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Herpetofauna from Cherny Yar Sands of the Cherny Yar-Nizhnee Zaimishche Section, Lower Povolzhye (Volga Region)

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Abstract—**Fossil remains of *Bombina variegata, Pelobates fuscus, Bufo raddei, Rana lessonae, Rana arvalis, Lacerta agilis, Elaphe longissima, Natrix natrix, Natrix* cf. *tesselata,* and *Vvpera ursini* from Khazarian deposits of the Cherny Yar-Nizhnee Zaimishche section are described. To date, five species have disappeared from the region of the locality. Paleogeographic conditions in this region are considered.**

INTRODUCTION

The stratotype section of the Khazarian deposits outcropping on the right bank of the Volga River, from the village of Cherny Yar to Nizhnee Zaimishche (Akhtubinskii District of the Astrakhan Region), was studied by geologists for many years. Fossils of small mammals were collected and examined by a number of researchers, including Aleksandrova (1976), Agadjanian, and Kirillova (Kirillova and Svitoch, 1994). Amphibian and reptile remains collected by these researchers were kindly placed at the author's disposal.

Fossil bones were found in various points of the section, but they came from the same stratigraphic level. The geological structure of the locality was described in a number of papers (Moskvitin, 1962; Aleksandrova, 1976; Sedaikin, 1988; Kirillova and Svitoch, 1994). The list of amphibians and reptiles includes the following forms (followed by the sample sizes in parentheses): ***Bombina variegata*** (L.) (1); ***Pelobates fuscus*** (Laurenti) (4); ***Pelobates*** cf. ***fuscus*** (1); ***Pelobates*** sp. (9); ***Bufo raddei*** Strauch (5); ***Bufo*** cf. ***raddei*** Strauch (1); ***Bufo viridis*** complex (4); ***Bufo bufo*** complex (2); ***Bufo*** sp. (9); ***Rana lessonae*** Camerano (2); ***Rana esculenta*** complex (2); ***Rana arvalis*** Nilsson (6); ***Rana temporaria*** complex (1); ***Rana*** sp. (24); Anura indet. (17); ***Lacerta agilis*** L. (9); ***Lacerta*** cf. ***agilis*** (4); Lacertidae indet. (1); ***Natrix natrix*** (L.) (5); ***Natrix*** cf. ***tesselata*** (Laurenti) (7), ***Natrix*** sp. (1); ***Elaphe longissima*** (Laurenti) (10); ***Elaphe*** aff. ***longissima*** (1); ***Elaphe*** sp. (1); Colubrinae indet. (10); ***Vipera ursini*** (Bonaparte) (2); and Serpentes indet. (4). The specimens that are particularly important for the taxonomy and interpretation are described below.

Material	Distinctive features
	Bombina variegata **(L., 1758), yellow-spotted fire-bellied toad**
Fragmentary humerus (Fig. la)	**The distal head of the bone is displaced laterally; the lateral and medial crests are developed to a greater extent than in *B. bombina* and to a lesser extent than in *B. orientalis***
	Pelobates **(cf.)** ***fuscus*** **(Laurenti, 1768), toad frog**
Occipitootic (Figs, lb and lc)	**The occipital condyle weakly tapers ventrally; the process restricting the foramen for nerves V-VH is relatively long; and dorsally, the lateral ramus is relatively narrow**
Two frontoparietals (Fig. Id)	**Unpaired, with peculiar tuberculate sculpturing on the dorsal surface; the anterior edge is weakly serrated. The central part of the dorsal surface is convex and bounded posteriorly by a crest**
Maxilla (Figs, le and 10	**High, with denticles and surface sculpture composed of small tubercles and crests; the posterior edge of the palatine part is rounded and lacks processes**
Vertebra (Figs, lg and lh)	**Procoelous. The neural arch gradually expands posteriorly and does not form a shelflike projection; medially, the posterior edge of the neural arch strongly extends posteriorly and forms a process; and the anterior edge has a deep and narrow notch. The bases of the diapophyses are round in cross section and face anteriorly. The neural arch is relatively short**
	Bufo **(cf.)** ***raddei*** **Strauch, 1876, Radde's toad**
Abdominal vertebra (Figs, li and lj)	**The cotylus is oval and low. The neural arch is flattened; the posterior edge of the ventral surface projects beyond the posterior edge of the dorsal surface; the latter bears longitudinal ridges**
Fragmentary humerus (Fig. Ik)	**The bone is covered by peculiar toad-specific hatching. The proximal part of the specimen bears the distal endings of two ventral crests, the crista ventralis secundaria extends somewhat more distally**
Four ilia (Fig. 11)	**The preacetabular fossa is available; the superior tuber is symmetrical and bears single large knob with a fossa on the upper surface; in three specimens, this fossa is very small**

