Birds of the Late Pleistocene and Holocene from the Palaeolithic Djuktai Cave site of Yakutia, Eastern Siberia

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ABSTRACT - Avian remains from the Late Palaeolithic Djuktai Cave (15000 – 740 years B.P.) are represented by more than 700 bones. We identified 65 species from 10 modern orders. The most abundant are remains of the Willow Grouse (*Lagopus lagopus*), and Ptarmigan (*L. mutus*). The remains of Ducks (Anatidae), Waders (Scolopacidae), and Thrushes (*Turdus spp.*) are less numerous. Except for a few cases, most avian species identified represent the fauna of open-land habitats, for example *Otis tarda*. In modern faunas these birds are inhabitants of steppe landscapes which are absent in the Aldan basin now. Thus the presence of these species indicates that there was a steppe near the Cave at the end of the Pleistocene. In addition, some of the Waterfowl bones recovered have cut-marks made by Palaeolithic man.

Key words *- Quaternary birds, Eastern Siberia,* Lagopus, *Holocene, Late Pleistocene, Djuktai Cave, open landscapes.*

Oiseaux du Pléistocène supérieur et de l'Holocène du site paléolithique de la grotte de Djuktai, Yakoutie, Sibérie orientale – Les restes d'oiseaux du Paléolithique supérieur de la grotte de Djuktai (15000 – 740 ans B.P.) sont représentés par plus de 700 os. Nous avons identifié 65 espèces appartenant à 10 ordres modernes. Les plus abondants sont ceux de *Lagopus lagopus* et de *L. mutus*. Les restes d'Anatidae, Scolopacidae et *Turdus spp*. Sont moins nombreux. A l'exception de quelques cas, la plupart des espèces d'oiseaux identifiées correspondent à une faune d'habitats ouverts, par exemple *Otis tarda*. Dans les faunes actuelles ces oiseaux habitent des paysages de steppe qui sont actuellement absents dans le bassin de l'Aldan. La présence de ces espèces indique donc qu'il existait une steppe à proximité de la grotte à la fin du Pléistocène. En outre, certains des os d'oiseaux aquatiques montrent des entailles faites par les hommes du Paléolithique.

Mots clés *– Oiseaux quaternaires, Sibérie orientale,* Lagopus, *Holocène, Pléistocène supérieur, grotte de Djuktai Cave, paysages ouverts.*

INTRODUCTION

Siberia is a very large region of Russia, spreading from the Ural Mountains in the West to the Pacific Ocean in the East. Nevertheless, Quaternary avian remains from this Asian part of Russia are very poorly known -- birds of this age are relatively well studied only from the Altai, the Krasnoyarsk and Irkutsk regions of Russia, and also from the southern part of Far Eastern Russia (Panteleyev, 1999). The most important results on fossil Pleistocene and Holocene birds of these regions are those of Martynovich (e. g. 1990, 1998; Ovodov *et al.,* 1998), Panteleyev (e. g. Panteleyev & Alekseeva, 1993), and Mlikovsky (Mlíkovský *et al.,* 1997). Only a few works deal with the Quaternary birds of Western Siberia (e.g. Potapova & Panteleyev, 1999), and the northern part of the Russian Far East (e.g., Savinetsky, 2002). In Yakutia (Fig. 1), three localities with avian remains are known. Remains of *Lagopus lagopus* were identified from Late Pleistocene sediments at a Palaeolithic site at the Bereleh River (71° N) and Gureev identified 15 species of birds from the Neolithic site Kullaty near Yakutsk (Panteleyev, 1999). E.N. Kurochkin and P. Ballmann previously identified 49 bones from the Djuktai Cave collected in 1968 and found 9 species which have been listed by Mochanov (1970). Thus the aim of our work was to provide data on the Quaternary avifauna of the Yakutia region based on the bird bones collected in the Djuktai Cave in 1969-1973.

LOCALITY AND BONE DEPOSITS

Djuktai Cave is located in the eastern part of Yakutia (fig. 1), on the right bank of the Djuktai River near its connection with the Aldan River (Lena River Basin). This cave was discovered in 1967 by archeologist Jurii Mochanov during the Prilenskaya Archeological Expedition, organized by the Siberian Branch of the USSR Academy of Science.

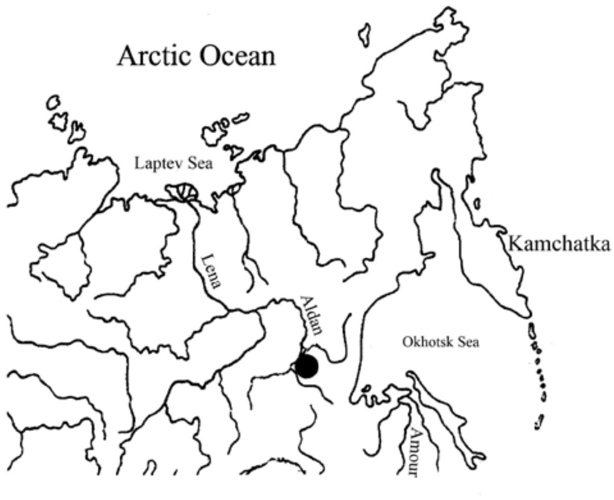

Figure 1 - Map of Eastern Siberia, showing location of the Djuktai Cave (black circle).

Mochanov (1977: p. 13; fig. 7) recognized several layers in the cave deposits. The layers differ from each other by their absolute age and the type of sediment accumulation, but layer 3 is the youngest, situated under grass cover near the cave entrance and also inside the cave. This layer appears to be of alluvial origin (Mochanov, 1977); its age is estimated to be between 790-690 years old (B.P.) on the basis of radiocarbon data (Mochanov, 1977; p. 9). A few stone artefacts of Neolithic age as well as avian and mammalian bones were found in this layer.

