

# Neogene Larks (Aves: Alaudidae (Vigors, 1825)) from Bulgaria

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**Abstract:** Complete review of Bulgarian alaudid Neogene fauna has been presented. 17 bones and bone fragments, representing 10 skeletal elements (MNI 10) from 3 localities are referred to 9 taxa – 8 new species and 1 new genus: *Melanocorypha serdicensis* sp. n., *Eremarida xerophila* gen. n. et sp. n., *Melanocorypha donchevi* sp. n., *Lullula balcanica* sp. n., *Eremophila prealpestris* sp. n., *Alauda xerarvensis* sp. n., *Galerida bulgarica* sp. n., and *Lullula slivnicensis* sp. n.

**Key words:** Larks, Fossil birds, Palearctic Passeres, Late Miocene – Late Pliocene, Bulgaria

## Introduction

The Neogene record of birds in Bulgaria consists of 120 taxa (29 families, 15 orders) from 16 localities of middle Miocene (MN 5-8) to the very end of late Pliocene (MNQ 18-19) (BOEV 2000, 2002, 2011). The present paper aims to describe all Miocene and Pliocene record of Alaudidae (VIGORS 1825) from Bulgaria. Some data of the taxonomic composition of larks have been also published by BOEV (1995, 1996)<sup>1</sup>.

The Neogene fossil record of larks is poor worldwide and no fossil species have been described so far in Europe (MLÍKOVSKÝ 2002). Tertiary record of alaudids from Europe includes (except Bulgarian record) three Mediterranean countries: France, Italy and Spain (MLÍKOVSKÝ 1996). According to the same author in Europe Alaudidae were present in the Orleanian (MN 3-5), Astaracian (MN 6-8); Turolian (MN 11-13), and Villanyian (MN 16-17).

Latterly ZELENKOV (2011) reported two larks – *Eremophila* aff. *E. alpestris* and *Calandrella* cf. *C. rufescens* in late Pliocene (MN 16b; ~ 2.7-2.5 mya) of Beregovaya (Bichursky District, Republic of Buryatia). In North Africa (Morocco) MOURER-CHAUVIRÉ & GERAADS (2010) reported on ‘few elements [which] can be attributed to species of the family Alaudidae’.

After the exhaustive review of TYRBERG (1998), at least 2 fossil species of larks have been described from Pleistocene deposits in Palearctic: *Melanocorypha gracilis* Tchernov, 1968 and *Alauda jordanica* Tchernov, 1968<sup>1</sup>.

The cold deserts of Caspian-Mongolian region are considered one of the centers of endemism, including 15 species. The World recent alaudid fauna comprises a total of 96 species (407 taxa) of 21 genera. The larks are typical for the treeless regions of

<sup>1</sup> During the preparation of this issue for print, a paper of KESSLER & JÁNOS (2012) has been published. It describes a new genus and tree new species of larks from Northern Hungary, all of Miocene age: *Galerida cserhatensis* Kessler & János, 2012 (Litke 2, Early Miocene; MN 5; tbt dist., ulna prox.); *Lullula neogradensis* Kessler & János, 2012 (Mátraszőlös 1, Middle Miocene; MN 7/8; tbt dist.); *Praealauda hevesensis* Kessler & János, 2012 (Felsőtárkány, Middle Miocene; MN 7-8; tbt dist.). As seen, only two skeletal elements have been examined and described, tbt dist. and ulna prox. Unfortunately, both are lacking in the studied material from Bulgaria. The chronostratigraphic difference is also considerable (MN 5 to MN 8 /Hungary/ against MN 11-13 to MN 18 /Bulgaria/) and we could exclude a taxonomic identity of the described taxa.

Africa and Eurasia. Only one species is spread in each, Australia, Madagascar and Central and South America (very restricted range). The evolutionary origins of Alaudidae were in Africa, where 78 species occur and the range of 60 is confined to that continent (DE JUANA *et al.* 2004). These authors listed 6 species for the modern Balkan alaudid fauna but recently have been accumulated proofs for the occurring of 9 species at least in that region (Bulgaria): Calandra Lark (*Melanocorypha calandra* (Linnaeus, 1766)), White-winged Lark), Woodlark (*Lullula arborea* (Linnaeus, 1758, (*Melanocorypha leucoptera* (Pallas, 1811))), Black Lark (*Melanocorypha yeltoniensis* (Forster, 1768)), Greater Short-toed Lark (*Calandrella brachydactyla* (Leisler, 1814)), Lesser Short-toed Lark (*Calandrella rufescens* (Vieillot, 1820)), Crested Lark (*Galerida cristata* (Linnaeus, 1758)), Eurasian Skylark (*Alauda arvensis* Linnaeus, 1758), and Horned Lark (*Eremophila alpestris* (Linnaeus, 1758)) (BUNARCO, 2009).

## Material and Methods

**Abbreviations:** acroc. – acrocoracoideus; cmc – carpometacarpus; cor. – coracoid, coracoidal; cran. – cranial, cranialis; cr. – crista; dex. – dextra; dist. – distal, distalis; dors. – dorsal, dorsalis; f. a. – facies articularis; lat. – latral, lateralis; man. – manubrium; m. – musculi; maj. – majoris; med. – medial, medialis; mya – million years ago; pect. – pectoralis; phal. – phalanx; prox. – proximal, proximalis; sin. – sinistra, s.t. – sulcus tendineus; tbt – tibiotarsus, tr. – trochlea; ventr. – ventral, ventralis.

The material consists of 17 bones and bone fragments of 10 skeletal elements: 1 os premaxillare, 2 mandibulae, 2 sterni, 3 cor., 2 humeri, 3 ulnae, 2 cmc, 1 phal. prox. dig. maj. and 1 tbt. The three sites encompass a time scope from Late Miocene (Turolian, Hrabarsko) to the very Late Pliocene (Villanyian, Slivnitsa). This material is referred to MNI 10 and 9 taxa at least (Table 1). It was determined by the comparative avian skeleton collections of 17 species of Alaudidae (72 specimens) (See Appendix 1) of the collections of Vertebrate Animals Department of National Museum of Natural History, Bulgarian Academy of Sciences (VAD-NMNHS) in Sofia (1995-2002), University Claude Bernard Lyon 1, Department of Earth Sciences (UCBL) in Lyon (1994-1995), Natural History Museum (NHM) in Tring, a part of Natural History Museum, London

(1999; 2003) and Institute of Systematics and Evolution of Animals, Polish Academy of Sciences (ISEAK) in Krakow (1998; 2001).

The osteological terminology follows BAUMEL & WITMER (1993). The associated faunas and considerations for the dating of sites were given by BOEV (1996, 2000, and 2002). The biochronology of the site is given after MEIN (1990).

### Systematic part

Order PASSERIFORMES L., 1758

Family Alaudidae (Vigors, 1825)

***Melanocorypha* Boie, 1828**

*Melanocorypha serdicensis* sp.n.

**Holotype:** Cor. sin. NMNH 475. (Pl. 1 – a, b), collections of VAD-NMNHS. Collected by Dr. Ivan Nikolov in the 1960s in the former coal mines ‘Plamak’.

**Paratypes:** No paratypes has been collected.

**Etymology:** The name ‘*serdicensis*’ is given after the ancient (Roman) name of Sofia City, center of Sofia District, where the holotype locality is referred to.

**Measurements** of holotype: Table 2; Fig.1-A.

**Diagnose:** A fossil species of *Melanocorypha*, differing from the all hitherto known species by more transversal (diagonal), instead longitudinal, orientation of the linea intermuscularis, limiting impressio m. sternocoracoidei on med. surface of cor.

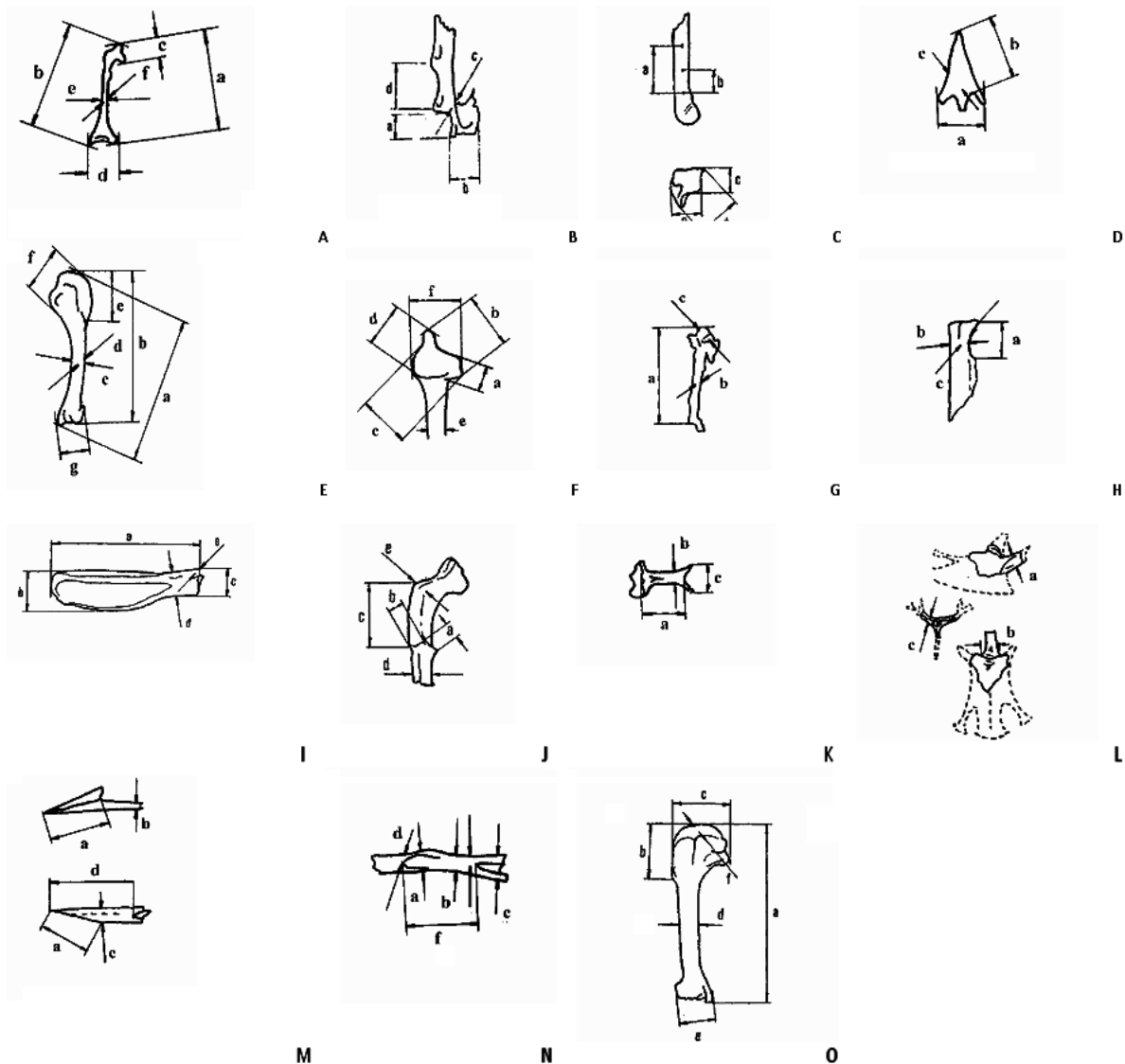
**Locality:** Hrabarsko. Geographical location: Vicinity of Hrabarsko village (Sofia District; W Bulgaria), 24 km NW of Sofia City. 42.48 N, 23.03 E; UTM grid: FN 64.650 m a.s.l. The finds come from the former ‘Plamak’ coal mines near Hrabarsko village.

**Horizon and Chronology:** The layers belong to Balsha member of Gnilyane Formation (KAMENOV & KOYUMDZHEVA 1983). SPASSOV & GINSBURG (1999) refer the site to Middle (sooner Upper) Pontian, i. e. Late Miocene.

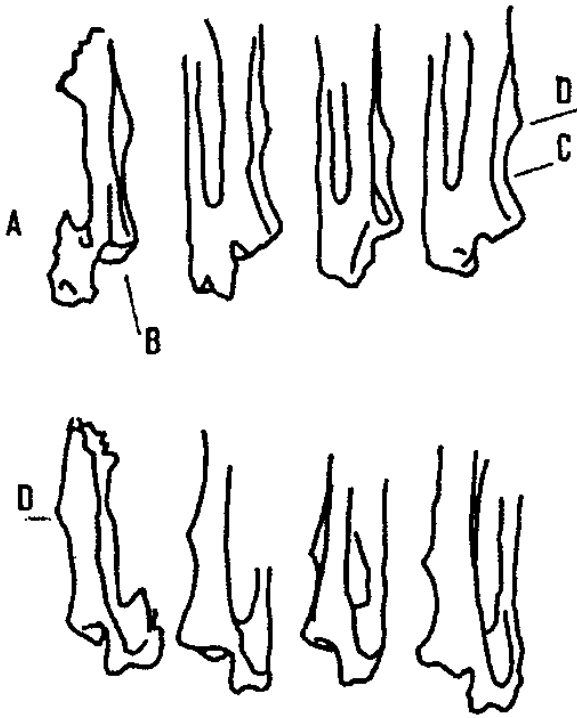
**Comparison:** The characteristic for Alaudidae foramen on the base of pr. acroc. is well developed. It differs from: *L. arborea*: similar in morphology of the acrocoracoidal part but differs by much larger size, and more diagonal, than longitudinal, orientation of linea intermuscularis on med. surface of humeral half of bone. *Galerida* spp.: by larger size, longer edge of f. a. sternalis, i. e. its cut, instead arc-like, shape of f. a. sternalis. *G. cristata*: by much larger size, the ‘cut’ shape and lower ridge in the middle part of f. a. sternalis, instead a whole arc as a sickle-like shape, higher limiting ridge of

**Table 1.** Taxonomic distribution and skeletal elements of Neogene alaudid finds from Bulgaria.

Taxa	Skeletal elements and collection numbers (NMNHS)	Localities	Number of finds	MNI
<i>Melanocorypha serdicensis</i> sp. n.	cor. sin. 475	Hrabarsko	1	1
<i>Melanocorypha donchevi</i> sp. n.	os premaxillare 16540 ulna dex. dist. 295 cmc dex. dist. 296	Varshets	3	1
<i>Eremophila prealpestris</i> sp. n.	humerus dex. 179 ulna sin. prox. 12353	Varshets	2	1
<i>Eremarida xerophila</i> gen. n. et sp. n.	cor. sin. 476	Hrabarsko	1	1
<i>Galerida bulgarica</i> sp. n.	cmc dex. 153 tbt sin. prox. 155	Varshets	2	1
<i>Alauda xerarvensis</i> sp. n.	mandibula 297 mandibula sin. 298 ulna sin. prox. 12469 sternum, pars cran. 174	Varshets	4	2
<i>Lullula balcanica</i> sp. n.	phal. prox. dig. maj. sin. 173	Varshets	1	1
<i>Lullula slivnicensis</i> sp. n.	cor. sin. dist. 451 sternum, pars cran. 430	Slivnitsa	2	1
Alaudidae gen. indet.	humerus sin. 270	Varshets	1	1
<b>Total</b>			<b>17</b>	<b>10</b>



**Fig. 1.** The manner of measuring of the skeletal elements of fossil and recent Alaudidae (ref. to Tables 2-16). Drawings: Vera Hristova.