Material	Distinctive features
Two humeri (Figs, lm and In)	The long axis of the olecranon imprint extends along the long axis of the bone, the medial and lateral crests are short and broad and lack dorsal curvature
	Rana arvalis Nilsson, 1842, brown frog
Scapula (Fig. lo)	The pars acromialis and pars glenoidalis overlap each other, the facies lunata is not turned dorsally. The bone is elongated, the neck is narrow, and the longitudinal crest is well developed
Fragmentary humerus (Figs, lp and lq)	The olecranon imprint is not displaced laterally; the medial crest curves dorsally; the lateral crest is well developed, its proximal ending closely approaches the medial cres
Four ilia (Fig. lr)	The dorsal crest is high; the highest point is located above the superior tuber; the latter is convex and covered by tubercles; the subacetabular zone is narrow
	Lacerta (cf.) *agilis* Linnaeus, 1758, sand lizard
Three fragmentary maxillae (Fig. 2a)	The teeth are pleurodont, with two apices. The anterior edge of the bone, framing the nares, is high and ascends abruptly. A sculptured band extends along the upper edge of the bone. The bone is larger than those of *L. vivipara* and smaller than those of *L. viridis*
Eight fragmentary dentaries (Fig. 2b)	The teeth are pleurodont, with two apices. A deep groove for the splenial reaches the massive anterior edge of the bone
	Elaphe longissima (Laurenti, 1768), chicken-snake
Ten thoracic vertebrae(Figs. 2c-2f)	The haemal keel is spatulate (sensu Auffenberg, 1963). The prezygapophyseal processes are shorter than the prezygapophyseal facet, rounded at the endings, and project almost strictly laterally. The ratio CL/NAW ranges from 1.14 to 1.35
	Elaphe aff. *longissima* (Laurenti, 1768)
Posterior cervical vertebra	The proportions of the centrum, the gladiate (sensu Auffenberg, 1963) haemal keel, the shapes of the cotylus and condyle are most similar to those of the anterior thoracic or posterior cervical vertebrae of *E. longissima.* However, in the latter the tip of the haemal keel curves ventrally, whereas in the specimen considered, the posterior half of the keel is probably convex, and the tip does not curve
	Natrix natrix (Linnaeus, 1758), common grass snake
Five thoracic vertebrae (Figs. 3a-3c)	The vertebral centrum is flattened ventrally and occasionally framed by subcentral crests, extending along almost the entire length of the centrum. The hypapophysis is present; the cotylus and condyle are small in diameter; and the cotylar rim bears well-pronounced subcentral knobs. The ratio CL/NAW ranges from 1.51 to 1.63. In three vertebrae, the articular facets of the zygosphene raise above the anterior concave edge; this is characteristic of N. *natrix*
	Natrix cf. *tesselata* (Laurenti, 1768), aquatic grass snake
Seven thoracic vertebrae	The vertebral centrum is flattened ventrally and occasionally framed by subcentral crests, extending along almost the entire length of the centrum. The hypapophysis is present; the cotylus and condyle are small in diameter; the cotylar rim bears well-pronounced subcentral knobs. The ratio CL/NAW ranges from 1.23 to 1.39.
	Vipera ursini (Bonaparte, 1835), steppe viper
Two thoracic vertebrae (Figs. 3d and 3e)	The hypapophyses are present; the centrum is rounded in cross section; the cotylus and condyle are large; the neural arch is low; the anterior keel is relatively narrow; in lateral view, the parapophyseal process projects mainly ventrally rather than anteriorly; the ratio CL/NAW is 1.63

MATERIAL AND DISCUSSION

The herpetofauna from Cherny Yar sands is rather diverse and includes members of the following seven families: Discoglossidae, Pelobatidae, Bufonidae, Ranidae, Lacertidae, Colubridae, and Viperidae. To date, a number of species from the above list are located only at a large distance from the Cherny Yar locality.