Layer 5 is positioned beneath the third in the area next to the cave entrance. It was long assumed (Mochanov, 1977) that this was grass cover overlaid by the alluvial sediments of layer 3, however stone artefacts and bones of *Alces alces, Rangifer tarandus, Sciurus vulgaris, Martes* sp., and *Castor* sp. were found in this layer alongside some avian remains. Unfortunately, no data concerning the age of this layer were published by Mochanov (1977).

Layer 7 occurs beneath layer 5, inside the cave and in the area next to the entrance. This layer contains abundant Palaeolithic stone artefacts as well as the bones of mammals and birds. Typical components of the mammoth fauna, such as *Mammuthus primigenius, Bison priscus, Equus caballus*, and others are copiously represented in this layer. In addition, Mochanov (1977; pp. 11-13) mentioned a few radiocarbon dates that range from 12100±120 years B.P. to 14000±90 years B.P; this layer is thus Late Pleistocene in age.

Layer 8, underneath layer 3 inside the cave, also contains avian fossils. Although no data on the age of this layer are available, the abundance of Palaeolithic stone artefacts and the remains of Pleistocene animals allowed Mochanov (1977) to suppose that this layer should be considered the same age as layer 7.

A total of 716 complete bones or bone fragments have been collected during field work in 1967-1973. However, 51 percent of avian bones are not assigned to any layer.

TAXONOMY AND FAUNAL CHARACTERISTICS

The bird bones from the deposits of the Djuktai Cave belong to 65 extant species and 2 undescribed extinct species belonging to the genera *Anser* and *Mergellus*. The majority of the bones are well-preserved, and therefore it is possible to identify them to the species level. We identified 162 remains belonging to 17 genera, and 30 remains were identified as representatives of a specific family. It was impossible to identify to the family level 24 passerine bones (tabl. 1). Some fragments could not be determined.

The remains of ptarmigans and waterfowl are the most numerous in the collection while remains of the Willow Grouse (*Lagopus lagopus*) add up to 16% of the total number of bones. The bones of the Ptarmigan (*L. mutus*) are less abundant (5%), while Anatidae are represented by 13 species with species of the genus *Anas* dominant (including the two new species). In addition the waders (Limicolae) form a considerable part of the collection (13%) and are represented by 14 species. Within Limicolae, species of the genera *Gallinago*, *Tringa* as well as *Numenius minutus* are the most abundant. Within Passeriformes, thrushes (*Turdus* spp.) are the more numerous, forming about 12% of the total of bones. In total we identified 4 species of *Turdus* (tabl. 1) including some remains the size of *T. naumanni*. However, because we were unable to examine skeletons of *T. sibiricus*, which is similar in size to some of the material collected, all is included in *Turdus* sp. Thus, at least 5 species of *Turdus* are represented in Djuktai Cave.

The remains of different species vary in number from layer to layer, based on the total number of bones collected. For example, Anatidae are the most numerous in layers 3 (fig. 2) and 5 (fig. 3), where they amount to about 40 and 50% respectively of the total bird bones. The bulk of Limicolae remains (90%) were concentrated in layer 7,

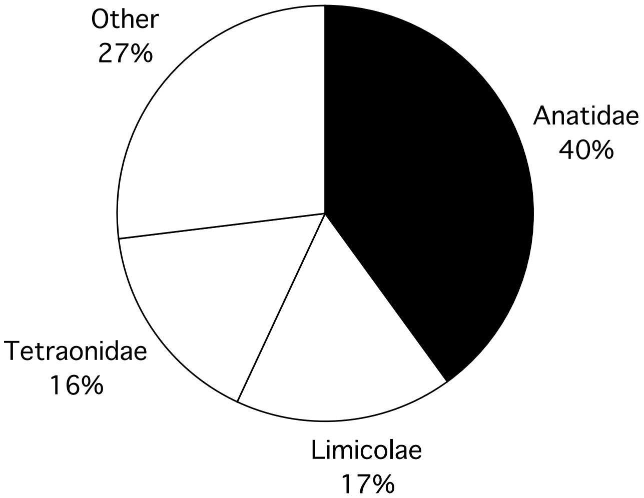

Figure 2 - Relative abundance of the bones of Waterfowls, Waders, Grouses, and the other birds in layer 3. (N=19)

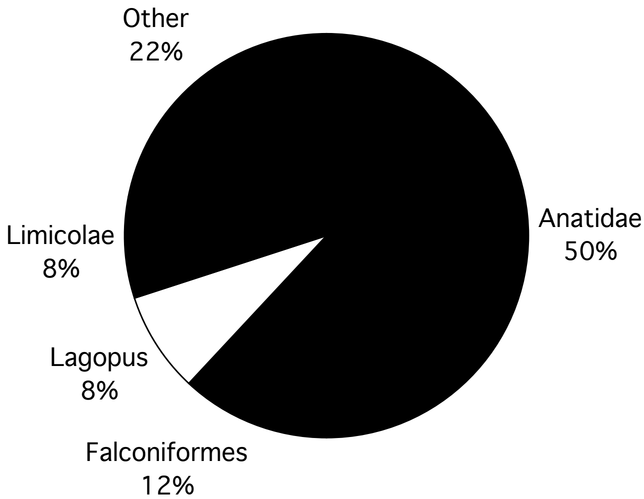

Figure 3 - Relative abundance of the bones of Diurnal Raptors, Waterfowls, Grouses, Waders, and the other birds in layer 5. (N=52)

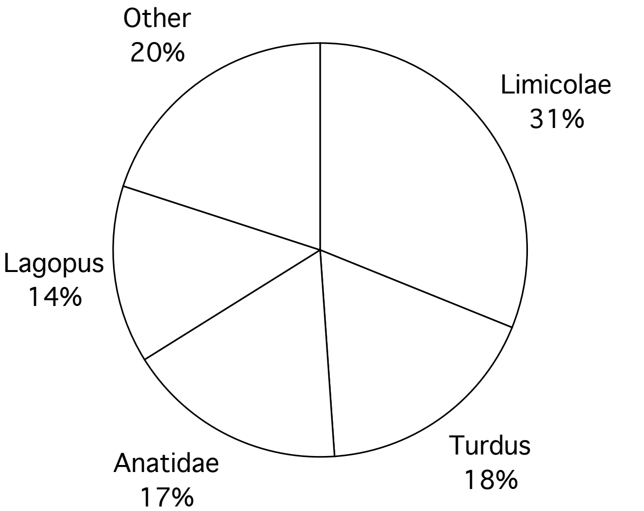

Figure 4 - Relative abundance of the bones of Thrushes, Waterfowls, Waders, Grouses, and the other birds in layer 7. (N=144)