**Fig. 2.** Comparisons of cmc dex. dist. in fossil and recent Alaudidae: upper row – med. view of *Melanocorypha donchevi* sp. n., *M. calandra*, *M. leucoptera*, *M. mongolica*; lower row – lat. view of *Melanocorypha donchevi* sp. n., *M. calandra*, *M. leucoptera*, *M. mongolica*. Drawings: Vera Hristova.

f. a. sternalis, relatively longer pr. acroc., more caudal position of wider part of f. a. sternalis, and lacking of a longitudinal groove on cran. surface of diaphysis. *Eremophila* spp.: resembles by shape (1) of f. a. sternalis, but differs by smaller size, details of the relief of prox. (sternal) half of the bone, the much shallower concavity of impressio m. sternocoracoidei, rounded, instead of edges, cran. surface of diaphysis. *A. arvensis*: by larger size, more oblique, than steep, protruding of pr. acroc., narrower f. a. sternalis, and more caudal position of its wider part in ventr. view. *Eremopterix*: by larger size and more upright pr. acroc. *A. deserti*: by larger size, more developed relief on med. surface of bone, and longer edge of f. a. sternalis. *L. arborea* and *C. brachydactyla*: by larger size and longer edge of f. a. sternalis. *Mirafra* spp.: by larger size, slightly curved diaphysis, and longer edge of f. a. sternalis. *C. cinerea*: by much larger size, and cut, instead arc-like, shape of f. a. sternalis. *C. rufescens*: by much larger size, and absence of a protruding ridge on lat. side of f. a. sternalis. *Eremarida xerophila* sp. n. (NMNHS 476): similar

in general morphology but differs by larger size, lacking of a ‘cut’ part of the arc of f. a. sternalis, and more transversal (diagonal), instead longitudinal, orientation of linea intermuscularis, limiting impressio m. sternocoracoidei on med. surface, by the relief of med. surface of prox. part, height of pr. lat., and line of its dist. prolongation. *M. calandra*: considerable similarity but differs by wider and more massive edge of f. a. sternalis, slightly arc-like cranially curved diaphysis, and more clearly marked dors. line (edge) of pr. lat. along diaphysis. *M. yeltoniensis*: very similar but differing mainly by more transversal (diagonal), instead longitudinal, orientation of linea intermuscularis, limiting impressio m. sternocoracoidei on med. surface, as well as by clearer edges along diaphysis, more edged pr. acroc., and longer hook-like processus on the acrocoracoidal part. Early Pleistocene *M. gracilis*: The species is ‘smaller ... than *M. calandra*...’, and it is dated ‘post-Villafranchian’ (680 000 ± 50 000 BP; TCHERNOV 1980), i.e. the chronostratigraphical difference is considerable enough to suppose a taxonomical identity.

***Melanocorypha donchevi* sp. n.**

**Holotype:** Cmc dex. dist. NMNHS 296 (Table 3; Pl. 1 – h, i), collections of VAD-NMNHS. Collected by the author between 1990 and 2000.

**Paratypes:** Ulna dex. dist. NMNHS 295 (Table 4; Pl. 1 – f, g), collected by the author between 1990 and 2000; os premaxillare NMNHS 16540 (Table 5; Pl. 1 – c, d, e), collected by Mr. ANDREY STOYANOV and Dr. NIKOLAY TSANKOV (NMNHS) on 01.12. 2010.

**Etymology:** The name ‘*donchevi*’ is given after the name of Bulgarian ornithologist Dr. STEFAN DONCHEV (1931-2010), contributed much for the exploration of modern avifauna of Bulgaria.

**Measurements** of holotype: Table 3; Fig.1-B.

**Measurements** of paratypes: NMNHS 295: Table 4; Fig.1-C; length of the fragment – 7.49 mm; NMNHS 16540: Table 5; Fig.1-D.

**Diagnose:** A Late Pliocene species of *Melanocorypha*, differing from all hitherto known recent and fossil species of this genus by the: (1) cmc: more prox. position of the exostosis on the cranio-lat. edge on the os metacarpale majus; (2) ulna: more developed and clearly protruding papillae remigales caudales.

**Locality, Horizon and Chronology:** Varshets. Vicinity (6 km NNE) of the town of Varshets near

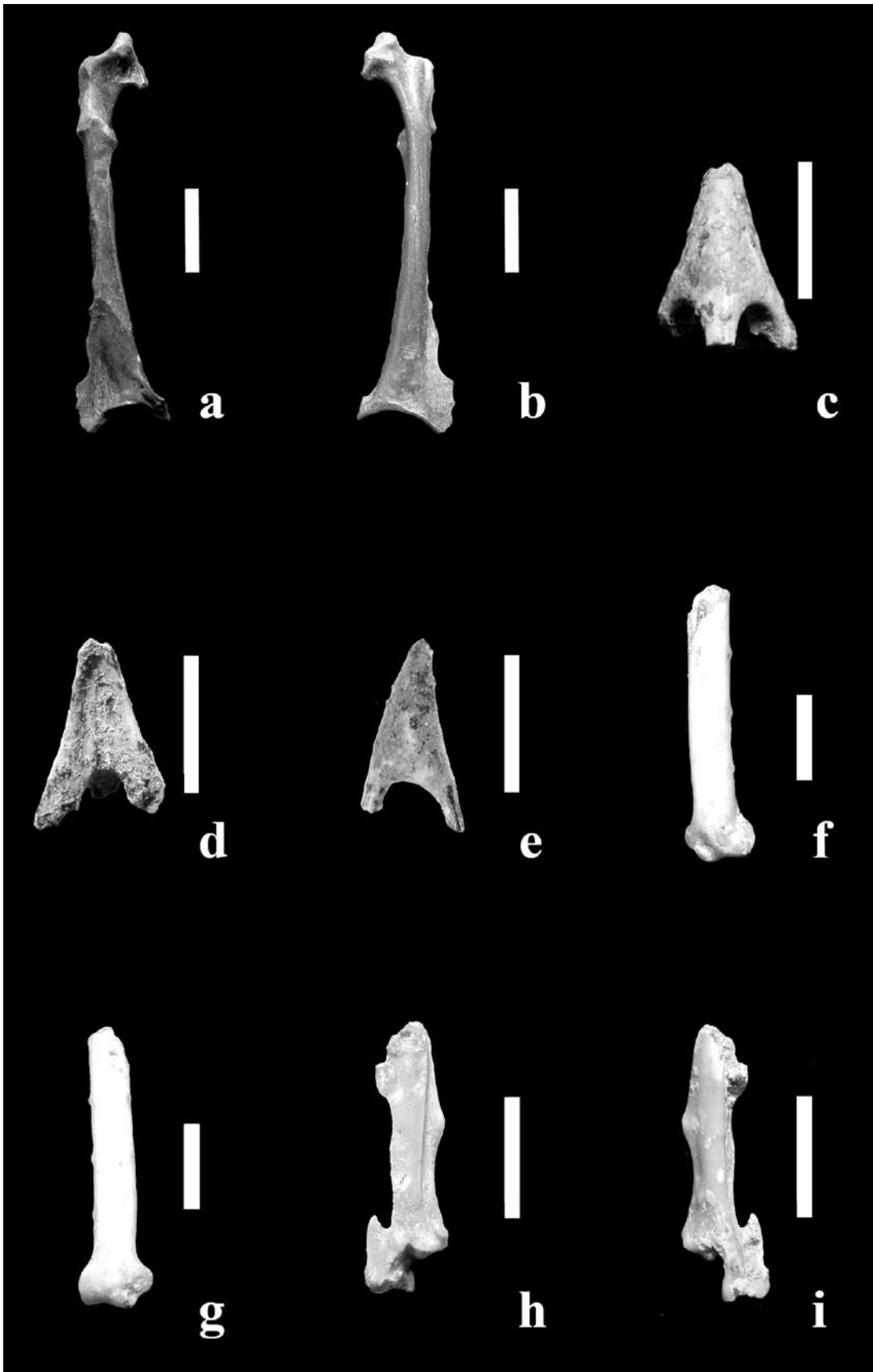
**Table 2.** The measurements of cor. in fossil and recent Alaudidae (ref. to Fig. 1-A).

Taxa	a	b	c	d	e	f
Fossil – Hrabarsko						
<i>Melanocorypha serdicensis</i> sp. n. NMNHS 475	24.2	25.2	3.9	5.5	1.5	1.7
<i>Eremarida xerophila</i> gen. n. et sp. n. NMNHS 476	22.2	22.9	3.4	4.9	1.3	1.4
Recent						
<i>Melanocorypha calandra</i> NMNHS 1/2002	24.7	25.4	3.4	5.5	1.5	1.8
<i>Melanocorypha calandra</i> NHM 1952.2.599	24.3	25.0	3.4	5.1	1.5	1.6
<i>Melanocorypha mongolica</i> NHM 1911.9.12.1	-	-	3.4	-	-	-
<i>Melanocorypha yeltoniensis</i> NHM 1856.7.20.8	24.7	25.7	3.8	5.1	1.5	1.8
<i>Melanocorypha yeltoniensis</i> NHM 1952.2.600	ca.23.6	ca.25.2	3.7	-	1.6	-
<i>Alauda arvensis</i> NHM 1983.100.3	20.8	21.4	2.9	4.4	1.3	1.5
<i>Alauda arvensis</i> NHM 1983.100.5	19.8	ca.20.6	2.9	4.0	1.1	1.5
<i>Alauda arvensis</i> NHM 1983.100.6	19.8	20.3	2.9	3.6	1.2	1.5
<i>Alauda arvensis</i> NHM 1983.100.7	19.3	20.6	3.0	3.8	1.2	1.4
<i>Alauda arvensis</i> NMNHS 3/1997	21.0	21.8	3.1	5.0	1.3	1.6
<i>Alauda arvensis</i> NMNHS 5/2008	20.3	21.5	3.3	4.9	1.2	1.5
<i>Ammomanes deserti</i> NHM 1978.3.3	14.9	15.7	2.7	3.3	1.0	1.1
<i>Calandrella brachydactyla</i> NHM 1952.2.601	16.3	16.8	2.4	3.0	0.9	1.2
<i>Calandrella brachydactyla</i> NHM 1961.13.34	16.7	17.2	-	4.0	1.1	1.2
<i>Calandrella cinerea</i> NHM 1903.1.6.3	19.8	20.5	3.0	3.8	1.2	1.2
<i>Calandrella cinerea</i> NHM 1961.13.21	17.3	17.9	2.5	3.3	1.0	1.2
<i>Calandrella cinerea</i> NHM 1961.13.34	16.7	17.3	2.3	3.6	1.0	1.1
<i>Eremophila alpestris</i> NHM 1869.9.12.15	20.5	21.1	3.0	4.2	1.2	1.4
<i>Eremophila alpestris</i> NHM 1930.3.24.513	20.1	20.5	3.0	4.5	1.3	1.3
<i>Eremophila alpestris</i> NHM 1963.15.1	20.3	21.7	3.4	5.2	1.3	1.4
<i>Eremopterix nigriceps</i> NHM 1996.69.13	15.7	15.9	2.6	3.0	1.0	1.1
<i>Galerida cristata</i> NHM 1853.1.18.16	20.4	21.4	3.2	5.5	1.2	1.5
<i>Galerida cristata</i> NHM 1998.92.35	21.1	22.0	3.3	4.1	1.3	1.4
<i>Galerida cristata</i> NMNHS 2/1998	19.6	20.0	-	4.4	1.3	1.5
<i>Galerida theklae</i> NHM 1965.16.2	19.6	20.8	3.1	3.8	1.3	1.5
<i>Lullula arborea</i> NHM 1952.2.602	17.5	18.6	2.7	3.6	1.2	1.3
<i>Lullula arborea</i> NHM 1965.15.2	18.5	19.4	3.0	3.1	1.1	1.3
<i>Lullula arborea</i> NHM 1965.15.4	18.6	19.5	3.0	3.3	1.2	1.4
<i>Lullula arborea</i> NMNHS 1/1990	18.6	19.2	3.0	4.2	1.1	1.4
<i>Lullula arborea</i> NMNHS 5/2000	18.1	18.6	2.8	3.6	1.0	1.2
<i>Mirafra hova</i> NHM 1897.5.10.59	15.6	ca.15.0	2.2	-	1.0	-
<i>Mirafra javanica</i> NHM 1969.4.53	17.0	17.6	2.7	2.9	0.9	1.1

