3	33.3	80.7
parursinii	31	100.0	0.0	96.8

Fig. 6. A female *Vipera altaica* sp. nov. from Kalgir valley in the Altay mountains, 4 km N. Village Chernyaevka, at river Kalgir (Kalgyr) (48°41′59″ N 85°2′24.6″ E) 218 – 327 m a.s.l. in early July 1997. Topotype.

character. In *altaica* one fifth of the preoculars do not have contact with nasal.

Dorsal color is brownish, gray or bluish-gray (Figs. 5 – 11). The dorsal body pattern is characterized by pronounced windings and turns in the dorsal band on body. The mean value in *altaica* is 65.82, but it can be as high as 81 in related taxa (*lotievi*). A dorsal pattern of undulating isolated or united blotches, circles, or transverse rectangular bars are frequent in *renardi*.

Ventral color normally follows altitudinal pattern with lowland populations having dark bellies and mountain populations having whitish bellies. *Vipera altaica*, which is a foothill rocky hill inhabitant differ from this pattern by having whitish bellies The figures for specimens with white belly vary between 0% and 13.0% (*renardi*) for lowland taxa and from 71.8% (*eriwanensis*) to 100% in mountain taxa. In *V. altaica* 86.7% has whitish belly.

The figures for specimens which are lacking a dark suture between supralabials vary between none (in several) to all (*ebneri*). It seems not to follow an altitudinal, but a phylogenetic pattern. Besides *ebneri* also the other Asian mountain taxa (*lotievi*, *eriwanensis*) have a low percentage of specimens with dark sutures. In *Vipera altaica* there is a sexual dimorphism in this characteristic as only males have such dark sutures, while females lacks the same.

Fig. 8. A male *Vipera altaica* sp. nov. from east of Kaznakovka in the Altay mountains, at the village Slavyanka (48°49′20″ N 83°33′6″ E) at 425 m a.s.l. in late June 1999.

Fig. 9. A male *Vipera altaica* sp. nov. from east of Kaznakovka in the Altay mountains, at the village Slavyanka (48°49′20″ N 83°33′6″ E) at 425 m a.s.l. in late June 1999.

Dorsal side of snout is often concave resulting in raised and sharp canthus rostralis. However, there seems to be a geographical connection in the occurrence of this feature. The Asian populations (including *renardi*) have a high percentage of specimens with concave snout, which is not the case for the European taxa. The highest figure is found in 'west-*renardi*' where 88.5% of the examined specimens have concave snout. In *altaica* corresponding figure is 28.6% (Table 8).

The normal state in lateral pattern is clear lateral spots. In some cases they can be only weakly expressed. In the Asian group of mountain taxa (*eriwanensis*, *ebneri*, *lotievi*) this lateral pattern is lacking to a certain degree. In *altaica* as well as in *tienshanica* and *parursinii* each of the lateral spots consists of a short upper streak only.

The new species is remarkable in being shaped as the alpine members of the complex although being a lowland inhabitant. In several morphological characteristics it differs from the allopatric *renardi* except in having a high number of ventrals, a character that separates it from mountain taxa.

Reproductive biology

Several females gave birth to young during the investigation. Adult size of reproductive females was much below 40 cm total length.

Distribution (Fig. 12). It is distributed in Altay and Saur mountain ranges in lower sections (200 – 1200 m) with dry climate. Together with collection specimens (CAZ) we observed it in eleven localities in southwestern Altay and Saur mountains in Kazakhstan near the Chinese border, and specimens mentioned (Ananjeva et al., 1997) from the Mongolian Altay mountains in the China (Crick Chichkanty (tributary of Kurtu River) in upper basing of Black Irtysh River) may well belong to the same taxon. Beside it, specimens from mouth of Chulyshman River, Central Altay (Yakovlev, 1985) and

TABLE 8. Frequencies of Certain Characteristics in the Populations

Taxa	*N*	Snout concave on dorsal side, %	Belly whitish (not dark), %
renardi	57	84.2	20.3
'west-*renardi*'	26	88.5	7.7
'east-*renardi*'	30	79.3	37.0
eriwanensis	44	51.2	71.8
ebneri	16	43.8	87.5
lotievi	14	78.6	78.6
altaica	15	28.6	86.7
tienshanica	15	40.0	100.0
parursinii	30	36.7	100.0

