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DUDKA ISLAND REVISITED: THE GENERAL ARCHAEOZOOLOGICAL SEQUENCE

The archaeozoological sequence of terrestrial vertebrates from the multicomponent site Dudka, in the former Great Masurian Lake is confronted with other available bioarchaeological data and inferences. This evaluation supports the idea that Dudka island was occupied seasonally by Mesolithic, Zedmar and Late Neolithic people and hunting may have been an opportunistic activity on the island during the spring fishing and the fall gathering season there. The question is raised why people crossed from the mainland to Dudka island for fishing and gathering, fish and nuts being no doubt also accessible on the mainland in the appropriate seasons.

KEY WORDS: Mesolithic fauna, Paraneolithic fauna, Masuria (NE-Poland)

1. INTRODUCTION

The present paper deals with the remains of mammals and the limited herpetofauna collected at Dudka. The bird remains were analysed in Tomek and Gumiński (2003), the fish remains in Makowiecki (2003: 60-69). Dudka is located in the Great Masurian Lakeland, NE-Poland, more precisely within the Wydminy commune, Giżycko district. Prehistoric Dudka has been described as an island situated in the centre of an extensive peatbog, lake, called Staświńskie Łąki (Staświńskie Meadows) now reclaimed and pastured (Fig. 1). Several areas of the island were excavated in the past two decades and provided evidence of repeated occupation from Late Palaeolithic to Late Neolithic times; evidence from Medieval activities is also present in the middle of the island (trenches IX and X; Fig. 2). For a detailed account of the stratigraphy, archaeology and chronology of Dudka the reader is referred to Gumiński (1995; 1999 and other references there). Analyses of wood and charcoal, combined with palynological data, permitted to sketch the evolution of the regional landscape (Gumiński & Michniewicz 2003).

The material resulting from the successive excavation seasons at Dudka were analysed by me in the Institute of Archaeology and Ethnology, Polish Academy of Sciences, during short visits to Warsaw in 1991, 1992, 1994, 1995, 1997 and 2001. The large amount of material made it necessary to proceed with the analysis at a quick pace. Access

Fig. W. Gumiński

Fig. 1. Location of the Dudka site.

to comparative material and documentation was limited and only a small number of specimens could be taken abroad for more detailed analysis. The foregoing and the fact that the analysis was carried out with appreciable interruptions over a protracted period are no doubt responsible for a number of incorrect identifications, but these errors do not seem to affect the general picture emerging from the analysis and the faunal changes occurring at Dudka.

Gumiński (1995; 1999) used some preliminary faunal data provided by M.Sc. M. Nawrocka (State Archaeological Museum) and some of my preliminary notes in his general papers on the successive occupation phases of the site and the environmental changes of the site's setting. Since these data were preliminary, incomplete, perhaps not always well decodable, some of the inferences based on these data have to be reconsidered. As explained later, I also had doubts about the geographical context of Dudka: was it really an island?

The faunal samples have been grouped according to the excavation areas and layers according to sedimentary facies, stratigraphical and sometimes spatial position and by archaeological contents by Gumiński (1995; 1999). Table 1 presents the various assemblages analysed and their faunal contents. Excavation areas D(udka)I to DXII are located as shown in figure 2. In the excavations near the shore, the nature and position of the layers with respect to the shore, made possible a distinction between a littoral facies (L1 etc.), a beach facies (B1 etc.) and an interior one (I1 etc.); elsewhere all layers are I(nterior).

To the labels of the assemblages as presented in Table 1, the archaeological attributions have been added in abbreviated form. The following list explains these rather self-evident abbreviations, together with the chronostratigraphical position of the recognised archaeological units.