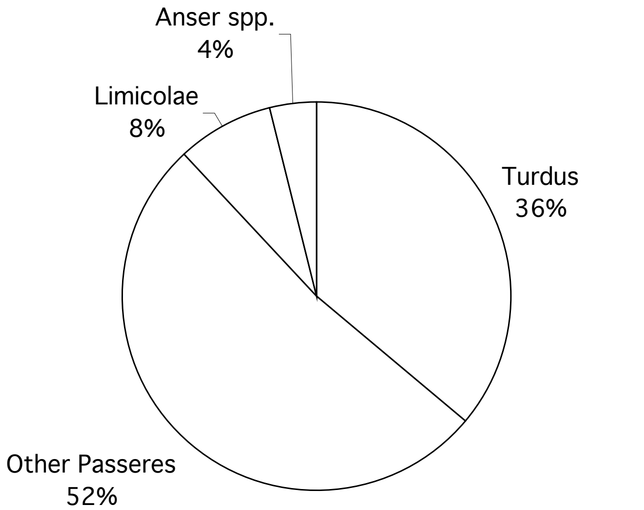

Figure 5 - Relative abundance of the bones of Thrushes, Waders, Geese, and other passerines in layer 8. (N=27)

where they add up to about 31% of the total number of bird bones (fig. 4). Remains of thrushes are numerous in layer 8 (36%), although other passerines -- mainly small ones -- are also well represented. Passeriformes, including thrushes, comprise 88% of the total bird bones from layer 8 (fig. 5). Interestingly, the genus *Lagopus* is not dominant in any layer, but most of the remains (78%) of this taxon originate from layer 7.

TAPHONOMY

The origin of fossil, or subfossil, avian remains is of great interest to palaeontologists; many studies have considered the problem of how to identify the source of accumulation ('anthropogenic' versus 'natural' or caused by the activity of a predator, for example). A few statistical methods that allow identification of the accumulation type have even been proposed: Mourer-Chauviré (1983) and Ericson (1987), for example, used either the 'distal to proximal' or 'wing to leg' ratios of skeletal elements in their analyses. However, as shown by later workers (e.g. Bramwell et al., 1987; Bocheński, 1997; Bocheński at al., 1997; Bocheński at al., 1999; Laroulandie, 2000; Martynovich, 2004), such numerical methods often do not allow for correct establishment of the source of accumulation. Because this is also the case for methods which use degree and features of bone fragmentation (e.g. Gourichon, 1994; Laroulandie, 1996, 1998), it is considered that the best criterion for identification of the origin of remains is direct evidence indicating the usage of bones by men, or animal predators (Laroulandie, 2000; Martynovich, 2004).

It is obvious that at least some of the avian remains

Figure 6 - Humerus of *Anser new sp.* (PIN № 2859-595) showing the cut-marks upon its ventral surface.

found in the proximity of the Djuktai Cave were accumulated as the result of human activity. The exploitation of the Pleistocene megafauna by 'Djuktai man' is further demonstrated by the presence of a great number of bone fragments together with stone artefacts. These bones have cut-marks on their surfaces. Moreover, some artefacts were even made from bones of Pleistocene animals (Mochanov, 1977). We conclude that at least some anseriforms might have been eaten by Paleolithic man, because two bones of *Anser* and a single coracoid of *Aythya fuligula* bear cut-marks which resemble transversal cuts – the signs of cutting the flesh off the bone (fig. 6).

The origin of bones of ptarmigans (*Lagopus* spp.) is unclear. Most of the bones -- 72% of the total -- of the Willow Grouse are distal limb elements: carpometacarpi, tarsometatarsi and the distal ends of ulnae, radii and tibiotarsi (fig. 5). According to Mourer-Chauviré (1983), this should be interpreted as evidence for predator activity. For the Willow Grouse, the percentage of wing elements is 62 (compared to 63 in the case of the Ptarmigan) -- this should indicate an anthropogenic origin for these remains (Ericson, 1987). However, the same distribution (Bocheński et al., 1993; Bocheński, 1997) was also found for bones in pellets of the Eagle Owl (*Bubo bubo*) and the Snowy Owl (*Nyctea scandiaca*). Nevertheless, it is possible that at least some of the *Lagopus* remains may be of anthropogenic origin -- ptarmigans are very numerous in the deposits of Djuktai Cave, as well as in other archaeological sites (Stewart, 1999). It is relatively simple to obtain ptarmigans in large quantities, using methods that are still practised by the people of the northern tribes: nooses, traps or nets can be successfully used in the hunting process (Potapova & Panteleyev, 1999). Notably, the remains of ptarmigans originate mainly from cultural layer 7 (see above), where they were found besides artefacts. On the other hand, Limicolae, which comprise the majority of remains in the same layer 7 (31% of total number of bones from this layer), are represented mainly by proximal limb elements (72% of total wader's bones), the wing elements comprising 53% (n=81).

We cannot decide the exact causes for the Djuktai Cave bone accumulation. Most probably, however, the avian remains at this site are of mixed origin -- the presence of considerable numbers of medium- and small-sized woodland species might be indicative of the fact that at least some birds were deposited without any human activity.