Bombina variegata from the family Discoglossidae currently inhabits central and southern Europe; the eastern boundary of the species range is in trans-Carpathian Ukraine (Bannikov ***et al,*** 1977). The specimen examined in the present study is the second find of ***B. variegata*** in the Neopleistocene of the Russian Platform, which shows the changes of the species range with time. The first find came from the Lower Neopleistocene of the Upper Don Basin (Ratnikov, 1996b).

PelobatesJuscus is common in the Russian Platform and occurs in many localities aged as the Neogene to the Holocene inclusive (Chkhikvadze, 1984; Ratnikov, 1995). The caudal edge of the dorsal surface of the frontoparietals is located anterior to the caudal edge of the ventral surface, which is in contrast to those of the subspecies ***P. Juscus dispar*** (Ratnikov, 1993); therefore, I have assigned the specimens from Cherny Yar to the nominative subspecies.

Bufo raddei was a common species from the Pliocene to the Middle Neopleistocene (Ratnikov, 1996a). Currently, it inhabits Transbaikalia, Mongolia, and the Far East (Bannikov ***et al,*** 1977). Six bones from Cherny Yar have been determined as ***B. raddei.*** Four are referred to as ***Bufo viridis*** complex; however, they most likely belong to ***B. raddei.*** Unfortunately, it is impossible to identify to the level of species the available material on gray toads.

Both green and brown frogs of the genus ***Rana*** were identified. ***Rana lessonae*** represents green frogs; it has disappeared from the region of the locality. The brown frogs are represented by ***Rana arvalis,*** the present-day range of which is 250-300 km north of the locality