TABLE 9. Frequencies of Certain Characteristics in the Population

Taxa	*N*	Upper nasal split, %	Supralabial dark sutures, %	Lateral body blotches missing, %
renardi	56		100.0	5.5
'west-*renardi*'	26	34.3 (*N* = 35)	100.0	0.0
'east-*renardi*'	30		100.0	10.7
eriwanensis	44	28.6	53.5	38.6
ebneri	16	33.3	0.0	12.5
lotievi	14	56.2	28.6	28.6
altaica	11	25.0	37.5	0.0
tienshanica	15	10.5	93.3	6.7
parursinii	30	10.0	100.0	3.3

Fig. 10. A male *Vipera altaica* sp. nov. from a deserthill 50 km south of Kurtchum in the Altay mountains (48°27′44.8″ N 84°8′4.3″ E) at 422 m a.s.l. in early July 1999.

Fig. 11. A female *Vipera altaica* sp. nov. from the Saur mountains, at the village Prezval'skoye (47°25′43.9″ N 85°17′11.5″ E) at 914 m a.s.l. in July 1999.

rite bank of Irtysh River near Ust'-Kamenogorsk might belong to the same species. We did not see these specimens (3 specimens, Zoological Institute, No. 198871, Altay State Reserve, and Valley of river Chulyshman, Chodra Katu Yarykh, Leg. Vladimir Yakovlev, 1974, 1979, 1982; 1 specimens, Zoological Institute of National Academy of Sciences of Kazakhstan, No. 2203, rite bank of Irtysh River, near village Kamyshenka, 1955).

DISCUSSION

The *ursinii* complex constitutes of three 'species groups' where the most eastern ones contain the members of the *renardi* group. *Vipera renardi* is a lowland inhabitant with a rather large distribution in European and Asian steppe habitats in Russia, Ukraine and Kazakhstan.

The remaining taxa within this species group have all a more southern range and are all mountainous in their habitat choice. For these, the normal habitat are subalpine meadows or mountain steppes and these taxa all have developed phenetics that either reflect the mountainous habitat or the phylogenetic history (Nilson and Andrén, 2001). The mountainous members of the *ursinii* complex are rather small snakes with maximum lengths normally below half a meter. The lowland taxa are bigger. In our material *renardi* reaches 60.7 and sizes of 66 cm (Ostrovskikh, 1997) and 70 cm (Kotenko, 1989) are given in the literature.

In this scenario the new species is interesting as maximum size from this foothill species is 39.9 cm in our material. This fits in well with the mountain taxa although being lowland adopted. *Vipera altaica* seems to be a very small taxon as maximum size is below 40 cm.

This taxon is distributed with a number of populations along the southern foothills of the Altay Mountains as well as in the Saur mountains in Kazakhstan in altitude from 200 m up to 1200 m above sea level. Besides differing in a number of morphological characteristics, it is also special in habitat choice. These are small snakes, inhabiting foothill rocky habitats. However, they express typical size and color pattern of mountain taxa of the *ursinii* complex. The taxonomic position of the steppe vipers from east Altay and the Tuva region is still an open question.

It seems to be isolated from the allopatric and likewise lowland inhabiting typical *renardi*. Towards the south of its range is the Zaysan depression with the lake Zaysan. Towards the east is the Black Irtysh desert and adjacent lowland dry desert habitats. Towards the north is the high Altay with dense forests (*Abies sibirica*, *Larix*) and snowfields. Finally towards the west is the Irtysh River, now changed into a huge artificial lake and together with the surrounding Kaznakovka sand dune fields making an extensive barrier against dispersal. We found only *Gloydius h. halys* in these surrounding hot and dry habitats.