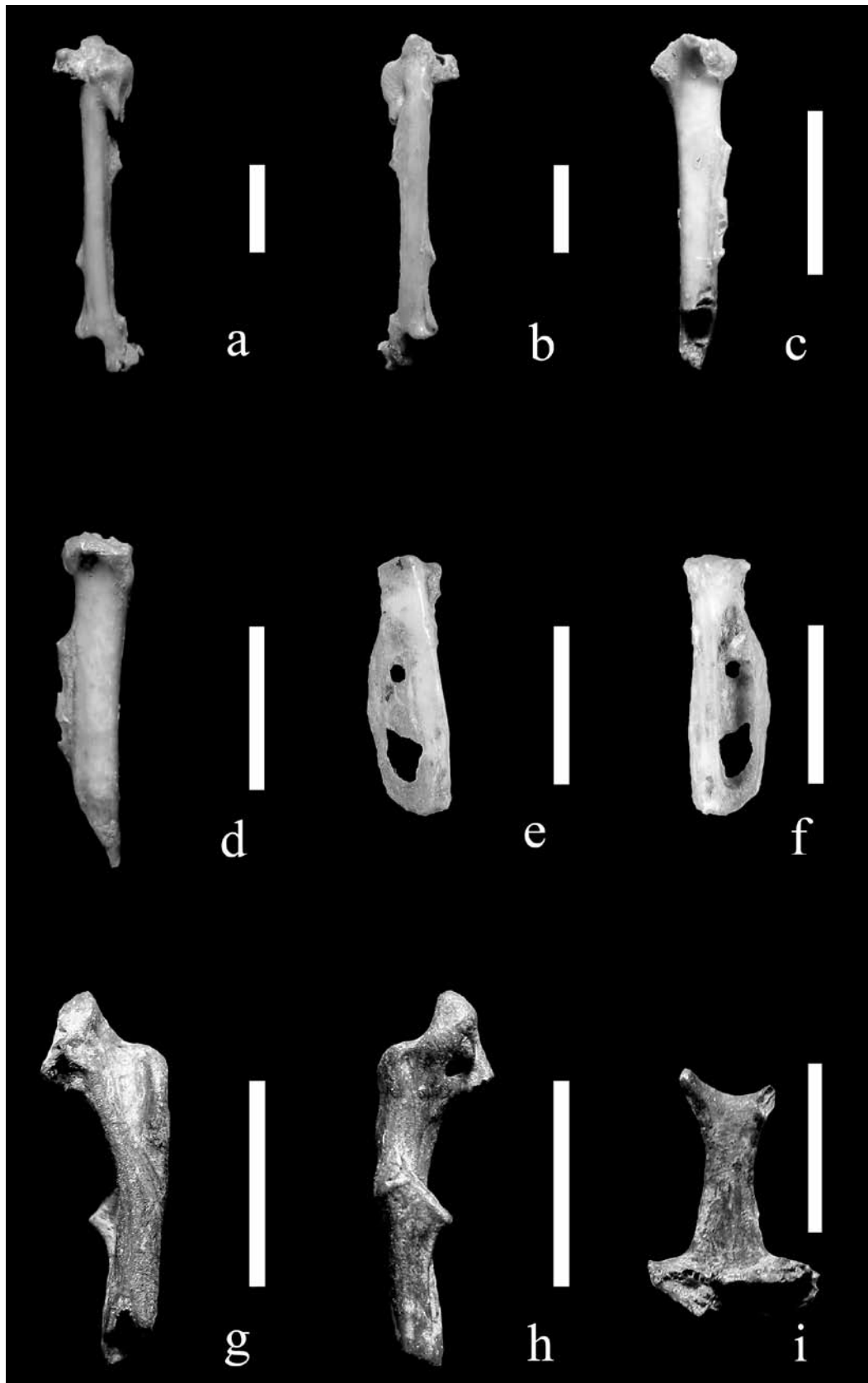
the town of Vratsa (Montana District; NW Bulgaria), 43.13 N, 23.17 E; UTM grid: FN 89). 650 m a. s. l. A ponor in a rocky hill. Unconsolidated, unstratified sediments accumulated in the filling of clay terra-rossa. The fossil bones are broken, sometimes making a kind of bone breccia. Late Pliocene (Middle Villafranchian; SCT 11 (sooner SCT 12) of MNQ 17 zone, dated ca. 2.23-2.40 mya) (SPASSOV 1997).

Cmc dex. dist. NMNHS 296 (Table 3). It was compared with species of the all families of recent passerine avifauna of Western Palearctic. It shows all the features, specific for Alaudidae family. It differs from: *A. deserti*: by much larger size. *M.*

*javanica*: by much larger size. *E. alpestris*: by larger size, and relatively thicker os metacarpalis majus in its dist. third. *E. nigriceps*: by larger size and deeper s. t. on lat. surface of os metacarpalis majus. *C. brachydactyla*: by more relief articular face of synostosis metacarpalis dist. *G. theklae*: by larger size, more relief articular face of synostosis metacarpalis dist., and relatively larger measurement 'd'. *G. cristata*: by larger dimensions 'a' and 'd'. *A. arvensis*: by larger size and relatively larger measurement 'd'. *E. leucotis*: clearly by much larger size. *C. rufescens*: by much larger size, relatively larger measurement 'd', deeper s. t., and presence of



**Pl. 1.** *Melanocorypha serdicensis* sp. n. (Late Miocene) Hrabarsko, CW Bulgaria – cor. sin. NMNHS 475: a – med. view; b – lat. view; *Melanocorypha donchevi* sp. n. (Late Pliocene) Varshets, NW Bulgaria – os premaxillare NMNHS 16540: c – dors. view; d – ventr. view; e – lat. view; ulna dex. dist. NMNHS 295: f – lat. view; g – med. view; cmc dex. dist. NMNHS 296: h – lat. view; i – med. view. Scale bare = 5 mm (Photographs: Assen Ignatov).



**Pl. 2.** *Galerida bulgarica* sp. n. (Late Pliocene) Varshets, NW Bulgaria – cmc. dex. NMNHS 153: a – med. view; b – lat. view; tbt sin. prox. NMNHS 155: c – cran. view; d – caudal view; *Lullula balcanica* sp. n. (Late Pliocene) Varshets, NW Bulgaria – phal. prox. dig. maj. NMNHS 173: e – lat. view; f – med. view; *Lullula slivnicensis* sp. n. (Late Pliocene) Slivnitsa, CW Bulgaria – cor. sin. dist. NMNHS 451: g – lat. view; h – med. view; sternum NMNHS 430: i – dors. view. Scale bare = 5 mm (Photographs: Assen Ignatov).

**Table 3.** The measurements of cmc sin. dist. in fossil and recent Alaudidae (ref. to Fig. 1-C).

Taxa	a	b	c	d
Fossil – Varshets				
<i>Melanocorypha donchevi</i> sp. n. NMNHS 296	1.9	2.4	2.0	5.0
Recent				
<i>Melanocorypha calandra</i> NMNHS 1/2002	1.7	2.5	2.0	4.3
<i>Melanocorypha calandra</i> ISEAK A-3864/81	2.0	2.2	1.8	4.8
<i>Melanocorypha calandra</i> NHM 1952.2.599	ca. 1.6	ca. 2.5	2.0	4.8
<i>Melanocorypha leucoptera</i> ISEAK A-2153/70	1.8	2.1	1.7	3.4
<i>Melanocorypha yeltoniensis</i> NHM 1856.7.20.8	2.0	3.0	2.1	4.8
<i>Melanocorypha yeltoniensis</i> NHM 1952.2.600	2.2	2.4	2.0	4.4
<i>Alauda arvensis</i> NHM 1983.100.7	1.3	1.6	1.6	3.6
<i>Alauda arvensis</i> NMNHS 1/1989	1.3	1.8	1.6	3.1
<i>Alauda arvensis</i> NMNHS 3/1997	1.4	1.7	1.7	3.7
<i>Alauda arvensis</i> NMNHS 5/2008	1.5	1.8	1.7	4.2
<i>Ammomanes deserti</i> NHM 1978.3.3	1.3	1.5	1.4	3.4
<i>Calandrella brachydactyla</i> ISEAK A-3504/78	1.4	1.6	1.5	3.2
<i>Calandrella cinerea</i> ISEAK A-3850/81	1.4	1.6	1.6	3.2
<i>Calandrella rufescens</i> ISEAK A-3855/81	1.5	1.6	1.4	3.5
<i>Eremophila alpestris balcanica</i> NMNHS 1/1991	1.6	1.8	1.7	3.8
<i>Eremopterix leucotis</i> ISEAK A-3192/76	1.1	1.3	1.3	3.0
<i>Eremopterix nigriceps</i> NHM 1996.69.13	1.0	1.4	1.3	3.0
<i>Galerida cristata</i> NMNHS 2/1998	1.3	1.9	1.6	4.2
<i>Galerida cristata</i> ISEAK A-2372/71	1.3	2.1	1.9	3.8
<i>Galerida cristata</i> NHM 1853.1.18.16	1.3	2.0	1.7	4.2
<i>Galerida theklae</i> ISEAK A-3849/81	1.7	2.0	1.7	3.5
<i>Galerida theklae</i> NHM 1965.16.2	1.7	2.0	1.7	3.8
<i>Lullula arborea</i> NMNHS 1/1990	1.4	1.8	1.7	3.6
<i>Lullula arborea</i> NMNHS 3/1997	1.0	1.2	1.6	2.9
<i>Lullula arborea</i> NMNHS 4/1998	1.4	1.8	1.6	3.4
<i>Lullula arborea</i> NMNHS 5/2000	1.0	1.6	1.6	3.9
<i>Mirafra javanica</i> NHM 1969.4.58	1.0	1.3	1.3	3.1

protuberance (A) (Fig. 2). *C. cinerea*: by more prox. location of exostosis (D), and notably deeper s. t. *M. calandra*: high similarity but differs by deeper s. t. on os metacarpale majus, presence of protuberance (A), shorter synostosis metacarpalis dist., and presence of a ‘rib-isation’ on ventr. surface of symphyseal part. *M. yeltoniensis*: by slightly smaller size, and more prox. position of exostosis on cran. edge of os metacarpale majus (smaller measurement ‘d’). *M. leucoptera*: by larger measurement ‘d’. *M. mongolica*: by clear widening of s. t. (B), shallower s. t. in its dist. end (C). Early Pleistocene *M. gracilis*: The species is ‘smaller ... than *M. calandra*...’, and it is dated ‘post-Villafranchian’ (680 000 ± 50 000 BP; TCHERNOV 1980), i. e. the chronostratigraphical difference is considerable enough to suppose a taxonomical identity.

*Melanocorypha serdicensis* sp. n. (present paper): Could not be compared, because of lacking of

analogous skeletal elements. Another reason: the chronostratigraphical differences are considerable (ca. 5-3 my) for taxonomical identity. *Alauda xerarvensis* sp. n. (present paper): Could not be compared, because of lacking of analogous skeletal elements.

Ulna dex. dist. NMNHS 295 (Table 4). Length of the fragment: 17.0 mm. It differs from: *A. arvensis*: by larger size. *A. deserti*: by much larger size and relatively thicker diaphysis in its dist. third. *M. javanica*: by much larger size. *E. alpestris*: by larger size, and more developed papillae remigales caudales. *E. nigriceps*: by larger size and sharper transition in lat. view between shaft of diaphysis and condylus dors. *G. theklae*: by larger size and rounder c. dors. in lat. view. *G. cristata*: by larger size, more protruding papillae remigales caudales, and relatively bigger c. ventr. of dist. epiphysis in lat. view. *Lullula arborea*: by larger size and stronger robustness. *M. leucoptera*: high similarity, both