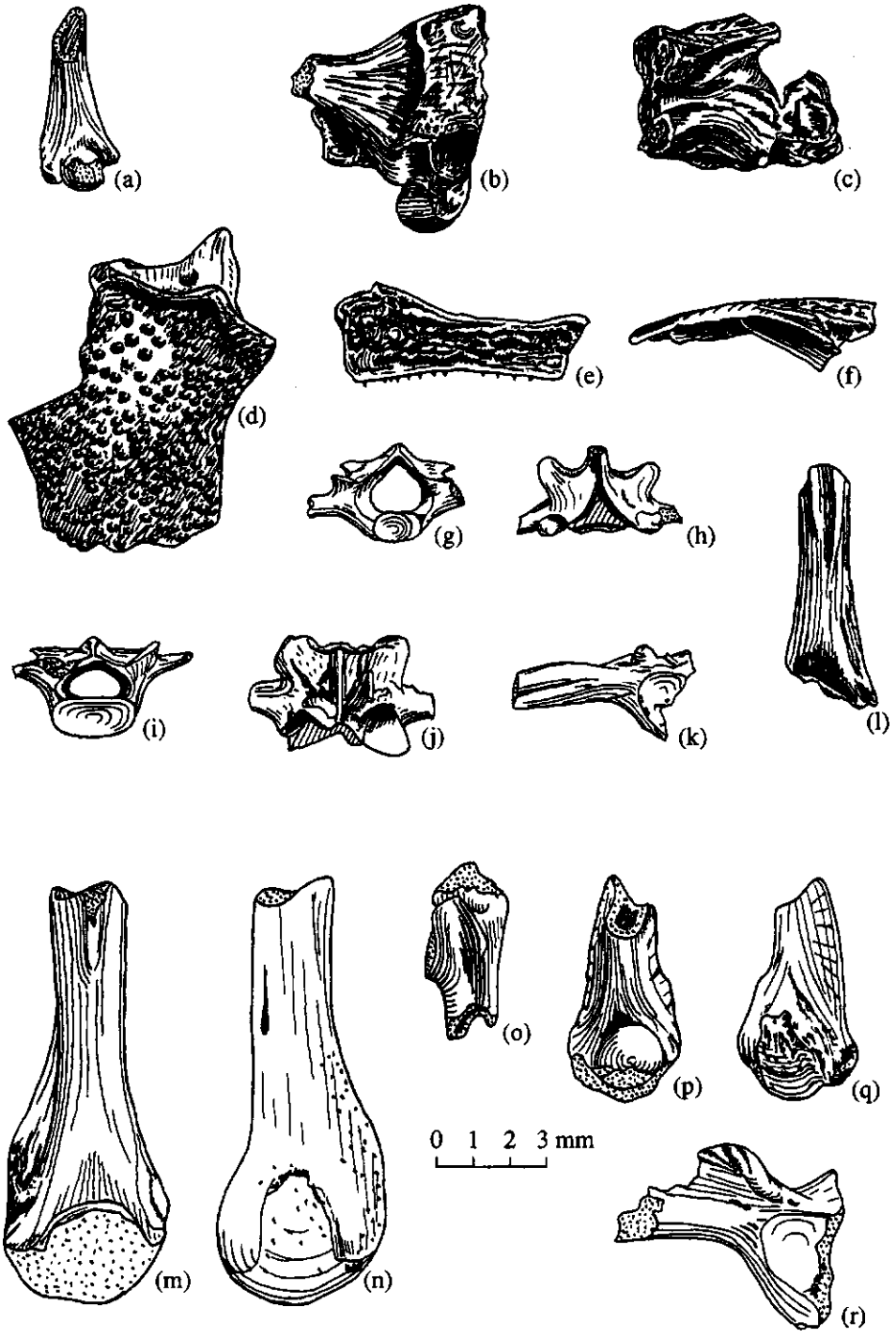

Fig. 1. Amphibians from Cherny Yar sands: *(a) Bombina variegata,* specimen no. 561-1/20, humerus, ventral view; (b-h) *Pelobates fuscus:* (b and c) specimen no. 561-1/39, occipitootic, dorsal and frontal views; (d) specimen no. 561-1/40, frontoparietal, dorsal view; (e and f) specimen no. 561-3/32, maxilla, (e) lateral and (f) dorsal views; and (g and h) specimen no. 561-3/33, vertebra, (g) frontal and (h) dorsal views; (i-1) *Bufo raddei:* (i and j) specimen no. 561-1/42, vertebra, (i) frontal and (j) dorsal views; (k) specimen no. 561-1/15, humerus, ventral view; and (l) specimen no. 561-1/1, ilium, lateral view; (m and *rx)Rana lessonae,* specimen no. 561-1/18, humerus, (m) ventral and (n) dorsal views; and *(o-r)Rana arvalis:* (o) specimen no. 561-1/38, scapula, dorsal view; (p and q) specimen no. 561-1/17, humerus, (p) ventral and (q) dorsal view; and (r) specimen no. 561-3/1, ilium, lateral view.

(Bannikov ***et al,*** 1977). The previous fossil records of these species occurred within the present-day range (Ratnikov, 1992,1996b, 1996c, 1997a, 1997b, 1999a).

Lizards are represented by ***Lacerta agilis,*** the only species of the group that is still widespread. At the same time, snakes are relatively diverse (six species). Both