In the mountain ridges toward south and east, and forming the border towards China (Tarbagatai) we found typical *renardi*. These ridges are separated from Altay by the Zaysan depression. We have examined three specimens in the Chengdu collection (Sichuan, China) from the Xinkiang lowland areas east of the Black Irtysh desert and steppes, and which form the eastern border towards China and two specimens in Almaty Zoological

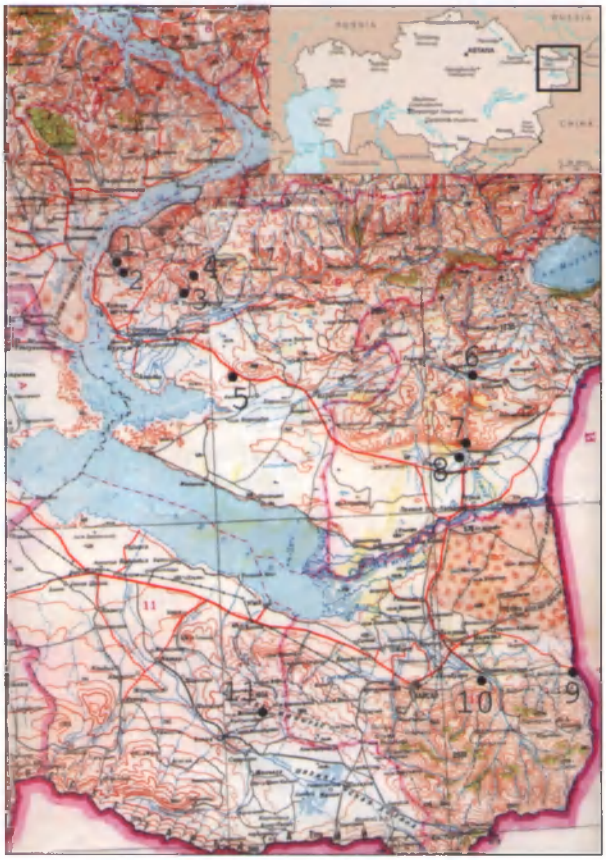

Fig. 12. Distribution of *Vipera altaica* sp. nov. in eastern Kazakhstan with studied records:

1, No. 831:207/76 (KAZ). Altay, foothills of Narymsky Ridge southward from settlement Slavyanka;

2, No. 21076a-x (ZIN), 23 specimens plus No. 526a-d (SNP), 4 specimens. Altay, Slavyanka settlement, Southern Altay, Kazakhstan (48°49′20″ N 83°33′6″ E), Leg. Boris Tuniyev, Sergey Starikov. 1997-07-08;

3, No. 4022, 4023 (KAZ). Altay, Kurchumsky district, low flow of Zhenishke River, 20 km southward from Sergeevka village. 1987;

4, No. 4021, 4053 – 4058 (KAZ). Altay, Kurchumsky district, upper flow of Zhenishke River, 9 km eastward from Sergeevka village. 1987;

5, Deserthill 50 km south of Kurtchum in the Altay mountains (48°27′44.8″ N 84°8′4.3″ E) at 422 m a.s.l. in early July 1999;

6, No. 527 (SNP). Altay, eastern Kazakhstan. 4 km eastward Village Prirechnoye, at river Kalgyr (Kalgir). Leg. Tatjana Duysebaeva. 1997-07-06;

7, No. 6639 – 6646 (GNM), 8 specimens. Altay, eastern Kazakhstan. 4 km N. Village Chernyaevka, at river Kalgyr (Kalgir) E. Kazakhstan (48°41′59″ N 85°2′24.6″ E), 218 – 327 m a.s.l. Leg. Göran Nilson 1997-06-01;

8, No. 4025 (KAZ). Altay, eastern Kazakhstan. Village Chernyaevka, at river Kalgyr (Kalgir);

9, No. 445 (KAZ). Saur mountains, Zaisan district, 3 km westward from wintering Maikapchagai;

10, No. 5668 (GNM). Saur mountains. Village Prezval'skoye (47°25′43.9″ N 85°17′11.5″ E) at 914 m a.s.l. 1999-07;

11, No. 394 (KAZ). Saur mountains, Tarbagatay district, Shiliktinskaya Valley, Monaryk Ridge, 1200 m a.s.l.

Institute of National Academy of Sciences of Kazakhstan (CAZ, No. 1873, 1874) from Western Tarbagatai mountains, southward from village Urzhar and village Novotroitskoye. Also these vipers are typical *renardi*.