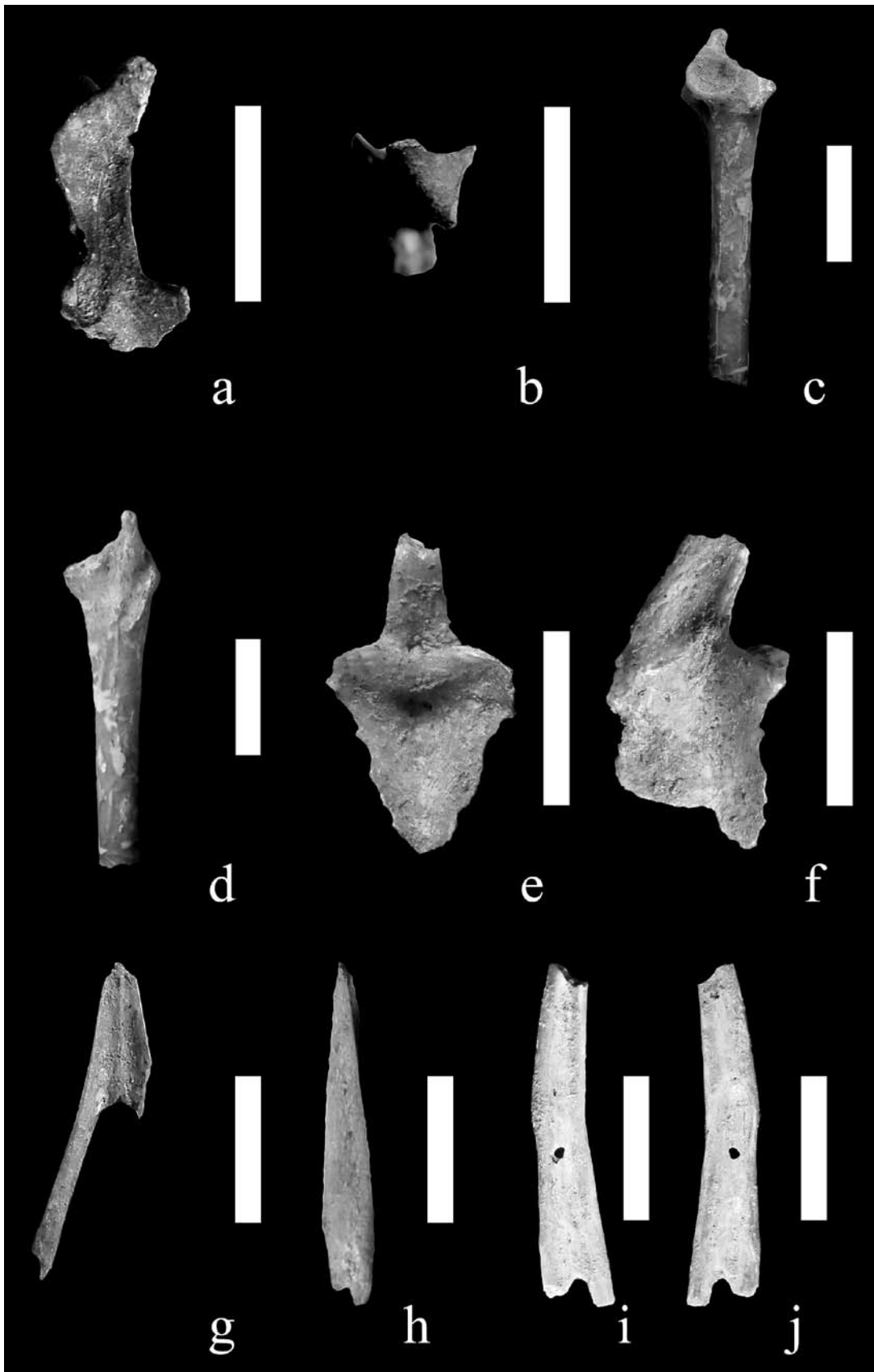


**Table 4.** The measurements of ulna sin. dist. in fossil and recent Alaudidae (ref. to Fig. 4).

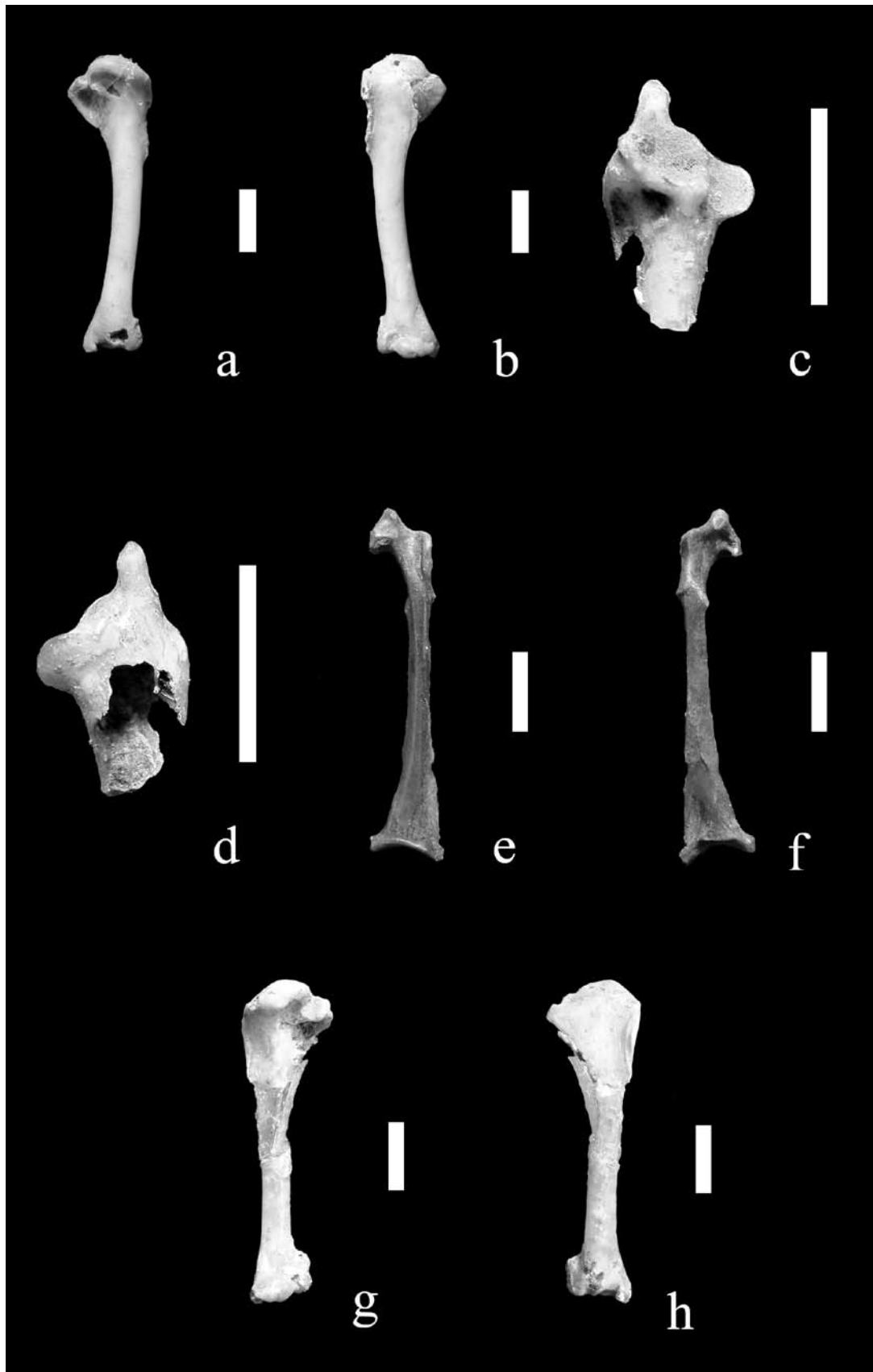
Taxa	a	B	c	D	e
Fossil – Varshets					
<i>Melanocorypha donchevi</i> sp. n. NMNHS 295	7.1	3.5	2.8	4.2	2.6
Recent					
<i>Melanocorypha calandra</i> NMNHS 1/2002	7.0	3.4	2.8	2.9	4.3
<i>Melanocorypha calandra</i> ISEAK A-3506/78	7.5	3.6	2.9	4.3	2.5
<i>Melanocorypha calandra</i> ISEAK A-3864/75	7.6	3.7	2.8	4.1	2.4
<i>Melanocorypha calandra</i> NHM 1952.2.599	6.8	3.3	3.5	3.9	2.4
<i>Melanocorypha leucoptera</i> ISEAK A-2153/60	5.9	2.8	2.4	3.5	2.0
<i>Melanocorypha mongolica</i> ISEAK A-3094/75	ca. 7.8	3.3	2.7	4.2	2.3
<i>Melanocorypha yeltoniensis</i> NHM 1856.7.20.8	8.5	4.6	2.9	4.4	2.6
<i>Melanocorypha yeltoniensis</i> NHM 1952.2.600	ca. 7.5	ca. 3.0	2.9	4.4	2.5
<i>Alauda arvensis</i> NMNHS 3/1997	7.6	3.5	2.2	3.7	2.0
<i>Alauda arvensis</i> NMNHS 5/2008	6.9	3.2	2.3	3.6	2.1
<i>Alauda arvensis</i> UCBL 286/1	7.2	3.4	2.4	3.7	2.3
<i>Alauda arvensis</i> UCBL 286/2	6.8	3.3	2.4	3.6	2.4
<i>Alauda arvensis</i> UCBL 286/4	-	3.0	2.3	3.6	2.2
<i>Alauda arvensis</i> UCBL 286/5	7.4	3.6	2.5	3.8	2.1
<i>Ammomanes deserti</i> NHM 1978.3.3	ca. 6.0	ca. 3.1	1.8	3.1	1.9
<i>Eremophila alpestris balcanica</i> NMNHS 1/1991	6.1	2.9	2.2	3.4	2.1
<i>Eremophila alpestris</i> NHM 1869.9.12.15	ca.5.1	2.8	2.2	3.3	2.0
<i>Eremopterix nigriceps</i> NHM 1996.69.13	5.5	3.1	1.8	2.8	1.8
<i>Galerida cristata</i> NMNHS 2/1998	7.1	3.5	2.5	3.4	2.1
<i>Galerida cristata</i> UCBL 283/1	6.3	3.0	2.1	3.2	2.1
<i>Galerida cristata</i> UCBL 283/2	6.8	3.0	2.3	3.6	2.0
<i>Galerida theklae</i> NHM 1965.16.2	6.6	3.2	2.4	3.6	2.2
<i>Lullula arborea</i> NMNHS 1/1990	6.3	3.1	2.2	3.4	2.1
<i>Lullula arborea</i> NMNHS 3/1997	-	-	1.9	3.4	2.3
<i>Lullula arborea</i> NMNHS 4/1998	ca.5.8	ca.3.3	1.9	3.2	1.9
<i>Lullula arborea</i> NMNHS 5/2000	6.1	3.0	1.9	3.0	1.8
<i>Lullula arborea</i> UCBL 285/1	6.0	3.0	2.1	3.2	2.0
<i>Mirafra javanica</i> NHM 1969.4.58	5.9	2.7	1.8	2.9	1.7

**Table 5.** The measurements of os premaxillare in fossil and recent Alaudidae (ref. to Fig. 1-D).

Taxa	a	b	c
Fossil – Varshets			
<i>Melanocorypha donchevi</i> sp. n. NMNHS 16540	4.5	ca.7.0	3.1
Recent			
<i>Melanocorypha mongolica</i> NMNHS 1/2010	ca.5.0	ca.7.5	ca.4.1
<i>Melanocorypha calandra</i> NMNHS 1/2002	5.4	9.8	4.0
<i>Melanocorypha calandra</i> NMNHS 1/2002	4.8	10.1	4.1
<i>Alauda arvensis</i> NMNHS 1/1989	4.1	5.6	2.1
<i>Lullula arborea</i> NMNHS 1/1990	3.0	6.0	2.0
<i>Lullula arborea</i> NMNHS 1/1990	2.7	5.7	1.7
<i>Alauda arvensis</i> NMNHS 4/1997	4.0	6.0	2.5
<i>Lullula arborea</i> NMNHS 5/2000	2,8	56.0	1.7
<i>Lullula arborea</i> NMNHS 5/2000	-	5.1	-
<i>Alauda arvensis</i> NMNHS 5/2008	4.5	6.8	2.5
<i>Alauda arvensis</i> NMNHS 5/2008	3.4	6.9	2.2
<i>Alauda arvensis</i> NMNHS 2/1990	3.8	5.7	2.5
<i>Calandrella cinerea</i> NMNHS 1/1981	4.4	5.6	2.2
<i>Eremophila alpestris balcanica</i> NMNHS 1/1991	3.8	ca.7,7	3.0
<i>Galerida crisrtata</i> NMNHS 1/1981	3.6	8.1	2.6
<i>Calandrella cinerea</i> NMNHS 1/1981	3.6	5.4	2.3
<i>Galerida crisrtata</i> NMNHS 1/1981	3.7	7.5	2.3



**Pl. 3.** *Lullula slivnicensis* sp. n.(Late Pliocene) Slivnitsa, CW Bulgaria – sternum NMNHS 430: a – lat. view; b – cran. view; *Alauda xerarvensis* sp. n. (Late Pliocene) Varshets, NW Bulgaria – ulna sin. prox. NMNHS 12469: c – med. view; d – lat. view; sternum NMNHS 174: e – dors. view; f – lat. view; mandibula NMNHS 297: g – dors. view; h – lat. view; mandibula sin. NMNHS 298: i – med. view; j – lat. view. Scale bare = 5 mm (Photographs: Assen Ignatov).



**Pl. 4.** *Eremophila prealpestris* sp. n. (Late Pliocene) Varshets, NW Bulgaria – humerus dex. NMNHS 179: a – med. view; b – lat. view; ulna sin. prox. NMNHS 12353: c – med. view; d – lat. view; *Eremarida xerophila* gen. n. et sp. n. – cor. sin. NMNMS 476: e – lat. view; f – med. view; Alaudidae gen. indet. (Late Pliocene) Varshets, NW Bulgaria – humerus sin. NMNHS 270: g – med. view; h – lat. view. Scale bare = 5 mm (Photographs: Assen Ignatov).

**Table 6.** The measurements of humerus dex. in some fossil and recent Alaudidae (ref. to Fig. 1-E; measurements ‘c’ and ‘d’ taken in the middle of diaphysis).

Taxa	a	b	c	d	e	f	g
Fossil – Varshets							
<i>Eremophila prealpestris</i> sp. n. NMNHS 179	24.2	23.8	2.3	2.0	9.0	7.2	5.0
Recent							
<i>Eremophila alpestris balcanica</i> NMNHS 1/1991	24.4	24.2	2.2	1.8	8.4	7.4	5.3
<i>Eremophila alpestris</i> NHM 1869.9.12.15	24.4	24.0	2.4	2.0	8.3	7.2	5.3
<i>Eremophila alpestris</i> NHM 1930.3.24.513	24.3	24.0	2.3	1.9	8.7	7.5	5.3
<i>Eremophila alpestris</i> NHM 1968.15.1	24.5	24.0	2.1	2.0	8.4	6.5	5.3
<i>Alaemon alaudipes</i> NHM 1927.12.27.80	29.0	28.6	2.9	2.4	ca. 10.9	7.9	6.8
<i>Alauda arvensis</i> NHM 1976.22.1	25.1	24.9	2.1	1.8	9.0	7.5	5.2
<i>Alauda arvensis</i> NHM 1980.37.1	24.8	24.3	2.1	2.0	8.8	6.6	5.0
<i>Alauda arvensis</i> NHM 1981.13.13	24.3	24.1	2.3	1.9	8.8	7.2	5.1
<i>Alauda arvensis</i> NHM 1983.100.3	26.0	25.8	2.4	2.1	9.7	7.0	5.5
<i>Alauda arvensis</i> NHM 1984.15.6	27.1	26.7	2.4	2.0	10.0	7.6	6.0
<i>Alauda arvensis</i> NMNHS 3/1997	-	-	2.4	2.0	7.8	8.1	
<i>Alauda arvensis</i> NMNHS 5/2008	25.8	25.4	2.4	2.1	8.7	2.6	5.4
<i>Ammomanes deserti</i> NHM 1978.3.3	21.1	20.9	2.0	1.6	7.8	5.8	4.7
<i>Calandrella brachydactyla</i> NHM 1961.13.21	21.4	21.0	1.8	1.8	6.5	5.6	4.4
<i>Calandrella cinerea</i> NHM 1903.1.6.3	26.2	24.0	2.1	2.1	7.9	6.4	5.7
<i>Calandrella cinerea</i> NHM 1961.13.21	21.4	20.8	1.8	1.7	6.6	5.3	4.5
<i>Calandrella cinerea</i> NHM 1961.13.34	20.3	20.0	1.7	1.6	6.8	5.2	4.7
<i>Eremopterix nigriceps</i> NHM 1996.69.13	18.6	18.3	1.7	1.5	6.4	4.7	4.3
<i>Galerida cristata</i> NMNHS 2/1998	25.2	24.8	2.0	1.9	8.0	6.6	4.9
<i>Galerida cristata</i> NHM 1853.1.18.16	26.5	25.8	2.3	2.2	9.1	7.4	6.0
<i>Galerida cristata</i> NHM 1998.92.35	26.4	26.0	2.3	2.1	10.1	6.6	5.8
<i>Galerida theklae</i> NHM 1965.16.2	25.5	25.3	2.2	2.0	9.4	6.5	6.0
<i>Lullula arborea</i> NHM 1952.2.602	22.8	22.2	2.1	1.8	8.4	5.8	4.9
<i>Lullula arborea</i> NHM 1965.15.2	23.9	23.4	2.3	1.8	8.8	7.0	5.0
<i>Lullula arborea</i> NHM 1965.15.4	24.0	23.6	2.2	2.0	9.0	6.3	5.2
<i>Lullula arborea</i> NMNHS 1/1990	23.6	23.2	2.1	1.7	8.2	7.1	5.4
<i>Lullula arborea</i> NMNHS 2/1996	-	-	2.2	1.8	8.4	6.6	-
<i>Lullula arborea</i> NMNHS 3/1997	24.2	23.6	2.0	1.8	8.1	ca. 7.2	5.8
<i>Lullula arborea</i> NMNHS 5/2000	22.8	22.2	1.9	1.7	7.7	6.4	4.7
<i>Melanocorypha calandra</i> NMNHS 1/2002	29.9	29.3	2.8	2.5	9.9	8.9	6.2
<i>Melanocorypha calandra</i> NMNHS 3/2010	-	-	2.3	1.9	8.3	7.0	-
<i>Melanocorypha calandra</i> NHM 1952.2.599	28.2	27.7	2.5	2.1	9.1	7.4	6.2
<i>Melanocorypha yeltoniensis</i> NHM 1856.7.20.8	29.6	28.6	2.9	2.5	9.7	9.4	6.5
<i>Melanocorypha yeltoniensis</i> NHM 1952.2.600	29.3	28.5	2.7	2.4	10.2	8.9	6.1
<i>Mirafra javanica</i> NHM 1969.4.58	21.7	21.2	1.8	1.6	7.8	5.5	4.7

in dimensions and morphology, but differs by larger size, and more protruding papillae remigales caudales. *M. yeltoniensis*: very similar, but differs by more protruding papillae remigales caudales, and lesser tuberculum retinaculi. *M. mongolica*: very similar, but differs by blunter tuberculum carpale, and more straight, instead curved, diaphysis in its dist. half. *M. calandra*: also considerable similarity, but differs by relatively thicker diaphysis, wider tuberculum carpale, better developed papillae remigales caudales, and sharper transition in lat. view between shaft of

diaphysis and condylus dors. Early Pleistocene *M. gracilis*: The species is ‘smaller ... than *M. calandra*...’, and it is dated ‘post-Villafranchian’ (680 000 ± 50 000 BP; TCHERNOV, 1980), i. e. the chronostratigraphical difference is considerable enough to suppose a taxonomical identity.