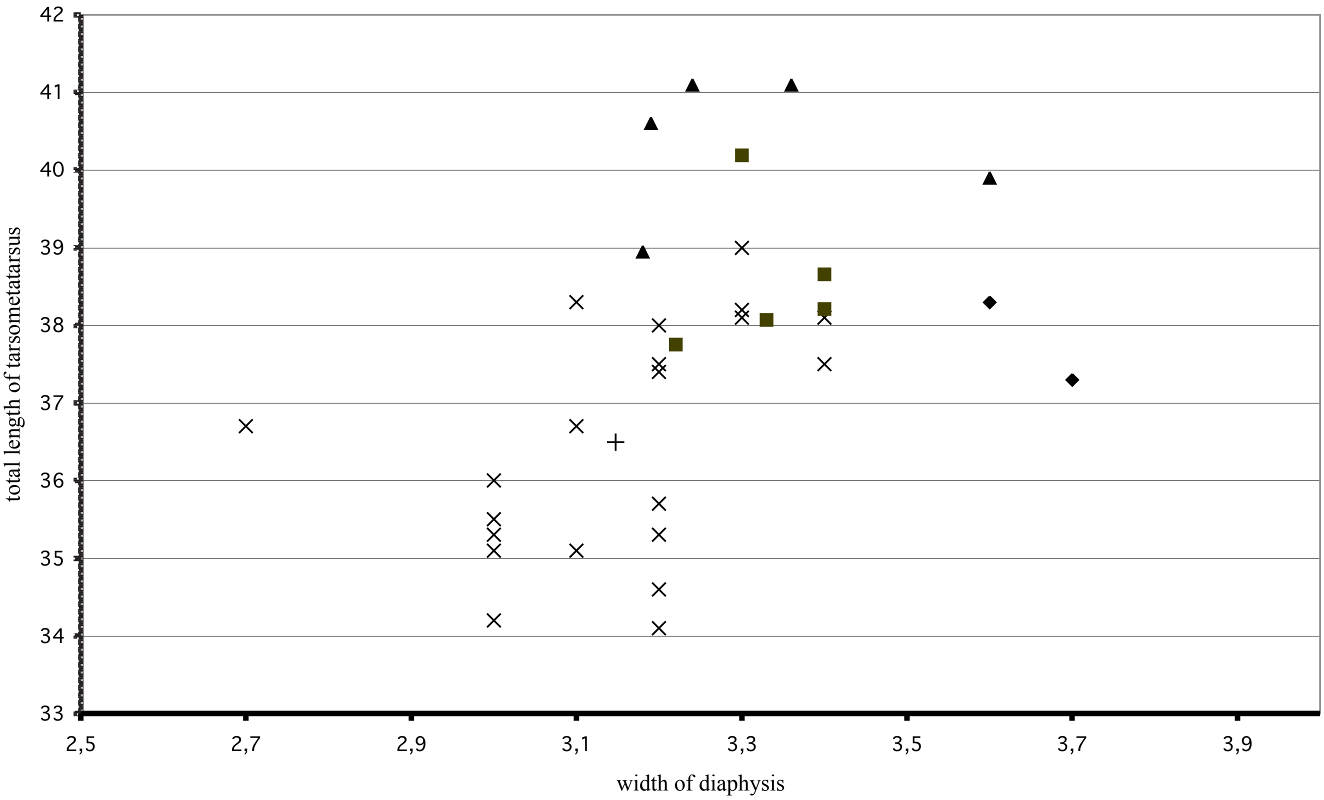

Figure 7 - General proportions of the tarsometatarsus in the recent and some fossil populations of the Willow Grouse (Lagopus lagopus). ▲- the mean values for the recent population of the grouse (from Stewart, 1999 and Potapova, 1986); ♦ - the mean values for the grouse from Medvezhya Cave (Nothern Urals; 16-20 KA, from Potapova, 1986); ■ – the mean values for the fossil grouse from Europe (from Stewart, 1999); x – the grouse from the Djuktai Cave; + - the mean for the grouse from Djuktai Cave.

BIOMETRY

Willow Grouse from the deposits of the Djuktai Cave differ from their recent counterparts in the proportions of their limb bones. This is interesting because the morphometry of limb proportions in fossil grouse has been considered by many previous authors (e.g. Bocheński, 1985, 1991; Potapova, 1986; Stewart, 1999), and it is well know that fossil Late Pleistocene and Holocene grouse had shorter legs and longer wings than their extant counterparts. This difference in biometry is reflected in the shortening of the tarsometatarsus and in the lengthening of the humerus and the carpometacarpi, and has been clearly demonstrated in grouse from Eastern (Bocheński, 1985; Bocheński & Tomek, 1994) and Western Europe (Mourer-Chauviré, 1975), as well as in the grouse from Western Siberia (Potapova, 1986). However, no data on the proportions of the grouse from Eastern Siberia were available until this study.

We measured the maximum length, the width of the proximal and distal epiphyses, and the shaft width of the tarsometatarsus of all ptarmigans from Djuktai Cave. We also measured the carpometacarpus (tabl. 2) of fossil *Lagopus* from this site -- these two skeletal elements are the most numerous, the tarsometatarsi (n=47) representing 40% of the total *L. lagopus* bones and the carpometacarpi (n=19) 16%.

Willow Grouse from Djuktai Cave possess shorter tarsometatarsi, compared to extant *L. lagopus* (fig. 8). The length of the tarsometatarsus in these specimens ranges from 34,1 to 39 mm (36,5 on average, n=21), while recent *L. lagopus lagopus* from Yakutia have a tarsometatarsus that ranges in length from 37,7 to 42,3 mm (40,1 mm on average, n=17;Panteleyev & Potapova, 2000). Stewart (1999) mentioned one *Lagopus lagopus* tarsometatarsus from Kazakhstan that is 45,3 mm in length while the length of this element in European populations ranges from 34,3 to 43,6 mm (39,5 on average, n=88; Bocheński, 1985).