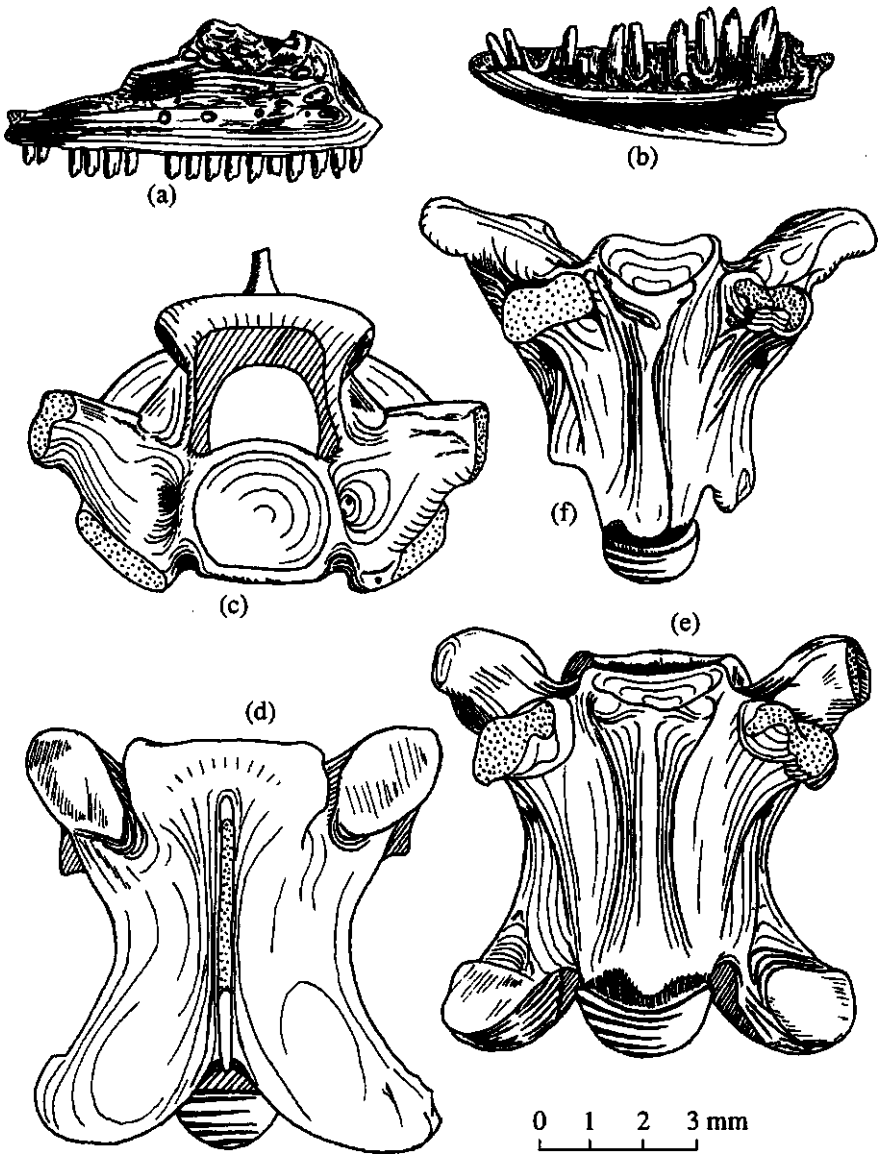

Fig. 2. Reptiles from Cherny Yar sands: (a and b) *Lacerta agilis:* **(a) specimen no. 561-3/57, maxilla, lateral view; and (b) specimen no. 562-2/5, dentary, inner view; (c-f)** *Elaphe longissima:* **(c-e) specimen no. 562-1/5, thoracic vertebra: (c) frontal, (d) dorsal, and (e) ventral views; and (0 specimen no. 562-1/9, thoracic vertebra, ventral view.**

species of grass snakes ***(Natrix natrix*** and ***N. tesselata)*** currently inhabiting Russia, including the region of the locality, are present among the fossil specimens.

To date, the range of ***Elaphe longissima*** is far from the locality. This snake occurs in the southern regions of western Europe, including southwestern Ukraine and southern Moldova, and reaches the Caucasus (Fritzsche, 1985). In the past, ***E. longissima*** had a substantially wider distribution in western Europe. The northern edge of the range reached southern England (Holman, 1998). Previously, the species occurred in the East European Platform, as evidenced by the vertebrae described in the present paper and by ***Elaphe*** cf. ***longissima*** found in the Krasnaya Luka locality, Nizhni Novgorod Region (Ratnikov, 1999b). The Cherny Yar Fauna also contains the other chicken-snake species, a vertebra of which is referred to as ***Elaphe*** sp. This vertebra is morphologically similar to those of ***E. dione,*** currently inhabiting the region of the locality.