Os premaxillare NMNHS 16 540 (Table 5). It bears the specific for *Melanocorypha* species longitudinal axial groove on the palatal surface of the os praemaxillare. It clearly differs from *Calandrella*, *Lullula* and *Alauda* by its strong robustness and

**Table 7.** The measurements of ulna prox. in fossil and recent Alaudidae (ref. to Fig. 1-F).

Taxa	a	b	c	d	e	f
Fossil – Varshets						
<i>Eremophila prealpestris</i> sp. n. NMNHS 12353	1.8	4.3	4.0	3.8	-	4.0
<i>Alauda xerarvensis</i> sp.N.NMNHS 12469	1.7	4.3	3.9	4.1	1.9	4.1
Recent						
<i>Alauda arvensis</i> NHM 1976.22.1	2.0	4.7	4.4	4.3	2.1	4.4
<i>Alauda arvensis</i> NHM 1979.31.4	2.1	4.4	3.9	3.9	2.0	4.0
<i>Alauda arvensis</i> NHM 1983.100.4	1.8	4.1	3.9	3.8	2.0	4.0
<i>Alauda arvensis</i> NHM 1985.06.1	2.2	4.3	4.2	4.2	2.1	4.3
<i>Alauda arvensis</i> NMNHS 4/1997	2.2	4.9	4.6	3.9	1.9	4.3
<i>Alauda arvensis</i> NMNHS 5/2008	2.4	4.9	4.8	4.1	1.8	4.5
<i>Calandrella cinerea</i> NHM 1903.1.6.3	1.9	4.3	3.9	3.7	1.7	3.9
<i>Calandrella cinerea</i> NHM 1961.13.21	1.4	4.2	3.2	3.4	1.5	3.2
<i>Eremophila alpestris balcanica</i> NMNHS 1/1991	2.1	4.3	4.0	3.8	1.7	4.1
<i>Eremophila alpestris</i> NHM 1869.9.12.15	2.0	4.7	3.8	4.1	2.1	4.1
<i>Eremophila alpestris</i> NHM 1930.3.24.513	2.1	4.3	4.0	3.8	2.1	3.9
<i>Eremophila alpestris</i> NHM 1963.15.1	2.0	4.4	4.0	3.8	1.7	3.7
<i>Galerida cristata</i> NMNHS 2/1998	2.3	4.5	4.3	3.6	1.8	4.0
<i>Galerida cristata</i> NHM 1853.1.18.16	2.1	4.8	4.2	4.2	2.0	4.2
<i>Galerida cristata</i> NHM 1998.92.35	2.0	4.8	4.1	4.4	2.2	4.0
<i>Galerida theklae</i> NHM 1965.16.2	1.7	4.6	4.0	4.5	2.0	4.1
<i>Lullula arborea</i> NHM 1965.15.2	1.8	4.2	3.8	3.7	1.9	3.9
<i>Lullula arborea</i> NHM 1965.15.4	1.8	4.2	3.8	3.8	2.0	3.8
<i>Lullula arborea</i> NMNHS 1/1990	1.9	4.0	3.6	3.9	1.6	3.6
<i>Lullula arborea</i> NMNHS 3/1997	1.9	4.8	4.7	5.2	1.7	4.1
<i>Lullula arborea</i> NMNHS 4/1998	1.7	4.0	3.5	4.5	1.7	3.8
<i>Lullula arborea</i> NMNHS 5/2000	1.9	4.2	3.5	3.7	1.7	3.6
<i>Melanocorypha calandra</i> NMNHS 1/2002	2.4	5.1	4.5	3.9	2.2	4.8
<i>Melanocorypha calandra</i> NMNHS 3/2010	-	-	-	-	1.8	-
<i>Melanocorypha calandra</i> NHM 1952.2.599	2.1	4.9	4.4	4.3	2.4	4.3
<i>Melanocorypha yeltoniensis</i> NHM 1952.2.600	2.4	5.4	4.9	5.0	2.4	5.0

curved margo tomialis, instead straight in the three listed genera. It also differs in size, being considerably larger.

#### ***Eremophila* Boie, 1828**

*Eremophila prealpestris* sp. n.

**Holotype:** Humerus dex. NMNHS 179 (Pl. 4 – a, b), collections of VAD-NMNHS. Collected by the author between 1990 and 2000.

**Paratypes:** Ulna sin. prox. NMNHS 12353 (Pl. 4 – c, d). Collected by the author between 1990 and 2000.

**Etymology:** The name ‘*prealpestris*’ is given after the name ‘*alpestris*’ and the prefix ‘*pre-*’, meaning ‘before’, i. e. ‘former’.

**Measurements** of holotype: Table 6; Fig. 1-E.

**Measurements** of paratype: Table 7; Fig. 1-F.

**Diagnose:** A fossil *Eremophila*, differing from *E. alpestris* by its longer cr. pect., and more

transversal, than longitudinal, direction of linea intermuscularis on cr. pect.

**Locality, Horizon and Chronology:** Varshets (see above for details). Late Pliocene (Middle Villafranchian; SCT 11 (sooner SCT 12) of MNQ 17 zone, dated ca. 2.23-2.40 mya) (SPASSOV, 1997).

Humerus dex. NMNHS 179 (Table 6). It differs from: *Alauda* spp.: by more transversal than longitudinal direction of linea intermuscularis on cr. pect., rounded, instead sharper, tip of pr. flexorius, and shorter tuberculum supracondylare ventrale. *A. arvensis*: by smaller size, and sharper prox. end of fossa brachialis. *Calandrella* spp.: by larger size, and thicker pr. flexorius in med. view. *C. cinerea*: by larger dimensions. *M. calandra*: by smaller size. *L. arborea*: very similar in size and morphology but differs by more protruding caput humeri in lat. view, and caudal bending of groove of intumescencia

**Table 8.** The measurements of cmc dex. in fossil and recent Alaudidae (ref. to Fig. 1-G).

Taxa	A	b	c
Fossil – Varshets			
<i>Galerida bulgarica</i> sp. n. NMNHS 153	16.0	1.6	1.8
Recent			
<i>Galerida cristata</i> NMNHS 2/1998	16.0	1.6	2.1
<i>Galerida cristata</i> ISEAK A-2238/70	15.8	1.6	2.0
<i>Galerida cristata</i> ISEAK A-2372/71	17.1	1.8	2.4
<i>Galerida cristata</i> NHM 1853.1.18.16	16.0	1.8	2.4
<i>Galerida cristata</i> NHM 1998.92.35	16.9	1.8	2.5
<i>Galerida theklae</i> ISEAK A-3849/81	16.0	1.8	2.0
<i>Galerida theklae</i> NHM 1965.16.2	16.1	1.7	2.0
<i>Alauda arvensis</i> ISEAK A-2863/73	17.3	1.9	2.0
<i>Alauda arvensis</i> ISEAK A-4974/91	16.5	1.6	2.0
<i>Alauda arvensis</i> NHM 1983.100.7	15.7	1.5	2.1
<i>Calandrella cinerea</i> ISEAK A-3850/81	14.0	1.3	2.0
<i>Lullula arborea</i> ISEAK A-2296/70	13.8	1.5	1.7
<i>Lullula arborea</i> NHM 1965.15.2	15.7	1.7	2.2
<i>Melanocorypha calandra</i> ISEAK A-3506/78	19.1	2.0	2.5
<i>Melanocorypha calandra</i> ISEAK A-3864/81	19.3	1.9	2.5
<i>Melanocorypha calandra</i> NHM 1952.2.599	17.8	1.7	2.4
<i>Melanocorypha mongolica</i> ISEAK A-3094/75	17.8	1.8	2.4
<i>Melanocorypha yeltoniensis</i> NHM 1856.7.20.8	19.6	2.0	2.4
<i>Melanocorypha yeltoniensis</i> NHM 1952.2.600	19.2	2.0	2.5
<i>Calandrella cinerea</i> NHM 1961.13.21	13.2	1.5	1.6
<i>Calandrella cinerea</i> NHM 1961.13.34	12.6	1.3	1.8
<i>Calandrella brachydactyla</i> ISEAK A-3504/78	13.6	1.5	1.6
<i>Calandrella rufescens</i> ISEAK A-3860/81	13.2	1.2	1.6
<i>Eremophila alpestris</i> ISEAK A-1689/66	15.7	1.7	2.0
<i>Eremophila alpestris</i> ISEAK A-1690/66	15.1	1.7	2.0
<i>Eremophila alpestris</i> NHM 1869.9.12.15	5.3	1.6	1.9
<i>Eremopterix leucotis</i> ISEAK A-3178/76	11.2	1.2	1.6
<i>Melanocorypha calandra</i> NMNHS 1/2002	19.5	1.9	2.5
<i>Alauda arvensis</i> NMNHS 3/1997	18.1	1.6	2.0
<i>Alauda arvensis</i> NMNHS 5/2008	16.8	1.7	2.6
<i>Lullula arborea</i> NMNHS 1/1990	14.8	1.6	2.2
<i>Lullula arborea</i> NMNHS 3/1997	14.9	1.4	2.0
<i>Lullula arborea</i> NMNHS 4/1998	13.2	1.5	2.4
<i>Lullula arborea</i> NMNHS 5/2000	14.2	1.6	2.0
<i>Eremophila alpestris balcanica</i> NMNHS 1/1991	15.5	1.7	2.0

capitis humeri. *Galerida* spp.: by rounder pr. flexorius and shorter tuberculum supracondylare ventrale. *Melanocorypha* spp.: by smaller size, and longer cr. pect. *Eremopterix* spp.: by larger size and transversal linea intermuscularis on cr. pect. *Alaemon* spp.: by smaller size. *Eremophila* spp.: resembles very much but differing from *E. alpestris* by its longer cr. pect., and more transversal than longitudinal direction of

linea intermuscularis on the cr. pect.

Ulna sin. prox. NMNHS 12353 (Table 7). Length of the fragment: 6.6 mm. It differs from: *M. yeltoniensis*: by smaller size and rounder olecranon. *M. calandra*: by smaller size and relatively thicker olecranon. *A. arvensis*: very similar but differs by shorter olecranon. *G. cristata*: by more angular, instead arc-like profile of cotyla ventr. in dors. view.

**Table 9.** The measurements of tbt in fossil and recent Alaudidae (ref. to Fig. 1-H).

Taxa	a	b	c
Fossil – Varshets			
<i>Galerida bulgarica</i> sp. n. NMNHS 155	2.7	1.6	1.4
Recent			
<i>Galerida cristata</i> NMNHS 2/1998	3.1	1.5	1.3
<i>Alauda arvensis</i> NMNHS 1/1989	2.5	1.8	1.4
<i>Alauda arvensis</i> NMNHS 2/1990	2.7	1.9	1.6
<i>Alauda arvensis</i> NMNHS 5/2008	2.9	2.1	1.6
<i>Lullula arborea</i> NMNHS 1/1990	3.5	1.4	1.2
<i>Eremophila alpestris balcanica</i> NMNHS 1/1991	3.5	1.6	1.4
<i>Lullula arborea</i> NMNHS 5/2000	3.4	1.5	1.4
<i>Melanocorypha calandra</i> NMNHS 1/2002	3.0	2.4	1.7

*G. theklae*: by relatively shorter cotyla dors. *L. arborea*: more angular, than rounded, cotyla dors. *M. javanica*, *M. hova*, *E. nigriceps* and *A. deserti*: by much larger size. *E. alpestris*: strong similarity but differs by slightly more angular, than rounded, shape of cotyla ventr. *C. cinerea*: by smaller size and shorter olecranon. *Melanocorypha donchevi* sp. n. (present paprt): Could not be compared, because of the lacking of analogous skeletal elements. *Alauda xerarvensis* sp. n. (present paper): by the less rounded edge of cond. dors.

***Eremarida*, gen. nov. Boev**

**Type species:** *Eremarida xerophila* sp. n.

**Included species:** only the type species.

**Etymology:** The name ‘*Eremarida*’ is given after the names of ‘*Erem*’-ophila’ and ‘*arid*’, indicating that the genus was probably more arid-like-habitats loving.

**Diagnose:** Fossil genus of larks, differing from all hitherto known genera by the presence of a ‘cut’ section of f. a. sternalis arc on med. surface of cor.

**Preservation** of the holotype: Excellent; complete bone preserved.

**Locality, Horizon and Chronology:** Hrabarsko (see above for details).

***Eremarida xerophila* sp. n.**

**Holotype:** Cor. sin. NMNH 476. (Pl. 4 – e, f), collections of VAD-NMNHS. Collected by Dr. IVAN NIKOLOV in the 1960s in the former coal mines “Plamak”.