LN/ME: mixed Late Neolithic and Medieval.
LN: Late Neolithic, mainly Corded Ware

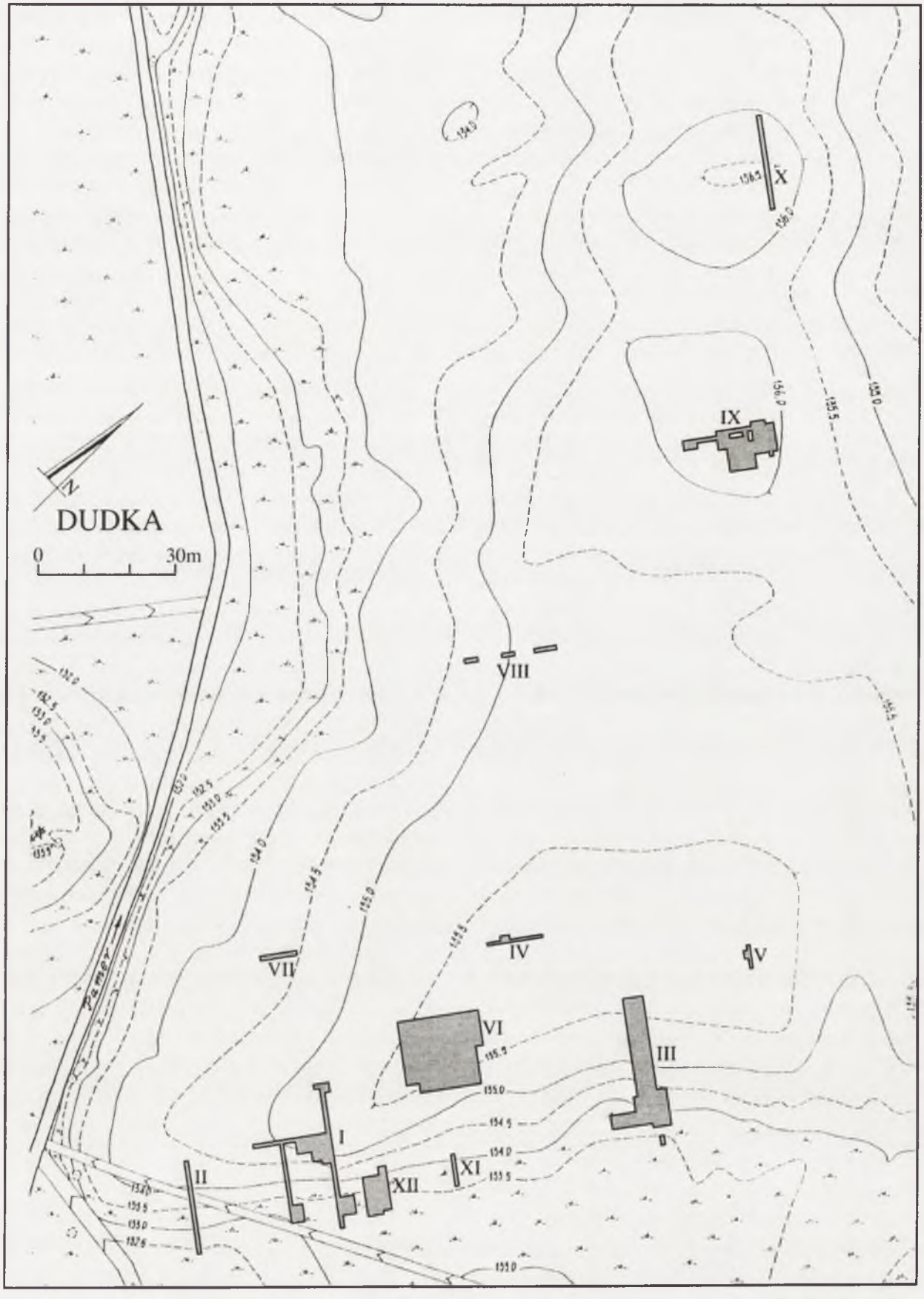

Fig. W. Gumiński

Fig. 2. The Dudka site, localization of archaeological trenches.

Culture (CWC); transition to middle Subboreal.

Z/LN: mixed Zedmar and Late Neolithic, mainly Post-Zedmar and Globular Amphorae Culture; early Subboreal.

Z: Zedmar; transition Atlanticum to Subboreal.

EZ: Early Zedmar; late Atlanticum.

LM: Late Mesolithic; early Atlanticum to transition of middle/late Atlanticum.

MM: Middle Mesolithic; Boreal and transition to Atlanticum.

EM: Early Mesolithic; late Preboreal and transition to Boreal.

LP: Late Palaeolithic; terminal Pleistocene and transition to Preboreal.

Table 1 does not list the excavation areas in numerical order. Instead, the excavation areas have been grouped according to location near the shore (DI, DII, DIII, DXI and DXII), farther away from the shore (DIV, DV, DVI and DVII and DVIII) and still farther (DIX and DX). I thought that differences in location might be reflected in some distinct faunal differences; this appears not to be the case. Not included in the assemblages listed in Table 1 are the remains collected from several pits, as they can often not be dated precisely. The contents of these pits are comparable with those of the assemblages of the strata. The same can be said about the various graves of DVI, of which Table 2 lists the animal contents. Most of these remains are no doubt part of the fill of the graves, except for the two dog skeletons in graves DVI-8 and DVI-15.