The fossil Willow Grouse that are known to date from the uppermost Pleistocene and early Holocene across Europe are characterized by rather short tarsometatarsi, but nevertheless longer than seen in the Djuktai birds. The mean length of this bone varies between 37,3 and 39,5 mm in fossil *Lagopus lagopus* (Bocheński 1974, 1985; Potapova, 1986; Stewart, 1999). Very short tarsometatarsi are found only in grouse from localities not younger than 50 KA: the mean length of this bone in Willow Grouse from two localities in Southern Poland of that age is 35,9 and 36,34 mm

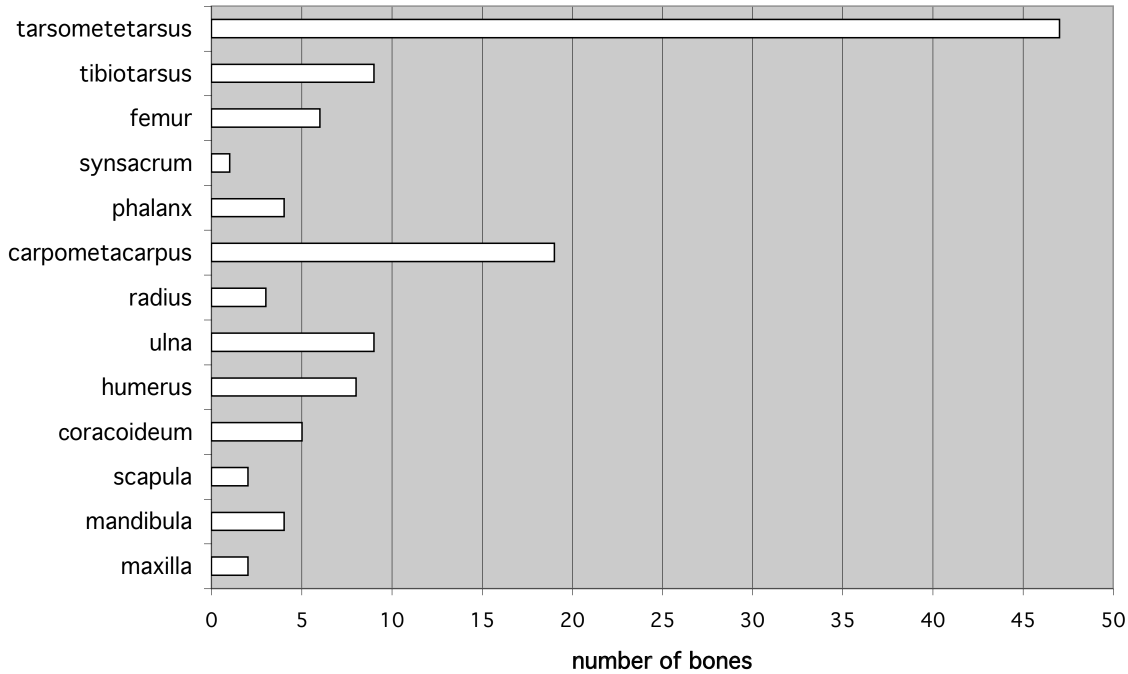

Figure 8 - Diagram of relative representation of main skeletal elements (N=117) for the Willow Grouse.

(Bocheński, 1974, 1985), very close to the index of the Djuktai taxa.

A positive correlation between body weight and width of the tarsometatarsal shaft in recent *Lagopus* was pointed out by Stewart (1999). However it has more recently been shown (Potapov et al., 2003), that Recent Willow Grouse do not always fit with the relationship proposed by Stewart (1999), especially taking into account the considerable seasonal fluctuations seen in the body weight of these birds. Nevertheless, this correlation is more profound than that seen between tarsometatarsal length and body weight. Although fossil *Lagopus* do possess a relatively shorter tarsometatarsus (Stewart, 1999), it also appears to be somewhat heavier than its modern counterpart owing to an increase in the general fatness of the birds in regions with more severe winters – such a situation was to be observed in the tundra-steppe of the Late Pleistocene (Potapov et al., 2003). *L. lagopus* from Djuktai Cave possess a tarsometatarsal shaft that is 3,2 mm on average, quite similar to the tarsometatarsal shaft width of recent *L. lagopus lagopus* from Scandinavia and Russia (Stewart, 1999). However, recent *Lagopus* with the same shaft width have a relatively longer tarsometatarsus.

The carpometacarpus of Willow Grouse from Djuktai Cave appears to be slightly longer than in recent *L. lagopus* -- the length of this bone in the Djuktai taxa ranges from 34,7 to 38,4 mm (36,0 mm on average, n=14). Recent grouse from Europe possess a relatively shorter carpometacarpus, with a length ranging from 30,1 to 37,3 mm (34,3 mm on average, n=22; Bocheński, 1985) while the length of Russian *L. lagopus* carpometacarpi is 32,5-37,5 mm (34,7 mm on average, n=19; Panteleyev & Potapova, 2000).

In conclusion, the Grouse from Djuktai Cave appear to have been somewhat larger than their recent counterparts from across Europe, especially with regard to the size of their wing elements. Nowadays, most short-legged grouse live under the most severe conditions (Potapova, 1986), so the grouse from Djuktai Cave may represent a relict population adapted to an extremely bleak climate; other birds of this morphotype may have disappeared across Europe earlier, about 50 KA, but are still seen in Eastern Siberia because of the more continental climate of this region, with very cold winters. Even today, the mean winter temperature in Yakutia is less than -38°C and it was even colder there in the uppermost Pleistocene (Andreev et al., 1992).