The habitats of *Vipera altaica* are very special and differ from other landscapes in this region. In the ecotone of the Altay Mountains and the plains of Kazakhstan a narrow section is develop with shrub steppes. Vegetation coverage normally formed by bushy farms of crops or semi shrubs (wormwood) have perishes under the influence of low temperatures. Ephemeral vegetation is scarcely developed (Korovin, 1934). This kind of vegetation impenetrate the wide river valleys of South Altay from the Zaysan Hollow. It consists of stony steppes with *Stipa capillata – Festuca sulcata* and with bushes like *Lonicera tatarica*, *Spiraea hypericifolia*, *Rosa spinosissima*, *Caragana frutex*, *Amygdalus nana*, *Daphne altaica*, and other. Among these associations of bushes the Eurasian species are dominating in the steppe area (Koropachinsky, 1975). At higher altitudes of 1000 m a.s.l. and at the border with the of the taiga districts the steppe vegetation is transformed into meadow-steppes. An altitude of 1200 m makes the upper limit of distribution for *V. altaica* both in the Altay as in the Saur Mountains.

The winter here is less severe than at the surrounding plains. The middle temperature of January on 2 – 3°C is higher than in the steppes of Kazakhstan. At the foothills the middle temperature of July stays near 19°C and at altitudes of 1000 – 1200 m it goes down to 14 – 15°C. At altitudes above 1200 m night frost is possible even in July (Koropachinsky, 1975).

Climatic characteristics are determining the upper limit of distribution of *Vipera altaica* (up to 1200 m) in the Altay as in the Saur Mountains. At higher elevations in Altay there are the boreal European species (*Bufo bufo*, *Rana arvalis*, *Zootoca vivipara*, *Vipera berus*), collected by us around Markakol Lake and at Village Medvedka in the Altay mountains, E. Kazakhstan (49°8′52.3″ N 85°20′45.2″ E).

South-west Altay, Saur and Tarbagatai unite in a joint dendrology area, different from all of other areas of Kazakhstan (Mushegyan, 1962). In vegetation south-west Altay is quite different from other districts of the Altay high mountain belts and is analogical to the flora located in south-west Tarbagatai (Koropachinsky, 1975).

There is a high degree of endemism in the flora of South-West Altay and it is very original in the district of Irtysh River, Kurchumsky and Narymsky Ridges (with species like *Astrogalus xanthotrichus*, *A. veresczaginii*, *A. inflatus*, and *A. majevskianus*).

Only in this district of Altay there are sub endemic species shared with Saur-Tarbagatai Mountains (like *Arenaria potanini*, *Astragalus scleropodius*, *Oxytropis hystris*, and *Hyssopus ambiguus*). This verifies the joint history of development of floras for these districts (Koropachinsky, 1975).

Vipera renardi parursinii from Nilka Zian and Xinyuan Xian, East Tien-Shan mountain range (Xinjiang), China is geographically relatively close to *altaica*. However, it is very different from the more northern *Vipera renardi* as already demonstrated by Zao and Jiang (1979), as well as from our new viper. By having 19 dorsal scale rows on neck and at midbody it is most similar to the European alpine populations in these characters. It also differs in labial color pattern, lateral body pattern, pronounced dorsolateral longitudinal lines on distal edges of ventrals, and number of ventrals from *altaica*.

There is a marked difference between *altaica* and populations from the different mountainous populations in Kyrgyzstan, south Kazakhstan, west Tien-Shan range in Xinjiang, N. W. China as can be seen when comparing the different taxa within this geographical region. But all these eastern mountain populations including lowland *altaica* probably have the eastern lowland *renardi* ('east-*renardi*') as their closest relative, in the same way as all the rest of the mountain populations in Europe and Asia have their closest relatives in the different northern lowland populations (Nilson and Andrén, 2001).

During the Tertiary there was an evergreen flora of the Poltavian type in the region. The fossil Oligocene flora from mountain Ashutas in the Zaysan Hollow was characterized by representatives of forests of monsoon type (Mushegyan, 1966). At the end of the Miocene – Pliocene the climate became more hot and dry with the formation of vast xerotic areas.