The bones were collected by hand and on sieves with a mesh of 3-4 mm. Most of them show complete brown to dark brown discoloration. In total, some 129.300 remains were collected, which were divided by the excavators into fishes (34.770 fragments), tortoise (1.100), birds (230), large mammals (91.300), microvertebrates and unidentified small remains (1.900) (Tomek & Gumiński 2003). Apparently not all the tortoise remains were included in the samples submitted for analysis (see Table 1) and no doubt carapace remains belonging to a single individual were counted separately. Anyhow, if we leave out the fish and bird remains, the identification rate can be estimated at about 4%. This low rate reflects the fact that most of the remains attributable to larger mammals are very fragmentary and rather brittle, suggesting that the bone collagen suffered marked deterioration and destruction, either due to prolonged exposure on the surface as a result of low sedimentation rates or caused by subsurface depletion processes, or a combination of both phenomena. As a result, few traces left by people or animals were observed.

Lasota-Moskalewska (1997: 200, table 3) summarises the known spectrum of wild mammals from Mesolithic to Medieval times in Poland, grouping Mesolithic and Neolithic occurrences. The Dudka spectrum encompasses most of the species listed for the Mesolithic and Neolithic, not taking into account marine forms such as porpoise and seals; for obvious reasons these are absent from Dudka. Some species have apparently not yet been recorded from Polish archaeological sites of the Mesolithic or Neolithic: hedgehog, mole, root vole, *Apodemus* and the Northern birchmouse, as well as a bat species the identification of which could not be established, but in Kowalski (1989) Pleistocene or Holocene occurrences of these taxa can be found.

In the following paragraphs some comments on the amphibians, tortoise and mammals identified at Dudka follow. General texts dealing with the European and Polish mammals used are van den Brink (1972), Pucek (1981) and Lange and collaborators (1986).

2. THE ANIMALS ENCOUNTERED

Finds of anurans comprise isolated postcranial remains as well as clusters representing more or less complete skeletons. No attempt was made to identify the species present, but a rapid check of some of the ilium remains with the aid of the diagnostic criteria given by Böhme (1977) suggests the presence of at least three species. Kowalski (1989: 73) summarises the records of various

anurans in Holocene, not necessarily archaeological contexts in Poland.

The European swamp tortoise is represented mainly by carapace fragments or clusters of such fragments evidently derived from one carapace or individual as exemplified by a find in DI-B3; only a few postcranial remains complete the sample. Kowalski (1989: 79) records some finds of this chelonian in Holocene, archaeological contexts, but an extensive inventory of such finds was published recently by Makowiecki and Rybacki (2001).

Hedgehog (Pl. I, fig. 2) is represented mainly by mandibular remains, some skull fragments and even less postcranial remains. The identification as *Erinaceus concolor* is based on the present day distribution of hedgehogs: the range of *E. europaeus* covers but the westernmost part of Poland. As to the mole, the other insectivore encountered, its presence was established on the basis of its characteristic long bones adapted for burrowing. In DIII-I1, a cluster of bones represents clearly what is left of a complete individual.

The hare remains include fragments of a skull with its mandibles, loose jugal teeth and a few postcranial fragments. Today the brown hare, *Lepus capensis* is widely found in open country in Poland, while the snow or mountain hare, *Lepus timidus*, occurs only in some forested areas of eastern Masuria. In the past, the distribution of both species was probably different and both species may be present at Dudka. Since the Dudka hares could not be identified precisely, Table 1 lists the hare finds as *Lepus* sp.

Rodents are well represented by two species of voles, identified on the basis of size and jugal teeth morphology of their mandibles and maxillae: the water vole (*Arvicola terrestris*) and the root vole (*Microtus oeconomus*). A few incomplete mandibles, represent a larger murid of the genus *Apodemus,* either wood mouse (*A. sylvaticus*), the yellow necked mouse (*A. flavicollis*) or the striped field mouse (*A. agrarius*). Two delicate mandibles from one individual derive from a fourth, much smaller rodent, identifiable on the basis of their general morphology and alveolar pattern as the remains of a Northern birchmouse (*Sicista betulina*); today the species is confined to northeastern Poland and its southern mountain ranges. One proximal moiety of a femur represents a squirrel (*Sciurus vulgaris*). As to the category "small rodents" in Table 1, it includes all small postcranial and other remains not easily identifiable and mostly derived from voles, most frequently the larger species, water vole. The beaver (*Castor fiber*) is the largest rodent at Dudka, represented by dental and postcranial remains; possibly some ill defined remains of this species may have been mistaken for those of one of the larger mustelids and vice versa.