**Paratypes:** No paratypes has been collected.

**Etymology:** The name ‘*xerophila*’ is given after ‘*xeric*’, i. e. adapted to dry habitats, and ‘*phileo*’ – loving.

**Measurements** of holotype: Table 2; Fig. 1-A.

**Diagnose:** as for the genus.

**Locality, Horizon and Chronology:** as for the genus.

Cor. sin. NMNH 476. The characteristic for Alaudidae foramen on the base of pr. acroc. is well developed. It differs from: *G. cristata*: very similar in sternal half and relief of med. surface but differs by more open acrocoracoidal part, ‘cut’ shape and lower ridge in its middle part of f. a. sternalis, instead a whole arc as a sickle-like shape, relatively longer f. a. humeralis, and higher limiting ridge of f. a. sternalis (all of wich completely exclude referring to genus *Galerida*). *Eremophila*: recembles by shape (1) of f. a. sternalis but differs by much shallower concavity of the impressio m. sternocoracoidei, rounded, instead of edges, cran. surface of diaphysis, and bigger size. *A. arvensis*: by bigger size, more oblique protruding of pr. acroc., higher cover edge of f. a. sternalis. *Amm. deserti*: by larger size, more developed relief on med. surface of bone, and longer edge of f. a. sternalis. *C. cinerea*: by much larger size, and longitudinal, instead diagonal linea intermuscularis on med. side. *C. rufescens*: by much larger size, and ‘cut’ profile of f. a. sternalis on its med. side. *C. brachydactyla*: by larger size and longer edge of f. a. sternalis. *L. arborea*: by larger size, relatively longer f. a. sternalis, and ‘cut’ shape of ridge arc of s. a. sternalis. *M. calandra* and *M. yeltoniensis*: by slightly smaller size and relatively narrower and relatively longer f. a. humeralis (which distinguishes it from genus *Melanocorypha*). *Melanocorypha serdicensis* sp. n. (NMNHS 475): by relief of med. surface of prox. part, height of pr. lat., and line of its dist. prolongation. *M. gracilis*: The species is ‘smaller ... than *M. calandra*...’, and it is dated ‘post-Villafranchian’ (680 000 ± 50 000 BP; TCHERNOV, 1980), i. e. the chronos-

**Table 10.** The measurements of phal. prox. dig. maj. dex. in fossil and recent Alaudidae (ref. to Fig. 1-I).

Taxa	a	b	c	d	e
Fossil – Varshets					
<i>Lullula balcanica</i> sp. n. NMNHS 173	8.4	2.4	2.1	1.95	1.8
Recent					
<i>Lullula arborea</i> NMNHS 3/1997	c.8.7	-	2.0	1.6	1.6
<i>Lullula arborea</i> NMNHS 4/1998	6.8	1.0	2.0	1.4	1.4
<i>Lullula arborea</i> UCBL 285/1	7.7	2.5	2.0	1.7	1.5
<i>Lullula arborea</i> ISEAK A-2296/70	6.9	2.4	2.0	1.7	1.6
<i>Lullula arborea</i> NHM 1965.15.2	8.2	2.2	2.0	1.8	1.6
<i>Alauda arvensis</i> UCBL 286/1	9.5	2.8	2.3	2.0	1.8
<i>Alauda arvensis</i> UCBL 286/2	9.7	2.6	2.4	2.0	2.0
<i>Alauda arvensis</i> NHM 1983.100.7	8.4	2.4	2.3	2.0	1.7
<i>Ammomanes deserti</i> NHM 1986.71.6	7.4	2.1	1.9	1.5	1.3
<i>Calandrella rufescens</i> NHM 1952.2.601	7.0	2.0	1.2	1.7	1.4
<i>Calandrella cinerea</i> NHM 1903.1.6.3	6.9	2.4	2.3	1.7	1.6
<i>Calandrella cinerea</i> NHM 1961.13.34	7.1	2.0	1.8	1.5	1.5
<i>Calandrella cinerea</i> ISEAK A-3850/81	7.6	2.2	2.1	1.7	1.6
<i>Eremophila alpestris</i> ISEAK A-1689/66	9.3	3.0	2.5	1.9	1.7
<i>Eremopterix leucotis</i> ISEAK A-3178/76	6.5	2.1	1.7	1.5	1.4
<i>Eremopterix nigriceps</i> NHM 1996.69.136.5	1.8	1.7	1.5	1.4	1.4
<i>Galerida cristata</i> UCBL 283/1	8.0	2.4	2.1	2.0	1.7
<i>Galerida cristata</i> NHM 1853.1.18.16	8.4	2.4	2.2	1.7	1.8
<i>Galerida theklae</i> NHM 1965.16.2	8.1	2.6	2.4	2.1	1.8
<i>Melanocorypha calandra</i> NHM 1952.2.599	9.1	2.8	2.4	2.2	1.9
<i>Melanocorypha yeltoniensis</i> NHM 1952.2.600	10.7	3.0	2.8	2.2	3.1
<i>Melanocorypha yeltoniensis</i> NHM 1856.7.20.8	10.8	3.8	2.8	2.4	3.1

stratigraphical difference (7 to 6 my) is considerable enough to suppose a taxonomical identity.

### **Galerida Boie, 1828**

*Galerida bulgarica* sp. n.

**Holotype:** NMNHS cmc dex. NMNHS 153 (Pl.2 – a, b), collections of VAD-NMNHS. Collected by the author between 1990 and 2000.

**Paratypes:** Tbt sin. prox. NMNHS 155 (Pl. 2 – c, d), collected together by the author between 1990 and 2000.

**Etymology:** The name ‘*bulgarica*’ is given after the name of Bulgaria state, where the find was collected from.

**Measurements** of holotype: Table 8; Fig. 1-G.

**Measurements** of paratype: Table 9; Fig. 1-H.

**Diagnose:** A late Pliocene species of *Galerida* with blunter tip of os metacarpale alulare, smaller size, and sharper exostosis on the dist. end of os metacarpale majus.

**Locality, Horizon and Chronology:** Varshets (see above for details). Late Pliocene (Middle

Villafranchian; SCT 11 (sooner SCT 12) of MNQ 17 zone, dated ca. 2.23-2.40 mya) (SPASSOV, 1997).

Cmc dex. NMNHS 153 (Table 8). It differs from: *M. calandra*: by smaller size, and blunter proc. pisiformis. *A. arvensis*: by smaller inclination of axis of tr. carpalis, and narrower tr. carpalis (measurement ‘c’). *M. mongolica*: by smaller size, and stronger constriction of condylus med. of thochlea carpalis. *L. arborea*: by larger size and more prominent profile of tr. carpalis over os metacarpale alulare. *C. cinerea*: by larger size and more concave profile of tr. carpalis in caudal view. *C. brachydactyla*: by larger size, and blunter tip of proc. extensorius. *C. rufescens*: by much larger size. *E. alpestris*: by narrower tr. carpalis, and steeper inclination of axis of tr. carpalis towards the diaphysis. *E. leucotis*: by larger size and lesser inclination of diaphysis. *G. theklae*: very similar but differing by slender (mainly in dist. half) diaphysis of os metacarpale mdjus, wider angle of tr. carpalis, and narrower s. t. on diaphysis of os metacarpale mdjus. *G. cristata*: high similarity



**Table 11.** The measurements of cor. sin. dist. in fossil and recent Alaudidae (ref. to Fig. 1-J).

Taxa	A	b	c	d	e
Fossil – Slivnitsa					
<i>Lullula slivnicensis</i> sp. n. NMNHS 451	1.8	1.2	3.9	1.3	1.6
Recent					
<i>Lullula arborea</i> NHM 1965.15.2	1.7	1.5	4.3	1.3	1.7
<i>Lullula arborea</i> NHM 1965.15.4	2.3	1.2	4.1	1.2	1.7
<i>Lullula arborea</i> NMNHS 1/1990	2.1	1.2	4.2	1.0	1.6
<i>Lullula arborea</i> NMNHS 5/2000	2.0	1.1	3.7	0.9	1.4
<i>Lullula arborea</i> UCBL 285/1	ca. 1.7	ca. 1.0	4.0	1.0	1.5
<i>Alauda arvensis</i> NMNHS 3/1997	2.3	1.8	4.5	1.3	1.4
<i>Alauda arvensis</i> NMNHS 5/2008	2.4	1.3	4.2	1.2	1.1
<i>Alauda arvensis</i> UCBL 286/1	1.9	1.5	4.6	1.2	1.8
<i>Alauda arvensis</i> UCBL 286/2	1.7	1.4	4.4	1.2	1.9
<i>Alauda arvensis</i> UCBL 286/4	1.9	1.4	4.5	1.2	1.7
<i>Alauda arvensis</i> UCBL 286/5	2.0	1.5	4.5	1.2	1.9
<i>Ammomanes deserti</i> NHM 1986.71.6	ca. 1.0	ca. 0.7	3.3	1.1	1.3
<i>Calandrella cinerea</i> NHM 1903.1.6.3	1.1	1.4	3.7	1.3	1.6
<i>Calandrella cinerea</i> NHM 1961.13.21	1.3	1.1	3.5	1.0	1.6
<i>Calandrella cinerea</i> NHM 1961.13.34	1.2	1.3	3.3	1.0	1.3
<i>Calandrella rufescens</i> NHM 1952.2.601	-	-	3.3	1.1	1.6
<i>Eremophila alpestris</i> NHM 1930.3.24.513	1.7	1.3	4.3	1.2	1.5
<i>Eremophila alpestris</i> NHM 1963.15.1	1.5	1.5	4.2	1.2	2.0
<i>Eremophila alpestris</i> UCBL 188/1	1.8	1.4	4.0	1.3	1.7
<i>Galerida cristata</i> NHM 1853.1.18.16	1.6	1.4	3.5	1.3	1.8
<i>Galerida cristata</i> UCBL 283/1	-	1.2	4.0	1.2	1.6
<i>Galerida cristata</i> UCBL 283/2	-	1.5	4.5	1.3	1.7
<i>Galerida theklae</i> NHM 1965.16.2	1.6	1.4	4.5	1.3	1.8
<i>Melanocorypha calandra</i> NMNHS 1/2002	2.8	1.8	5.1	1.5	1.3
<i>Melanocorypha calandra</i> NHM 1952.2.599	2.2	1.4	4.6	1.8	2.1
<i>Melanocorypha yeltoniensis</i> NHM 1856.7.20.8	2.2	2.0	5.1	1.6	2.2
<i>Melanocorypha yeltoniensis</i> NHM 1952.2.600	-	-	5.0	1.8	2.3

but differs by blunter tip of os metacarpale alulare, smaller size, and sharper exostosis on dist. end of os metacarpale majus.

Tbt sin. prox. NMNHS 155 (Table 9). The fragment preserves part of diaphysis with cr. fibularis but any articular surfaces are lacking. It differs from: *M. calandra*, *M. leucoptera* and *M. mongolica*: by much smaller size, and shorter cr. fibularis. *A. arvensis*: by smaller foramen interosseum prox. e. *L. arborea*: by longer cr. fibularis. *C. cinerea*: by larger size. *E. alpestris*: by smaller dimensions, and lesser foramen interosseum prox. e. *E. leucotis*: by much larger size.

DE JUANA *et al.* (2004) list six recent species, two of them (*G. malabarica* (SCOPOLI, 1786) and *G. deva* (SYKES, 1832)), endemic for the Hindustan Peninsula, two species are endemic for Africa – *G. magnirostris* (STEPHENS, 1826) for Southern Africa, and *G. modesta* HEUGLIN, 1864 – for Sub-Saharan Africa, and two other species (*G. cristata* LINNAEUS, 1758 and *G. thek-*

*lae* A.E.BREHM, 1857) have Euro-Asiatic distribution. *G. cristata* is known by its 37 recent subspecies from Portugal to Western India and from C Europe to C Sudan. This wide range and the considerable number of the subspecies suggest an ancient origin.

#### ***Lullula* Kaup, 1829**

*Lullula balcanica* sp. n.

**Holotype:** Phal. prox. dig. maj. sin. NMNHS 173 (Pl. 2 – e, f), collections of VAD-NMNHS. Collected by the author between 1990 and 2000.

**Paratypes:** No.

**Etymology:** The name ‘*balcanica*’ is given after the name of the Balkan Peninsula, the region, where the find originated from.

**Measurements** of holotype: Table 10; Fig. 1-I.

**Diagnose:** A Late Pliocene woodlark, differing from recent *L. arborea* (phal. prox. dig. maj.) by slight protuberance, longer body of phal. and smaller size.

**Locality, Horizon and Chronology:** Varshets

**Table 12.** The measurements of sternum, man. in fossil and recent Alaudidae (ref. to Fig. 1-K).

Taxa	a	b	c
Fossil – Slivnitsa			
<i>Lullula slivnicensis</i> sp.n . NMNHS 430	4.9	1.4	ca.3.0
Recent			
<i>Lullula arborea</i> ISEAK A-2296/70	3.9	1.2	2.7
<i>Lullula arborea</i> NMNHS 1/1990	5.0	1.4	-
<i>Lullula arborea</i> NMNHS 5/2000	4.5	1.2	2.8
<i>Lullula arborea</i> UCBL 285/1	5.5	1.4	3.4
<i>Alauda arvensis</i> NMNHS 1/1989	4.7	1.4	3.4
<i>Alauda arvensis</i> NMNHS 4/1997	5.6	1.7	4.0
<i>Alauda arvensis</i> NMNHS 5/2008	5.2	1.5	ca. 3.1
<i>Alauda arvensis</i> UCBL 283/1	5.7	1.3	4.0
<i>Eremophila alpestris balcanica</i> NMNHS 1/1991	5.0	1.4	3.5
<i>Galerida cristata</i> NMNHS 2/1998	4.7	1.5	3.7
<i>Galerida cristata</i> UCBL 283/1	4.3	1.3	2.7
<i>Galerida cristata</i> UCBL 283/2	5.0	1.5	3.5
<i>Melanocorypha calandra</i> NMNHS 1/2002	6.6	1.8	4.0
<i>Melanocorypha calandra</i> ISEAK A-3864/81	5.4	1.5	3.7

(see above for details). Late Pliocene (Middle Villafranchian; SCT 11 (sooner SCT 12) of MNQ 17 zone, dated ca. 2.23–2.40 mya) (SPASSOV, 1997).

Phal. prox. dig. maj. sin. NMNHS 173 (Table 10). It differs from: *Galerida* spp.: by slight protuberance on dorso-lat. edge, slightly shallowed relief on f. a., and shorter shaft of prox. constriction. *E. alpestris* and *Calandrella* spp.: clearly by wider but not right, angle of f. a. caudalis. *L. arborea*: by slight protuberance, longer body of phal. and by smaller size.

***Lullula slivnicensis* sp. n.**

**Holotype:** Cor. sin. dist. NMNHS 451 (Pl. 2 – g, h), collections of VAD-NMNHS. Collected by the author in 1993.

**Paratypes:** Sternum, pars cran. NMNHS 430 (Pl. 2 – i; Pl. 3 – a, b).

**Etymology:** The name ‘*slivnicensis*’ is given after the name of Slivnitsa town, center of the area, where the finds originated from.

**Measurements** of holotype: Table 11; Fig. 1-J.

**Measurements** of paratype: Table 12; Fig. 1-K.

**Diagnose:** A Late Pliocene woodlark, differing from recent *L. arborea* (cor. dist.) by clearly shaped peaklet and presence of edgelets of f. a. clavicularis, instead its blunter edges.

**Locality, Horizon and Chronology:** Geographical location: Vicinity (3 km WNW) of the town of Slivnitsa, Nr Sofia (Sofia District; W Bulgaria). A destroyed cave in a rocky hill, now a stone quarry, 42.48 N, 23.05 E.; UTM grid: FN

64. 650 m a. s. l. Unconsolidated, unstratified bone elements accumulated in the filling of clay terra-rossa. Usually the fossil bones are broken. All finds are disarticulated. Late Pliocene (beginning of Late Villafranchian; SCT 10; first half of MNQ 18 a); dated ca. 1.9 mya) (SPASSOV, 1997, 2003).