Even during the period of maximal Pleistocene glaciations a bar of plains from the Caspian Sea to Altay and between 48 and 43° N was covered by deserts (Kul'tiasov, 1946). The genus Atraphaxis Kul'tiasov could be considered as a good example, illustrating connections from the Mediterranean region to west and Central Asia.

A modern vegetation with its present geographical distribution is 15 – 25 thousand years of age, and configurations and sizes of range of some species (without influence of man) were established 3 – 4 thousand years ago (Krishtofovich, 1946).

An ancestral 'pre-*ursinii*' was widespread in Pliocene along the north coast of Tethys from Europe to Central Asia. Further aridization resulted in saving of relict populations in the mountain areas of Tien Shan, Saur and Altay. Specialization of different viper forms took a place in the unique conditions of each mountain country.

During a Post Pleistocene period the wide settling apart happened along a Eurasian steppe zone with *Vipera renardi*, which had survived in Precaucasia during Pleistocene. A second contact between these two taxa did not take place, although these species dwelled geographically in a direct closeness to each other.

The second possible scenario is convergence speciation in European, Near East and Central Asian mountain systems of mountain species "*ursinii*-complex" from a joint Pliocene lowland ancestor with *Vipera renardi*.

Presently the distribution of *Vipera altaica* consists of two large fragments in South-West Altay and Saur mountains and, presumably, a few isolates in East Altay, Tuva and to the adjoining districts of China and Mongolia.

In an analysis of modern distribution of plants Tolmachev (1960) did consider that the fragmented distributions to remote localities were not only explained by migrations. It is possible that the ancestral forms of these species could have been raised in the past on vast territories at lower altitudes and where the formation of mountains took place at a later stage. Necessary to note that the foothills steppes of Western Altay, South-West Altay, Zaysan Hollow and Black Irtysh basin consists of a single unit presently (Koropachinsky, 1975).

The presence of two sibling species of vipers in the comparatively limited territory and in analogy with floristic examples, indicate heterogeneity of the fauna in the concerned region. It also demonstrates that *Vipera renardi* and *V. altaica* are connected to different geographical elements have differentiated in time of origin and in migration into the concerned region. They occupy different ecological niches. Together with wide-spread prosperous *Vipera renardi* we can thus recognize a relict species — *Vipera altaica*. This can be seen as a verification that repeated changes of climate can create similar ecological constellations in a geographic mosaic pattern for species of joint origin during different historical periods.

MATERIAL AND METHODS

Herpetological collections of the Zoological Institute, Russian Academy of Sciences, St. Petersburg and the Zoological Institute of National Academy of Sciences of Kazakhstan were studied beside material in our own collections.

Characters used in the study:

1) sex;

2) total length;

3) relative tail length;

4) number of preventrals, defined as those gular scales anterior to ventrals that are broader than long;

5) number of ventrals, following the Dowling (1951) method;

6) number of subcaudals;

7) number of anterior dorsal scale rows, counted one head length posterior of head;

8) number of mid-body dorsal scale rows, counted at the exact middle of the body;

9) number of posterior dorsal scale rows, counted one head length anterior to anal;

10) ventral number for the reduction of dorsal scale rows from 21 to 19;

11) the shape of the rostral, given as height/breadth;

12) number of apical plates in contact with rostral;

13) total number of plates in contact with rostral;

14) number of supralabials (right + left);

15) number of sublabials (right + left);

16) number of scales in the circumocular ring, counted as right and left sides together;

17) number of loreals (right + left);

18) number of second chinshields, i.e., the number of scales in the transverse mental row posterior to the anterior chinshields and on each side in contact with the sublabials;

19) number of mentals, between the anterior chinshields and the preventrals;

20) number of canthals;

21) number of crown scales (intercanthals + intersupraoculars);

22) if parietals are divided/fragmented or not;

23) if frontal is divided or not;

24) number of nasorostralia (right + left);

25) if nasalia is normal, divided or united with nasorostralia;

26) number of supralabials between rostral and level of eye (right + left);

36) number of windings in dorsal zigzag band;

37) ground color;

38) ventral color, which may be dark or light;

39) color of dorsal pattern;

40) labial-pattern, which may consist of dark labial sutures or not.

For comparative material see Nilson and Andrén (2001).

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