The canid remains comprise wolf (*Canis lupus*), fox (*Vulpes vulpes*) and dog (*Canis lupus* f. familiaris). Well preserved more or less complete dog skeletons were collected in two structures interpreted as dog burials, DVI-8 (Pl. I, figs. 4 & 6) and DVI-15 (Table 2). The first dog grave VI-8 is dated to the Early Zedmar; the second one (grave VI-15) can probably be more generally attributed to the Zedmar people. Some measurements on the two dogs follow together with some estimates of the height at the shoulders (SH) of the living animals, calculated with the aid of the multiplication factors given by von den Driesch and Boessneck (1974).

	grave VI-8		grave VI-15	
	L	SH	L	SH
Lower P1-M3	68.5 mm	–	+ 67 mm	–
Humerus	159.0	54 cm	136.0	46 cm
Femur	172.0	52	149.5	45
Tibia	170.0	50	146.0	43

The averages of the height estimates are about 52 cm and about 45 cm. The second dog differs from the first one not only by its smaller size, but also by its relatively heavy jaw. In the first dog, the calcaneum and astragalus of the hindleg have been completely fused. As it is clear that not all bones were collected, the absence of baculums does not allow the establish the sex of the animals. Both appear to be quite young adults.

Remains with canid-like morphology which were or appeared to be intermediate in size with respect to wolf or fox have been attributed to dogs in the size range of the ones described from the DVI-graves. Wolves attain shoulder heights of 70 to 80 cm, foxes reach but 35 to 40 cm and some remains attributed to dog may rather represent lar-

ger foxes. Gumiński (1995: 27) records a poorly preserved canine or fang and a rib fragment attributed to dog and perhaps associated with a late Mesolithic human burial (DIII-B6). The identification of the rib as derived from a young dog is doubtful. As to the fang, it was shown to several colleagues, who agreed that it was not a fang and canid, but could not offer a definite identification. It would hence seem that Dudka does not offer evidence for Mesolithic graves with people and dogs.

The small carnivore category comprises various remains of the mustelids listed by name and perhaps wild cat, which in the absence of adequate comparative material, I did not identify to species. The presence of wild cat, *Felis silvestris*, is well documented by the posterior half of a mandible in dog grave DVI-8 (Table 2). The grave has been dated to the Early Zedmar, so the presence of domestic cat is excluded and the jaw exhibits clearly typical features of the posterior mandible in wild cat illustrated by Kratochvil (1973: 21, fig. 13).

The mustelids listed by name in Table 1 include polecat (*Mustela putorius*), marten (*Martes martes*), badger (*Meles meles*) and otter (*Lutra lutra*, Pl. I, fig. 3), represented by cranial and postcranial remains identified with varying degree of confidence. One well preserved mandible in grave DVI-8, already mentioned because of the wild cat mandible it contained, exhibits clearly the position of the second mental foramen under the distal P3, diagnostic for the pine marten; a comparable mandible was found in DIII-B5. Taking into account the ecological preferences of the pine marten and those of its relative, the stone marten (*Mustela foina*), all the marten-like specimens have been attributed to the first species. Smaller mustelids such as stoat (*Mustela erminea)*, or weasel (*M. nivalis*) appear to be lacking, but the presence of the European mink, *Mustela lutreola*, which resembles the polecat as to size and osteology can not be excluded.

The bear (*Ursus arctos*) remains comprise cranial fragments, teeth or fragments of such teeth and some postcranial elements. No doubt, people hunted bears occasionally, otherwise the skeletal spectrum might have been restricted to distal leg elements derived from bear furs or isolated canines used for some cultural purpose, originating from animals killed elsewhere.