PALAEOGEOGRAPHY AND PALAEOECOLOGY

Most avian species from Djuktai Cave are now known in the fauna of Eastern Yakutia but a few species can no longer be found there. At the present time, some of these species (i.e., *Clangula hyemalis, Buteo lagopus, Limosa limosa, Phalaropus spp*., and *Philomachus pugnax)* can be seen in the area during the migration period but in the Pleistocene and Holocene we do not know whether they were breeders or migratory in Eastern Yakutia. A number of other species, like *Tetrao tetrix*, are in principal settled birds or their breeding range lies south of the Aldan River (*Gallinago megala*, *Podiceps nigricollis*, *P. cristatus*, and *Otis tarda*). Three out of five of these species are found in layer 7. *Lyrurus tetrix* is now found only in Western and Central Yakutia. The closest regions that *Gallinago megala, Podiceps nigricollis*, *P. cristatus*, and *Otis tarda* inhabit nowadays are the Baikal and Amur regions. Presently *Otis tarda* occupies only steppe landscapes. Thus, the presence of this species indicates that some kind of steppe landscapes were to be found near Djuktai Cave in the latest Pleistocene - that is in agreement with palynological data (Andreev et al., 1992). The relicts of such Pleistocene steppe and even sand deserts are found now in Central Yakutia, namely in the Vilyuy River basin. These landscapes resemble the deserts of Central Asia and the steppes of the Baikal region. Relict populations of *Corvus frugilegus*, *Falco vespertinus*, and also *Talpa* sp. are still extant in the basin of the Vilyuy River (Andreev, 1987).

Previously, Ballmann and Kurochkin identified the Gadwall (*Anas strepera*) and the Graylag (*Anser anser*), based respectively on the distal fragment of carpometacarpus PIN № 2859-661 and a series of bones now assigned to *Anser* new sp., These data were cited by a number of authors (Mochanov, 1970; Burchak-Abramovich & Burchak, 1998; Tyrberg, 1998; Panteleyev 2002). The noted carpometacarpus in fact does not belong to the Gadwall but rather to the Mallard (*A. platyrhynchos*) or the Pintail (*A. acuta*) and it is referred to *Anas sp*. As to the Graylag, the lack of comparative material at the end of the 1960s did not allow identification of this species as a new one. The comparisons made with 11 individuals of the recent *Anser anser* revealed that that particular goose could not be assigned to that species.

Many species (non-passerine and passerine forms) from Djuktai Cave are faunal elements of open land habitats (including wetlands). We can add to this list the river and lake dwellers, such as the Loons, Grebes, and Ducks, which are very numerous in Djuktai Cave. But there are also woodland species, namely *Accipiter cf. nisus*, *Tetrao parvirostris, Bonasa bonasia, Scolopax rusticola, Streptopelia orientalis, Asio otus, Strix spp., Bombycilla cf. garrulus, Fringilla montifringilla, Perisoreus infaustus*, and the Thrushes (*Turdus* spp., *Zoothera dauma*). As for the Thrushes, whose remains are also abundant in Djuktai Cave, they often use meadows and open countries when feeding. Hence the presence of these birds among the open-land dwellers seems appropriate. Most of the other woodland species are found in the Holocene sediments (layers 3 and 5) only. *Strix uralensis* is not connected to any specific layer. The presence of woodland species in the younger sediments (layers 3 and 5) may be a result of either change of vegetation or change of accumulation in the Holocene or both. The latter could be due to the fact that human-caused accumulation was limited to the Pleistocene.

CONCLUSIONS

This work completes the study of birds from the Late Palaeolithic site at Djuktai Cave undertaken in the 1960s. The faunal complex from Djuktai Cave includes 65 species (13 of them passerines), thus this locality is one of the three richest sites with Quaternary bird remains from the territory of Russia. The bulk of species identified from the cave deposits are open-land dwellers, but a number of woodland species confirm the presence of forests or at least bushes in the latest Pleistocene of South Yakutia. A few species are found to the north of their recent breeding range. The bones of juvenile specimens of the Whimbrel (*Numenius phaeopus*) and the Siberian White Crane (*Grus leucogeranus*) allow to suppose that these species once spread to the south of their recent breeding range. The presence of the Gadwall (*Anas strepera*) is not confirmed for Djuktai Cave and the lack of the Pintail (*A. acuta*) in Pleistocene layers may indicate that this species entered Eastern Siberia more recently. Two new extinct species of anseriforms were identified, they will be described elsewhere.

The Willow Grouse from Djuktai Cave possesses a very short tarsometatarsus – it is comparable with the tarsometatarsus of the Willow Grouse found in Europe localities dating from about 60-50 KA. The wing bones of the Djuktai Grouse were considerably larger than in recent *L. lagopus*.

A few bones bear cut-marks that are indicative of humans being involved in the process of bone accumulation. However, the presence of a number of small arboreal birds advocates a mixed type of accumulation.

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REFERENCES:

Andreev, A. A., Klimanov, V. A. & Sulerzhicky, L. D. 1992. History of vegetation and climate of Yakutia during the last 11000 years. *Komissiya po izucheniyu chetvertichnovogo perioda.* Moscow: Nauka : 112-117. [Russian]

Andreev, B. N. 1987. *Birds of Viljui basin.* Yakutsk: Yakutskoe knizhnoe izdatelstvo. 1-192. [Russian]

Bocheński, Z. 1985. Osteological differentiation in willow grouse. *Fortschunginstitut für Zoologie,* 30 : 69-72.

Bocheński, Z. 1991. Pliocene grouse of the genus *Lagopus* from Poland. *Acta zoologica cracoviensia,* 34 : 563-577.

Bocheński, Z. & Tomek, T. 1994. Fossil and subfossil bird remains from five Austrian caves. *Acta zoologica cracoviensia,* 37 : 347-358.

Bocheński, Z. M., 1997. Preliminary taphonomic studies on damage to bird bones by Snowy Owls *Nyctea scandiaca*, witn comments on the survival of bones in palaeontological sites. *Acta Zoologica Cracoviensia*, 40 : 279-292.

Bocheński, Z. M., Boev, Z., Mitev, I. & Tomek, T. 1993. Patterns of birds fragmentation in pellets of the Tawny Owl (*Strix aluco*) and the Eagle Owl (*Bubo bubo*) and their taphonomic implications. *Acta zoologica cracoviensia,* 36 : 313-328.