Cor. sin. dist. NMNHS 451 (Table 11). It differs from: *Alauda* spp.: by smaller size, wider dist. (humeral) ending, and more oblique acrocoracoidal (humeral) part. *Galerida* spp.: by presence of edgelets of f. a. clavicularis, and wider humeral epiphysis. *Melanocorypha* spp. are larger and more robust. *L. arborea*: by clearly shaped peaklet and presence of edgelets of f. a. clavicularis, instead its blunter edges. (High similarity in the surface of f. a. humeralis and its two fossae, as well as the relief of impressio ligamenti acrocoracoideum).

Sternum, pars cran. NMNHS 430 (Table 12). Length of the fragment: 6.7 mm. It differs from: *A. arvensis*: by shorter horns of man. sterni in lat. view, shorter man., and lesser constriction (measurement ‘b’). *Melanocorypha* spp.: by shorter man. *Galerida* spp.: by wider angle between horns of man. sterni, and more straight than drooping horns of man. sterni in cran. view. *L. arborea*: by shorter horns of man. sterni in cran. view; high similarity in morphology and size of man. sterni and the base of sulcus a. coracoideus. *Alauda xerarvensis* sp. n. (present paper): by less concave dorsal surface of man. and less developed edge (‘rib’) on lateral surface of man.

**Table 13.** The measurements of sternum, pars cran.in fossil and recent Alaudidae (ref. to Fig.1-L).

Taxa	a	b	c
Fossil – Varshets			
<i>Alauda xerarvensis</i> sp. n. NMNHS 174	2.9	2.0	1.3
Recent			
<i>Alauda arvensis</i> ISEAK A 2394/71	2.6	2.3	1.1
<i>Alauda arvensis</i> ISEAK A 2863/73	2.5	2.5	1.4
<i>Alauda arvensis</i> ISEAK A 4974/91	3.4	2.8	1.3
<i>Alauda arvensis</i> NMNHS 1/1989	2.5	2.3	1.2
<i>Alauda arvensis</i> NMNHS 5/2008	3.0	2.9	1.3
<i>Alauda arvensis</i> UCBL 286/1	2.6	2.0	1.5
<i>Alauda arvensis</i> UCBL 286/2	3.15	2.1	1.7
<i>Eremophila alpestris balcanica</i> NMNHS 1/1991	2.4	2.2	1.0
<i>Eremophila alpestris</i> ISEAK A 1689/66	2.5	2.8	1.3
<i>Galerida cristata</i> NMNHS 2/1998	2.9	2.9	1.1
<i>Galerida cristata</i> UCBL 283/1	3.0	2.1	1.4
<i>Galerida cristata</i> UCBL 283/2	2.9	2.2	1.4
<i>Lullula arborea</i> NMNHS 1/1990	2.9	2.2	1.2
<i>Lullula arborea</i> NMNHS 5/2000	2.1	1.9	1.2
<i>Lullula arborea</i> UCBL 285/1	3.45	2.0	1.6
<i>Melanocorypha calandra</i> NMNHS 1/2002	3.4	3.1	1.5

**Table 14.** The measurements of mandibula in fossil and recent Alaudidae (ref. To Fig. 2-M).

Taxa	a	b	c	d
Fossil – Varshets				
<i>Alauda xerarvensis</i> sp. n. NMNHS 297	ca. 5.4	0.7	1.2	10.1
Recent				
<i>Alauda arvensis</i> ISEAK A-2394/71	4.8	0.7	1.4	-
<i>Alauda arvensis</i> ISEAK A-4974/91	5.0	0.8	1.4	-
<i>Alauda arvensis</i> NMNHS 1/1989	4.7	0.5	1.5	8.0
<i>Alauda arvensis</i> NMNHS 4/1997	4.4	0.6	1.4	9.1
<i>Alauda arvensis</i> NMNHS 5/2008	5.5	0.5	1.3	ca. 7.2
<i>Alauda arvensis</i> UCBL 286/1	ca. 5.4	0.6	1.3	11.2
<i>Alauda arvensis</i> UCBL 286/2	5.45	0.55	1.3	11.4
<i>Calandrella cinerea</i> ISEAK A-3504/78	4.5	0.7	3.0	-
<i>Calandrella cinerea</i> NMNHS 1/1981	5.1	0.5	1.7	8.5
<i>Eremophila alpestris balcanica</i> NMNHS 1/1991	5.1		1.3	ca. 8.0
<i>Eremophila alpestris</i> ISEAK A-1689/66	ca. 5.6	0.9	1.2	-
<i>Galerida cristata</i> NMNHS 1/1981	6.2	0.6	1.4	9.6
<i>Galerida cristata</i> ISEAK A-2238/70	ca. 7.0	0.8	2.2	-
<i>Galerida cristata</i> UCBL 283/1	4.5	0.5	1.3	9.4
<i>Galerida cristata</i> UCBL 283/2	7.3	0.6	1.5	12.2
<i>Lullula arborea</i> ISEAK A-1837/67	5.0	1.2	1.1	-
<i>Lullula arborea</i> ISEAK A-2296/70	4.5	0.5	1.1	-
<i>Lullula arborea</i> NMNHS 1/1990	4.7	0.5	1.1	4.4
<i>Lullula arborea</i> NMNHS 5/2000	4.7	0.5	1.0	4.1
<i>Lullula arborea</i> UCBL 285/1	4.7	0.5	1.2	8.7
<i>Melanocorypha calandra</i> NMNHS 1/2002	8.6	1.0	2.9	13.1
<i>Melanocorypha calandra</i> NMNHS 2/2010	ca. 8.2	-	ca. 3.1	-
<i>Melanocorypha mongolica</i> NMNHS 1/2010	ca. 6.8	ca. 0.6	ca. 3.2	ca. 8.1
<i>Melanocorypha calandra</i> ISEAK A-3506/78	7.2	1.0	3.0	-

**Table 15.** The measurements of mandibula, rhamus sin.in fossil and recent Alaudidae (ref. to Fig.1-N).

Taxa	a	b	c	d	e	f
Fossil – Varshets						
<i>Alauda xerarvensis</i> sp. n. NMNHS 298	1.8	1.8	2.2	0.7	0.55	4.3
Recent						
<i>Alauda arvensis</i> NMNHS 1/1989	1.5	1.8	1.9	-	-	-
<i>Alauda arvensis</i> NMNHS 4/1997	1.7	1.8	2.0	0.6	0.5	7.3
<i>Alauda arvensis</i> NMNHS 5/2008	1.6	1.9	1.7	0.6	0.6	-
<i>Alauda arvensis</i> UCBL 286/1	1.9	1.85	2.15	0.7	0.6	8.1
<i>Alauda arvensis</i> UCBL 286/2	1.9	1.95	2.3	0.7	0.55	4.9
<i>Calandrella cinerea</i> NMNHS 1/1981	2.0	1.9	2.4	0.5	0.5	5.2
<i>Eremophila alpestris balcanica</i> NMNHS 1/1991	ca. 2.0	-	-	-	-	-
<i>Galerida cristata</i> UCBL 283/1	1.6	1.6	1.8	0.4	0.5	ca. 5.4
<i>Lullula arborea</i> NMNHS 1/1990	1.4	1.6	1.9	0.5	0.5	6.4
<i>Lullula arborea</i> NMNHS 5/2000	1.3	1.4	1.4	0.5	0.4	-
<i>Lullula arborea</i> UCBL 285/1	1.4	1.5	1.7	0.5	0.45	5.7
<i>Melanocorypha calandra</i> NMNHS 1/2002	3,5	3.6	4.6	1.1	1.0	5.5
<i>Melanocorypha calandra</i> NMNHS 2/2010	ca. 3.0	-	-	-	-	-

***Alauda* L., 1758*****Alauda xerarvensis* sp. n.**

**Holotype:** ulna sin. prox. NMNHS 12469 (Pl. 3 – c, d), collections of VAD-NMNHS. Collected by the author between 1990 and 2000.

**Paratypes:** sternum, pars cran. NMNHS 174 (Pl. 3 – e, f); mandibula NMNHS 297 (Pl. 3 – g, h); mandibula sin. NMNHS 298 (Pl. 3 – i, j). Collected by the author between 1990 and 2000.

**Etymology:** The name ‘*xerarvensis*’ is given after the prefix ‘*xer-*’ from ‘*xeric*’, i. e. adapted to dry habitats, and ‘*arvensis*’.

Measurements of holotype: Table 7; Fig. 1-F.

**Measurements** of paratypes: NMNHS 174 – Table 13, Fig. 1-L; NMNHS 297 – Table 14, Fig. 1-M; NMNHS 298 – Table 15, Fig. 1-N.

**Diagnose:** Late Pliocene skylark, differing from recent *A. arvensis* by the: (1) ulna prox.: thicker olecranon in ventr. view; (2) sternum, pars cran.: narrower f. a. sterno-coracoidales, sharper upper edges of sternal labrums, more developed foramen pneumaticum, and more open arc of med. part above the man.; (3) mandibula: by wider and longer symphyseal part.

Locality, Horizon and Chronology: Varshets (see above for details). Late Pliocene (Middle Villafranchian; SCT 11 (sooner SCT 12) of MNQ 17 zone, dated ca.2.23-2.40 mya) (SPASSOV, 1997).

Ulna sin. prox. NMNHS 12469 (Table 7). Length of the fragment: 15.3 mm. It differs from: *M. yeltoniensis*: by smaller size and sharper olecranon. *M. calandra*: by more rounded, instead polygonal,

shape of cotyla ventr. *E. alpestris*: by thicker base of olecranon on lat. side. *G. cristata*: by shorter and thicker olecranon. *G. theklae*: by shorter inception of cotyla dors. at the base of prox. epiphysis. *L. arborea*: more angular, than rounded, cotyla dors. *C. cinerea*: by smaller size and relatively narrower depressio m. brachialis. *M. javanica*, *M. hova*, *E. nigriceps* and *A. deserti*: by much larger size. *A. arvensis*: by thicker olecranon in ventr. view but some recent skylarks have similarly thick olecranon too. Early Pleistocene *A. jordanica*: The species has ‘much slender olecranon ... [than of *A. arvensis*]’, and it is dated ‘post-Villafranchian’ (680 000 ± 50 000 BP; TCHERNOV, 1980), i. e. chronostratigraphical difference is considerable enough to suppose a taxonomical identity. *Eremophila praealpestris* sp. n. (present paper): by the more rounded edge of cond. dors.

Sternum, pars cran. NMNHS 174 (Table 13). Length of the fragment: 10.0 mm. It differs from: *Galerida*: similar in shape and relief of man. sterni, the foramen between sternal labrums, and its shape around foramen pneumaticum but differs by less marked lat. edge of base of man. sterni, and thicker middle part of man. sterni (measurement ‘b’). *L. arborea*: by lacking of two axial edges on tabula sterni, dimensionally, and by narrower man. (measurement ‘a’). *E. alpestris*: by lacking of a foramen pneumaticum. *Melanocorypha* spp.: by much smaller size. *Alauda* spp.: by narrower f. a. sterno-coracoidales, sharper upper edges of sternal labrums, more developed foramen pneumaticum, and more open arc of med. part above man. *Lullula*

**Table 16.** The measurements of humerus sin. of some fossil and recent Alaudidae (ref. to Fig.1-O).

Taxa	a	B	c	d	e	f
Fossil – Varshets						
Alaudidae gen. indet. NMNHS 270	23.5	7.6	6.7	2.1	5.2	2.4
Recent						
<i>Alauda arvensis</i> ISEAK A-2394/71	24.4	8.5	7.2	2.2	5.7	2.1
<i>Alauda arvensis</i> ISEAK A-2863/73	26.6	9.5	7.7	2.5	5.7	2.7
<i>Alauda arvensis</i> ISEAK A-4974/91	25.0	9.3	7.3	2.2	5.5	2.5
<i>Alauda arvensis</i> NMNHS 3/1997	-	9.0	8.1	2.4	-	2.6
<i>Alauda arvensis</i> NMNHS 5/2008	25.8	8.5	7.4	2.3	5.3	2.8
<i>Alauda arvensis</i> UCBL 286/1	25.5	9.1	7.7	2.3	5.9	2.6
<i>Alauda arvensis</i> UCBL 286/2	27.4	9.3	7.9	2.4	5.9	2.7
<i>Alauda arvensis</i> UCBL 286/4	26.0	9.3	7.2	2.5	5.8	2.5
<i>Alauda arvensis</i> UCBL 286/5	26.4	9.0	7.6	2.5	5.5	2.6
<i>Ammomanes deserti</i> ISEAK A-4140/84	22.0	8.8	6.1	2.0	4.9	2.2
<i>Calandrella brachydactyla</i> ISEAK A-3504/78	21.7	7.0	6.5	2.0	5.0	2.2
<i>Calandrella cinerea</i> ISEAK A-3850/81	21.5	7.0	6.5	1.9	2.0	2.0
<i>Calandrella rufescens</i> ISEAK A-3855/81	21.0	6.6	6.4	1.9	5.0	2.1
<i>Calandrella rufescens</i> ISEAK A-3860/81	-	6.0	6.1	1.9	-	1.9
<i>Eremophila alpestris</i> ISEAK A1523/65	-	-	-	-	5.0	-
<i>Eremophila alpestris</i> ISEAK A-1689/66	24.3	8.0	7.2	2.1	5.5	2.4
<i>Eremophila alpestris</i> ISEAK A-1690/66	24.3	8.0	7.5	2.2	5.3	2.4
<i>Eremophila alpestris</i> UCBL 188/1	-	8.2	7.5	-	-	2.3
<i>Eremopterix leucotis</i> ISEAK A-3192/76	18.0	6.0	5.7	1.8	4.2	1.8
<i>Galerida cristata</i> ISEAK A-2238/70	-	-	-	-	5.5	-
<i>Galerida cristata</i> NHM 1853.1.18.16	26.2	9.3	7.9	2.3	5.5	2.6
<i>Galerida cristata</i> NHM 1998.92.35	26.3	9.3	8.1	2.2	5.8	2.6
<i>Galerida cristata</i> UCBL 283/1	22.9	8.0	7.2	2.1	5.4	2.2
<i>Galerida theklae</i> ISEAK A-3849/81	25.5	9.0	7.4	2.4	5.4	2.4
<i>Galerida theklae</i> NHM 1965.16.2	25.6	9.0	7.5	2.2	5.7	2.6
<i>Lullula arborea</i> ISEAK A-1837/67	24.1	8.2	7.1	2.2	5.1	2.2
<i>Lullula arborea</i> ISEAK A-2296/70	ca. 21.8	7.8	-	2.1	-	2.0
<i>Lullula arborea</i> ISEAK A-3154/77	23.9	8.7	7.1	2.3	4.9	2.3
<i>Lullula arborea</i> NMNHS 1/1990	23.6	8.3	7.2	2.1	5.3	2.3
<i>Lullula arborea</i> NMNHS 2/1996	-	8.1	6.7	-	-	2.1
<i>Lullula arborea</i> NMNHS 3/1997	24.4	7.9	-	2.0	5.4	2.6
<i>Lullula arborea</i> NMNHS 5/2000	22.4	6.5	6.8	2.0	4.8	2.4
<i>Lullula arborea</i> UCBL 285/1	23.1	7.3	7.0	2.1	5.2	2.4
<i>Melanocorypha calandra</i> ISEAK A-3506/78	29.0	9.6	8.8	2.7	-	2.9
<i>Melanocorypha calandra</i> ISEAK A-3864/81	30.3	9.8	8.7	2.6	6.7	2.9
<i>Melanocorypha calandra</i> NHM 1952.2.599	28.2	8.5	8.0	2.3	5.9	2.8
<i>Melanocorypha leucoptera</i> ISEAK A-2353/60	25.2	8.2	-	2.4	5.2	2.3
<i>Melanocorypha mongolica</i> ISEAK A-3094/75	28.6	9.3	8.0	2.7	6.8	2.7
<i>Melanocorypha yeltoniensis</i> NHM 1856.7.20.8	29.1	9.4	9.2	2.8	6.6	2.9
<i>Melanocorypha yeltoniensis</i> NHM 1952.2.600	29.3	10.2	8.9	2.7	6.6	2.9

*slivnicensis* sp. n. (present paper): by more concave dorsal surface of man. and better developed edge ('rib') on lateral surface of man.