Wild boar (*Sus scrofa*, Pl. II, fig. 1) is represented by some cranial remains, teeth and tooth fragments as well as postcranial remains. Many finds derive clearly of a suid of appreciably size representing without doubt wild boars of large size. Smaller remains which might in certain contexts indicate the presence of domestic pig (*Sus scrofa* f. domestica) have been assigned to smaller, immature and female wild boar, taking into consideration the conditions of preservation. As any practising archaeozoologist knows, bones of domestic animals are generally less well and differently preserved with respect to those of their wild relatives, because their bones are less compact; they are moreover more easily destroyed. The hypothesis advanced in previous publications that Zedmar people practised some form of "semi-husbandry" of wild boar at Dudka, is not substantiated by the definite analysis of the suid remains.

Among the larger game species, horse (*Equus ferus*; Anonymous 2003) is not well represented. The finds consist of teeth and tooth fragments and a few diagnostic postcranial remains. It is possible that some less diagnostic fragments have been erroneously thrown in the pile of the larger cervids.

Remains of roe deer (*Capreolus capreolus*, Pl. I, fig. 1) comprise skull remains, shed antlers, teeth and various postcranial remains. Sizewise roe deer compares with the smaller domestic ruminants, sheep and goat, and possibly ill defined remains of the second group have been included in roe deer. In case of doubt about the wild or domestic status of particular remains the preservation criteria, as already explained for the case of wild boar versus domestic pig, were applied.

The larger cervids, red deer (*Cervus elaphus*) and elk (*Alces alces*, Pl. II, figs. 2 to 5), form the bulk of the Dudka collection, and are represented by cranial, dental and postcranial remains. Red deer and elk differ markedly in size, but large male red deer and small, female elk approach each other in size. Because of the rapid analysis and visual misjudgment of size, less distinct remains of these cervids may have been confused. Moreover, some less distinct fragments of the large bovid group may have been added to the elk pile.

A large bovid is represented by dental and postcranial remains. The size of the better preserved

specimens indicates we are dealing with wisent or bison (*Bison bonasus*) or with aurochs or wild cattle (*Bos primigenius*). Three calcanea (DI-B1, DIII-I2, DVI-I2) exhibit features diagnostic for wild cattle (Bibikova 1958; Stampfli 1963) and all the finds have been referred to this species. As in the case of the suids and the smaller ruminants, some non-diagnostic fragments were included in the large wild bovid group because of preservational aspects. Domestic cattle (*Bos primigenius* f. taurus) is clearly present only in the mixed LN/ME context of D-IX. The finds include a fragment of a mandible and a distal metatarsus, both of small size; a few other remains are less diagnostic. These finds have not been included in the analysis, as they are most likely medieval, early domestic cattle being generally of large size.

Smaller domestic ruminants, either sheep (*Ovis ammon* f. aries) or goat (*Capra aegagrus* f. hircus), are mainly represented by fragments of their hypsodont teeth and some complete teeth. Postcranial fragments have been added to this collection with varying degree of confidence. Among these some terminal leg elements of which the diagnostic characters (see Boessneck 1969) were reasonably clear, suggest the predominance of sheep. The collection may contain some more remains of sheep or goat which ended up in the roe deer sample for reasons already explained. This would mean that these domesticates are better represented than the counts suggest, were it not that even quite small but diagnostic tooth fragments of sheep or goat were added to the counts; this was not always done for the cervid group. All in all, sheep and goat were of very limited importance. Most finds are Late Neolithic and mixed Late Neolithic and Zedmar. In the Zedmar assemblage, I identified tentatively a cannon-bone fragment (DI-B3) as ovicaprid, while a third phalanx (DIII-B3) was coded as definitely sheep. Since the strata boundaries are not always clear, the possibility of intrusion of younger material in older strata and the fact that one of the identifications is only tentative, the presence of domestic ovicaprids at Dudka during Zedmar times is not established firmly.

3. TRACE FOSSILS

As said in the introductory paragraphs, traces of modification by people or animals are few or not very obvious, because of the often fragmentary nature of the remains, but some less clear modifications caused by the mentioned agents may have been overlooked. A first phalanx of red deer (DI-B3; Pl. I, fig. 7) shows three distinct transverse cut-marks midway the palmar surface; such stigmata are quite frequently found (see for example, von den Driesch & Boessneck 1975). Bone remains have also been exposed to fire in variable degree; in my opinion these modifications are mainly due to accidental contact with hearths after disposal of the bone refuse.