Bocheński, Z. M., Huhtala, K., Sulkava, S. & Tornberg, R. 1999. Fragmentation and preservation of bird bones in food remains of the Golden Eagle *Aquila chrysaetos*. *Archaeofauna*, 8 : 31-38.

Bocheński, Z. M., Korovin, V. A., Nekrasov, A. E. & Tomek T., 1997. Fragmentation of bird bones in food remains of Imperial Eagles (*Aquila heliaca*). *International Journal of Osteoarchaeology*, 7 : 165-171.

Bramwell, D., Yalden, D.W. & Yalden, P. E. 1987. Black Grouse as Prey of the Golden Eagle at an Archaeological Site. *Journal of Archaeological Science*, 14 : 195-200.

Burchak-Abramovich, N. I. & Burchak, D. N. 1998. The birds of the Late Quaternary of the Altai Mts. *Acta zoologica cracoviensia*, 41 : 51-60.

Ericson, P. G. P. 1987. Interpretations of archaeological bird remains: a taphonomic approach. *Journal of archaeological science*, 14 : 65-75.

Gourichon, L. 1994. Les Harfangs (*Nyctea scandiaca* L.) du gisement magdalénien du Morin (Gironde). Analyse taphonomique des restes d'un rapace nocturne chassé et exploité par les hommes préhistoriques. Mémoire de Maîtrise (Ethnologie). Lyon : Université Lumiére-Lyon II.

Laroulandie, V. 1996. Etude archéozoologique de la faune aviaire de la grotte des Eglises (Ariége). Mémoire de D.E.A. (Anthropologie option Préhistoire). Bordeaux : Université de Bordeaux I.

Laroulandie, V. 1998. Etudes archéozoologique et taphonomique des Lagopédes des saules de la grotte magdalénienne des Eglises (Ariége). *Anthropozoologica*, 28: 45-54.

Laroulandie, V. 2000. Taphonomie et Archéozoologie des Oiseaux en Grotte: Applications aux sites Paléolithiques du Bois-Ragot (Vienne), de Combe Saunière (Dordogne) et de La Vache (Ariège). Thèse d'Université, Université de Bordeaux.

Martynovich, N. A. 1990. Birds of the Late Pleistocene from Okladnikova Cave as an object for paleolandscapes reconstructions. *Kompleksniye issledovaniya paleoliticheskih ob'ektov basseyna r. Anui.* Novosibirsk: Institut istorii, Filologii i Filosofii Sibirskogo otdelenija Rossiiskoi Academii Nauk. Pp. 66-81. [Russian]

Martynovich, N. A. 1998. Holocene birds of Denisova Cave; pp. 231-241. *In* Derevyanko, A. P. (ed.) *Paleoecologiya pleistocena i kulturi kamennogo veka Severnoi Asii i sopredelnich territoriy.* Novosibirsk: Institut Arheologii i Etnographii Rossiiskoi Academii Nauk. [Russian]

Martynovich, N. A. 2004. Late Quaternary birds from the cave sites of Southern Siberia. Unpublished PhD diss. Moscow: 1-278.

Mlíkovsky, J.; Chenzychenova, F. & Filippov, A. 1997. Quaternary birds of the Baikal region, East Siberia. *Acta Zoologica Societatis Bohemiae*, 61: 151-156.

Mochanov, JU. A. 1970. Djuktai Cave – new Palaeolithic site of Northeastern Asia (results of works in 1967). *Trudy prilenskoi arheologicheskoi ekspedicii.* Yakutsk. Pp. 40-64.

Mochanov, JU. A. 1977. *The oldest stages of colonization of the North-East Asia by man*. Novosibirsk: Nauka. 264 p. [Rus.]

Mourer-Chauviré, C. 1975. Les oiseaux du Pléistocène moyen et supérieur de France. *Documents des Laboratoires de Géologie de la Faculté de Sciences de Lyon,* 64: 1-624.

Mourer-Chauviré, C. 1983. Les oiseaux dans les habitats paléolithiques: gibier des hommes ou proies des rapaces?; pp. 111-124. In Grigson, C. & Clutton-Drock, J. (eds.) *Animals and archaeology : 2. Shell middens, fishes and birds*. Oxford : BAR International series, 183.

Ovodov, N. D., Martynovich, N. V. & Nadachowski, A. 1998. Eagle-owl niches in North-West Altai as taphonomic and paleoecological indicators; pp. 249-256. *In* Derevyanko, A. P. (ed.) *Paleoecologiya pleistocena I kulturi kamennogo veka Severnoi Asii I sopredelnich territoriy.* Novosibirsk: Institut Arheologii i Etnographii Rossiiskoi Academii Nauk. [Russian]

Panteleyev, A. V. 1999. The history of investigations of Quaternary birds in the Asian part of Russia and Mongolia. *Russkii Ornitologicheskii Zhurnal.* Ekspress-vypusk 72: 3-17. [Russian]

Panteleyev, A. V. 2002. Peculiarity distribution of some bird species in Northern, Central and Eastern Asia in Quaternary. *Russkii Ornitologicheskii Zhurnal.* Ekspress-vypusk. 186 : 471-484. [Russian]

Panteleyev, A. V. & Alekseeva, E. V. 1993. Fossil birds from Bliznec Cave (Southern Sikhote-Alin') and climatic and landscape conditions of their dwelling. *Russkii Ornitologicheskii Zhurnal.* 2: 133-148. [Russian with English summary]

Panteleyev, A. V. & Potapova, O. R. 2000. Late Holocene birds from archeological site near city Salekhard (North of Western Siberia) : *Russkii Ornitologicheskii Zhurnal.* Ekspress-vypusk 106: 3-31. [Russian]

Potapov, R. L., Potapova, O. R. & Pavlova, E. A. 2003. The genus *Lagopus* Brisson, 1760: taxonomy, paleontological dates, and evolution : *Proceedings of the Zoological Institute of Russian Academy of Sciences*, 299: 101-120.