Mandibula NMNHS 297 (Table 14). Length of the fragment: 10.5 mm. It differs from: *L. arborea*: dimensionally (chiefly the measurement 'a'; Fig. 15), more ventrally located foramina neurovascularia,

instead close to margo tomialis, presence of a well marked groove in the middle of lingual side of symphysis, and by much wider symphysal part. *E. alpestris*: by longer straight part of rhamus mandibulae. *Melanocorypha*: by much smaller dimensions. *G. cristata*: by better developed arc-like cutting on concavity of lat. side of mandible, and larger size. C.

*cinerea*: by longer symphysal part. *A. arvensis*: by wider and longer symphysal part. Early Pleistocene *A. jordanica*: 'The mandible is wider, flatter and shorter [than in *A. arvensis*]', and it is dated 'post-Villafranchian' (680 000 ± 50 000 BP; TCHERNOV, 1980), i. e. the chronostratigraphical difference is considerable enough to suppose a taxonomical identity.

Mandibula sin. NMNHS 298 (Table 15). It differs from: *Galerida* spp.: by better marked front edge of concave contours, and larger size. *L. arborea*: by larger size, and more gradual constriction in lat. view. *A. arvensis*: complete similarity according to the relief of lat. and med. surfaces but slightly differs by presence of an exostosis at bending, and shape of front edge of the first concave contour.

#### **Alaudidae gen. indet.**

Humerus sin. NMNHS 270 (Pl. 4 – g, h; Table 16). It differs from: *E. alpestris*: by relatively smaller diaphysis (measurements 'c' and 'e'; Fig. 1-O) (The index 'a/c' is 3.51 for N 270, 3.30 for *L. arborea*, and 3.18 for *A. arvensis*). *Alauda* spp.: by more transversal than longitudinal direction of linea intermuscularis on cr. pect. *A. arvensis*: by shorter cr. pect., and smaller impressio m. coracobrachialis cran. *Melanocorypha* spp.: by smaller size, and inclination of linea intermuscularis. *Galerida* spp.: by smaller size. *G. cristata*: by shape of ventr. tentacle of dist. epiphysis. *G. theklae*: by smaller size *G. cristata*: by longer diaphysis and shorter cr. deltopectoralis. *A. arvensis*: by shorter cr. deltopectoralis, smaller size, and shape of ventr. tentacle of dist. epiphysis. *Calandrella* spp.: by larger dimensions. *C. cinerea*: by larger size, and more arc-like prox. edge of fossa pneumotricipitalis. *C. rufescens*: by larger size, and more slender and straight diaphysis. *E. alpestris*: by smaller and more angular tuberculum ventrale, and smaller impressio m. coracobrachialis. *E. leucotis*: by larger size, longer cr. pect., and more slender diaphysis. *Amm. deserti*: by almost twice shorter cr. pect., and deeper fossa pneumotricipitalis. *L. arborea*: similar in general but differs by shorter cr. deltopectoralis, less medially curved epicondylus ventr., narrower and better developed fossa m. brachialis, relatively narrower epiphysis prox., the stronger inclination and stronger bending of linea intermuscularis on the cr. pect., and the smaller pr. flexorius in caudal view of epiphysis dist.

Hence, the comparative analysis excludes referring the find to any of the following eight genera: *Alauda* Linnaeus, 1758, *Ammomanes* Cabanis, 1851, *Eremophila* Boie, 1828, *Eremopterix* Kaup, 1836,

*Galerida* Boie, 1828, *Lullula* Kaup, 1829, *Calandrella* Kaup, 1829, and *Melanocorypha* Boie, 1828. It has not been compared to the remaining 13 genera (DE JUANA *et al.* 2004): *Mirafa* Horsfield, 1821, *Heteromirafa* C. H. B. Grant, 1913, *Calendulauda* Blyth, 1855, *Pinarocorys* Shelley, 1902, *Ammomanopsis* Bianchi, 1904, *Chersomanes* Cabanis, 1851, *Certhilauda* Swainson, 1827, *Alaemon* Keyserling & J. H. Blasius, 1840, *Chersophylus* Sharpe, 1890, *Ramphocorys* Bonaparte, 1850, *Eremalauda* W. L. Sclater, 1926, *Spizocorys* Sundevall, 1872, and *Pseudoalemon* E. L. Phillips, 1898

The alaudid fauna of Varshets includes 5 taxa at least: *Melanocorypha donchevi* sp. n., *Eremophila prealpestris* sp. n., *Galerida bulgarica* sp. n., *Alauda xerarvensis* sp. n., and *Lullula balcanica* sp. n. *Mirafa*, *Heteromirafa*, *Calendulauda*, *Pinarocorys*, *Ammomanopsis*, *Chersomanes*, *Certhilauda*, *Eremalauda*, and *Spizocorys* are spread in S and SE Asia and/or Sub-Saharan Africa, i. e. all ranges of recent species lie far from Balkan region. *Alaemon* approaches to Near East (and Balkans) but both species of the genus are considerably larger than the compared specimen.

The monotypic *Chersophylus* is spread in North Africa and Iberian Peninsula. In comparison to the species of the established genera in Varshets, dimensionally (body length: 17-18 cm; body weight: 32-47 g) it is smaller than *Melanocorypha*, *Galerida*, *Alauda*, while it is larger than *Eremophila*, and *Lullula* (DE JUANA *et al.* 2004). The monotypic *Ramphocorys* is spread in North Africa and Arabian Peninsula. In comparison to the species of the established genera in Varshets, dimensionally (body length: 17-18 cm; body weight: 52-55 g) it is smaller than *Melanocorypha*, while it is larger than *Eremophila*, *Galerida*, *Alauda*, and *Lullula* (DE JUANA *et al.* 2004). The monotypic *Eremalauda* is spread in Sub-Saharan Africa and Arabian Peninsula. In comparison to the species of the established genera in Varshets, dimensionally (body length: 14-15 cm) it is smaller than *Melanocorypha*, *Galerida*, *Alauda* (DE JUANA *et al.* 2004). The monotypic *Pseudoalemon* is spread in Sub-Saharan East Africa. In comparison to the species of the established genera in Varshets, dimensionally (body length: 14-15 cm; body weight: 23-26 g) it is smaller than *Melanocorypha*, *Eremophila*, *Galerida*, *Alauda*, and *Lullula* (DE JUANA *et al.* 2004). Thus, we could exclude *Chersophylus*, *Ramphocorys*, *Eremalauda* and *Pseudoalemon* of our comparisons.

## Discussion and Conclusions

It is accepted that the family of larks (Alaudidae) is of steppe origin (DE JUANA *et al.* 2004). Dry and relatively warmer climate in some regions in combination of more humid and warmer climate in other regions, formed forest-steppe mosaic biotopes or open forest habitats.

Such mosaic-like habitats were widely spread during the most of Late Pliocene in Bulgaria (and SE Europe; Spassov, 2005).

It is believed that Passeriformes L., 1758 accomplished their rapid flourishing in the Neogene. Alaudidae are usually placed as the first family of the suborder Passeri (former Oscines) in the Old World avian systematics (DE JUANA *et al.* 2004), and probably their origin is directly related to the openland (late) Neogene landscapes. The role of the impact of Plio-Pleistocene climatic oscillations on the speciation of two species of an openland genus of larks (*Galerida*) from both sides of the deserts belt of Africa and Asia has been examined by GUILLAUMET *et al.* (2008). Open park-like forest and mosaic habitats dominated in the areas of Bulgaria (SPASSOV, 2003) in late Pliocene localities Varshets and Slivnitsa, from where the remains of the established new alaudid taxa have been uncovered. Most of them are inhabitants of the openland and rocky habitats, but both *Lullula* species probably were confined to the woodland patches of the mosaic landscapes in Villafranchian of West Bulgaria (see footnote on p. 295). Both Early Pleistocene fossil species of larks (*M. gracilis* and *A. jordanica*) from Israel could also be referred to 'openland' group of larks. Lesser number of 'woodland' larks in the World's fossil record could also be explained by the poor taphonomic conditions in woodland habitats but also by general adaptation of alaudids to openland grass environment.

The extremely rare fossil record of the family (10 fossil species<sup>2</sup>, eight of which from present pa-

per) strongly disagrees with the relatively large number of the recent species (96). Its concentration (in Europe) in the southern regions (France, Italy, Spain, and Bulgaria) in Neogene probably suggests former richer avian diversity and more suitable (mainly open grassland) habitats. Some other avian taxa established in Bulgaria in Miocene (ostriches, ground hornbills, falcons, snake-eagles) and Pliocene (bustards, griffons, goldfinches, buntings) perfectly confirms their dominant distribution throughout the country in the Neogene.

According to available data so far, Varshets is the World's richest locality of alaudid fauna, providing record of 5 genera at least and one fossil genus Alaudidae gen. indet. and 5 fossil species: *Melanocorypha donchevi* sp. n., *Eremophila prealpestris* sp. n., *Galerida bulgarica* sp. n., *Alauda xerarvensis* sp. n., and *Lullula balcanica* sp. n.

Extremely diversified habitats in Bulgaria in Miocene and Pliocene and the unique geographical location of its territory on the crossroads between three continents, were the main preconditions for the abundant and diversified avian fauna since the late Neogene to recent times. This diversity was also demonstrated in the alaudid fauna, relatively poorly known from the European avian localities of Miocene and Pliocene epochs.

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<sup>2</sup> 13 species after the paper of Kessler & János, 2012.

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## APPENDIX 1

### Examined specimens

Greater Hoopoe-lark *Alaemon alaudipes* Desfontaines, 1789) NHM 1927.12.27.80; Skylark *Alauda arvensis* Linnaeus, 1758 NMNHS 1/1989; NMNHS 2/1990; NMNHS 4/1997; NMNHS 5/2008; ISEAK A-2394/71, ISEAK A-2863/73, ISEAK A-4974/91, NHM 1976.22.1, NHM 1979.31.4, NHM 1980.37.1, NHM 1981.13.13, NHM 1983.100.3, NHM 1983.100.4, NHM 1983.100.5, NHM 1983.100.6, NHM 1983.100.7, NHM 1984.15.6, NHM 1985.06.1, UCBL 286/1, UCBL 286/2, UCBL 286/4, UCBL 286/5; Dessert Lark *Ammomanes deserti* Lichtenstein, 1823 ISEAK A-4140/84, NHM 1978.3.3, NHM 1986.71.6; Greater Short-toed Lark *Calandrella brachydactyla* (Leisler, 1814) ISEAK A-3504/78, NHM 1952.2.601, NHM 1961.13.21, NHM 1961.13.34; Red-capped Lark *Calandrella cinerea* (Gmelin, 1789) NMNHS 1/1981; ISEAK A-3504/78, ISEAK A-3850/81, NHM 1903.1.6.3, NHM 1961.13.21, NHM 1961.13.34; Lesser Short-toed Lark *Calandrella rufescens* (Vieillot, 1820) ISEAK A-3855/81, ISEAK A-3860/81, NHM 1952.2.601; Chestnut-backed Sparrow-lark *Eremopterix leucotis* (Stanley, 1814) ISEAK A-3178/76; Black-crowned Sparrow-lark *Eremopterix nigriceps* (Gould, 1841) NHM 1996.69.13, NHM 1996.69.136.5; Shore Lark *Eremophila alpestris* (Linnaeus, 1758) NMNHS 1/1991; ISEAK A1523/65, ISEAK A-1689/66, ISEAK A-1690/66, NHM 1869.9.12.15, NHM 1930.3.24.513, NHM 1963.15.1, UCBL 188/1; Crested Lark *Galerida cristata* (Linnaeus, 1758) NMNHS 1/1981; ISEAK A-2238/70, ISEAK A-2372/71, NHM 1853.1.18.16, NHM 1998.92.35, UCBL 283/1, UCBL 283/2; *Galerida theklae* ISEAK A-3849/81, NHM 1965.16.2; Woodlark *Lullula arborea* (Linnaeus, 1758) NMNHS 1/1990; NMNHS 5/2000; ISEAK A-1837/67, ISEAK A-2296/70, ISEAK A-3154/77, NHM 1952.2.602, NHM 1965.15.2, NHM 1965.15.4, UCBL 285/1; Calandra Lark *Melanocorypha calandra* (Linnaeus, 1766) NMNHS 1/2002, ISEAK A-3506/78, ISEAK A-3864/75, ISEAK A-3864/81, NHM 1952.2.599; White-winged Lark *Melanocorypha leucoptera* (Pallas, 1811) ISEAK A-2153/60, ISEAK A-2153/70, ISEAK A-2353/60; Mongolian Lark *Melanocorypha mongolica* (Pallas, 1776) NMNHS 1/2010; ISEAK A-3094/75, NHM 1911.9.12.1; Black Lark *Melanocorypha yeltoniensis* (Forster, 1767) NHM 1856.7.20.8, NHM 1952.2.600; Madagascar Lark *Mirafra hova* Hartlaub, 1860 NHM 1897.5.10.59; Horsfield's Bush Lark *Mirafra javanica* Horsfield, 1821 NHM 1969.4.53, NHM 1969.4.58.