Several vertebrae referred to the Colubrinae and differing from the vertebrae described above indicate the presence of other members of the subfamily in the Lower Volga Region of that time.

The family Viperidae is represented by ***Vipera ursini,*** which remains in the region of the locality to the present day.

Most specimens of amphibians and reptiles belong to the species that inhabit open biotopes (green toads,

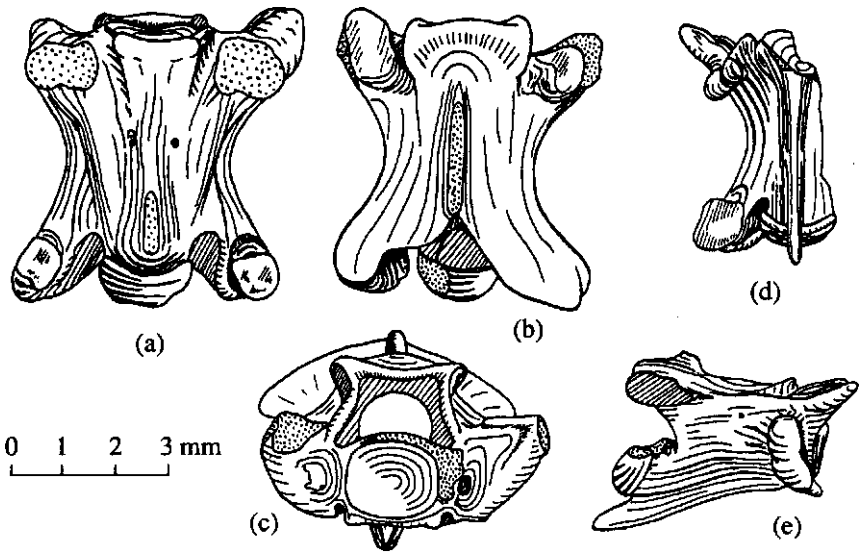

Fig. 3. Thoracic vertebrae of snakes from Cherny Yar sands: (a-c) Atari* *natrix*, specimen no. 562-1/3: (a) ventral, (b) dorsal, and (c) frontal views; and (d and e) *Vipera ursini*, specimen no. 561-3/50, (d) ventral and (e) lateral views.

lizards, ***Natrix tesselata,*** and ***Vipera ursini).*** The species inhabiting forested biotopes ***(Bufo bufo*** complex, ***Rana lessonae, R. arvalis,*** and ***Elaphe longissima)*** are approximately half as numerous. Since fossils are destroyed in the forest conditions at a higher rate than in the steppes (Agadjanian, 1979), the locality under study was probably formed under the conditions of forest-steppe landscapes. This is not at variance with a large number of ***Pelobates*** specimens found in the locality. It is highly probable that humid tall-grass meadows were also widespread. The latter inference follows from the presence of ***R. arvalis, Natrix,*** and ***E. longissima.***

In general, the herpetofauna from the Cherny Yar-Nizhnee Zaimishche locality strongly differs in taxonomic composition from the Late Neopleistocene and Holocene faunas from the Russian Platform, since the latter include only the species that presently inhabit this area (Ratnikov, 1998). The association described in this paper differs from the majority of Early and Middle Neopleistocene faunas by a greater number of forms. Only the herpetofauna from the Kuznetsovka locality (Ratnikov, 1997a) contains a larger number of species. However, this parameter strongly depends on the total number of specimens found in the localities and on burial conditions. At the same time, it is of little importance for stratigraphic and paleogeographic conclusions.

The majority of Early and Middle Neopleistocene herpetofaunas include species presently inhabiting the areas beyond the East European Platform. The ranges of these species are to the east, south, and west of the burials. The Cherny Yar-Nizhnee Zaimishche locality contains eastern ***(Bufo raddei),*** southern (Colubrinae), and western ***(Bombina variegata*** and ***Elaphe longissima)*** forms. This shows once again that, during the history of the Earth, animals migrated in various directions depending on climatic and landscape conditions; the species ranges were rather changeable.

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