Potapova, O. R. 1986. The Pleistocene Ptarmigans g. *Lagopus* from northern Ural. Leningrad : *Proceedings of the Zoological Institute,* 147 : 46-58. [Russian]

Potapova, O. R. & Panteleyev, A. V. 1999. Birds in the Economy and Culture of Early Iron Age Inhabitants of Ust' Poluisk, Lower Ob' river, Northwestern Siberia. *Smithsonian Contributions to Paleobiology*, 89: 129-137.

Savinetsky, A. B. 2002. Anseriformes of the Bering Sea coast and islands in the Holocene (based on the results of archeological studies). *Casarca*, 8: 169-198. [Russian with English summary]

Stewart, J.R. 1999. Intraspecific variation in modern and quaternary European *Lagopus. Smithsonian Contributions to Paleobiology*, 89: 159-168.

Tyrberg, T. 1998. Pleistocene birds of the Palaearctic: a catalogue. *Publications of the Nuttall Ornithological Club*, 27: 1-720.

	Taxa	No	No of ind.	Holoc.	Pleist.		Taxa	No	No of ind.	Holoc.	Pleist.
1	Gavia stellata	4	2	+		47	Tringa sp.	3	-		+
2	Gavia arctica	11	2	+		48	Xenus cinereus *	1	1		
3	Gavia sp.*	2	-			49	Philomachus pugnax *	3	1		
4	Podiceps nigricollis *	3	1			50	Calidris sp.	9	-		+
5	Podiceps auritus *	3	3			51	Gallinago gallinago	5	2		+
6	Podiceps grisegena	11	2	+	+	52	Gallinago megala	5	2		+
7	Podiceps cristatus	3	2	+	+	53	Gallinago stenura	10	2		+
8	Podiceps sp.	4	-	+		54	Gallinago sp.	17	-	+	+
9	Anser new sp.	13	2		+	55	Scolopax rusticola	2	1	+	
10	Anser sp.	5	-	+		56	Numenius minutus	10	2		+
11	Anas platyrhynchos	5	2	+	+	57	Numenius phaeopus	1	1		+
12	Anas crecca	15	3	+	+	58	Limosa limosa *	1	1		
13	Anas formosa	19	8	+	+	59	Scolopacidae gen. indet.	12	-	+	+
14	Anas penelope	4	2	+	+	60	Limicolae indet.	6	-		+
15	Anas acuta	12	3	+		61	Phalaropus fulcarius *	1	1		
16	Anas querquedula	2	1	+		62	Phalaropus lobatus	2	1		+
17	Anas clypeata	5	2	+		63	Larus ridibundus	3	2	+	+
18	Anas sp.	34	-	+	+	64	Larus canus *	1	1		
19	Aythya fuligula	15	3	+	+	65	Sterna sp. *	1	1		
20	Aythya sp. *	1	-			66	Streptopelia orientalis	1	1	+	
21	Clangula hyemalis	2	1		+	67	Asio flammeus *	1	1		
22	Melanitta deglandi *	2	1			68	Asio otus *	2	2		
23	Mergellus new sp.	6	3		+	69	Strix nebulosa	1	1	+	
24	Mergus serrator	2	1		+	70	Strix uralensis *	1	1		
25	Anatidae gen. indet.	8	-	+	+	71	Strix sp. *	1	-		
26	Milvus migrans	5	2	+	+	72	Riparia riparia	9	4		+
27	Accipiter cf. nisus	3	1	+		73	Hirundo rustica	3	1	+	+
28	Buteo lagopus *	1	1			74	Delichon urbica	3	1		+
29	Buteo buteo	2	1		+	75	Eremophila alpestris	12	3		+
30	Aquila chrysaetus	4	1		+	76	Anthus sp.	3	-		+
31	Accipitridae gen. indet. *	1	-			77	Motacillidae gen. indet. *	1	-		
32	Falco subbuteo *	2	1			78	Bombycilla cf. garrulus	2	1	+	
33	Falco columbarius *	1	1			79	Turdus pallidus	13	2	+	+
34	Falco sp.	1	-		+	80	Turdus hortulorum	6	2	+	+
35	Lagopus lagopus	117	24	+	+	81	Turdus pilaris	10	2	+	+
36	Lagopus mutus	38	6	+	+	82	Turdus iliacus	7	2	+	+
37	Lagopus sp.	17	-	+	+	83	Turdus sp.	53	-	+	+
38	Tetrao tetrix	5	2		+	84	Zoothera dauma *	5	1		
39	Tetrao parvirostris	2	1	+		85	Turdidae gen. indet.	1	1		+
40	Bonasa bonasia	2	1	+		86	Fringilla montifringilla	2	1		+
41	Grus leucogeranus *	1	1			87	Fringillidae gen. indet. *	1	1		
42	Otis tarda	1	1		+	88	Emberizidae gen. indet.	1	1	+	
43	Pluvialis sp.	2	-		+	89	Perisoreus infaustus	6	3	+	+
44	Tringa ochropus	2	2		+	90	Corvus corone *	1	1		
45	Tringa glareola	2	1		+	91	Passeriformes indet.	24	-	+	+
46	Tringa nebularia	15	4		+	92	Aves indet.	38	-	+	+

Table 1 - Avian taxa indentified in collections from the Djuktai Cave. *) “Pleistocene” or “Holocene” is not indicated when the layer of origin is not known.

Bone type and measurement (mm)	Lim	M ± σ,	n
Tarsometatarsus			
Maximal length	34,1-39	36,5 ± 1,5	23
Minimal shaft width	2,7-3,4	3,2 ± 0,2	28
Width of proximal head	7,5-8,6	8,0 ± 0,4	32
Width of distal head	6,7-9,0	8,0 ± 0,6	25
Carpometacarpus			
Maximal length	33,6-38,4	35,7 ± 1,4	14
Maximal shaft height	6,6-7,6	7,0 ± 0,3	8

Table 2 - Some measurements of Willow Grouse (*Lagopus lagopus*) from Djuktai Cave. Lim – range, M – mean, σ – standard dispersion, n – number of individuals.