Gnawing traces left by carnivores are not very obvious but present. I also noted traces of etching due to the gastric acids of carnivores, on an astragalus of roe deer (DI-B3) and on a fragment no longer identifiable as a result of the process (DIII-B3). Most likely dogs are responsible for these modifications. A second phalanx of elk (DI-B3) was put apart because it exhibit clear traces of rodent gnawing on several of its protruding parts, proximally and on its dorsal and palmar surface (Pl. I, fig. 5). Such traces were also clearly present on an antler fragment of a red deer (DVI-I2); comparable traces on some other antler remains were noted but not recorded. The size of the traces points to the water vole as the culprit.

4. TAPHONOMIC GROUPS

Dividing the faunal remains in taphonomic groups, i.e., groups of remains which have comparable death-to-discovery histories (Gautier 1987) presents no fundamental problem. Most important

is the distinction between the animals hunted or trapped by people for various reasons and the so-called intrusives, discussed in the next paragraph.

Intrusive faunal remains are those of animals which were incorporated in the archaeological deposits not as the result of human activities or unintentionally through such activities. The intrusives found at Dudka are penecontemporaneous with the various occupation phases or possibly in part late, i.e., they represent animals that lived or visited the various loci of Dudka much later. Their remains were incorporated in the deposits because of their burrowing activities or by some other factor. These intrusives include the anurans, the mole, the unidentified bat, the voles, *Apodemus* and the Northern birch mouse.

The consumption refuse consists no doubt of the larger herbivore game species, wild boar, horse, roe deer and red deer, elk and large bovids, mainly, if not only, representing wild cattle or aurochs. The domestic component of the consumption refuse is restricted to a few remains of sheep and goat in later assemblages. Beaver and several carnivores, including wolf, fox, wild cat, various larger mustelids and bear, were also bagged. Some of these animals no doubt were eaten, but all provided furs and perhaps other products useful to people. The taphonomic status of the carnivores is hence equivocal and some finds may fit in the workshop refuse category. This category is clearly represented by most of the antler remains, as evidenced by traces of working (Pl. I, fig. 5) and the fact that people collected shed antlers. Quantitative treatment of faunal remains as presented in Table 3 etc. should in principle distinguish between consumption and workshop refuse, especially in the case of antlers, but the contribution of workshop refuse to the counts is restricted and has little effect on the calculated frequency changes.

Beavers were no doubt trapped for their furs and meat. The single find of a squirrel does probably not represent an animal killed for its fur. Hedgehog on the contrary is well represented. No doubt, people had some use for this larger insectivore, but we can not rule out the presence of some intrusive remains of the animal. Some notes on the consumption of hedgehog follow. Burton (1973) reports that on the British Isles, people used to kill hedgehogs for their supposed many misdeeds, their meat, their pricky robe and their spines. Also, chips prepared with hedgehog meat were formerly sold in England, but are now replaced by chips with artificial hedgehog flavour (see Grant in the discussion following Reyniers 1988: 204). The paper by Reyniers itself (*ibid.*) stresses the importance of hedgehog in gipsy diets (see also Dewez 1988). A medieval cookbook provides a recipe for preparing hedgehog (Anonymous 1846). The creature is also present among the animals discussed in Hippocratic dietetics (Bertier 1988). Blench (2000) records the capture of white-bellied hedgehog (*Atelerix albiventris*) and its fattening in northern Nigeria.

Tortoise is quite well represented throughout the sequence, mainly by carapace remains, but the counts are no doubt inflated because one carapace can produce an appreciable number of separate, easily recognisable fragments. Differential destruction may account for the paucity of other remains. Willms (1986) has stressed the possible dietary significance of the European swamp tortoise during Neolithic times in Central Europe and most likely people at Dudka added the creature to their menu when possible. Młynarski (1971; 1980) has drawn the attention to the possible cultic significance of the tortoise in prehistoric times and it is possible that people had some use for the shell of the animal. Anyhow, the presence of intrusive tortoises can not always be ruled out.

Some of the dog finds fit in the category of buried animals (Table 2), but the status of the isolated dog finds is equivocal. Dogs may have died on the site and remnants of their carcasses were incorporated in the deposits by chance.

5. PALEOECOLOGY

Table 3 summarises the spectrum of the animals collected, trapped or hunted by the Dudka people in the subsequent periods. The small carnivores of which an appreciable amount were not

identified specifically have been grouped; the group includes wild cat and the mustelids. Red deer is beyond doubt the most frequent larger game, followed by elk, wild boar and roe deer. The relative frequencies of these major prey species are given in Table 4. Most obvious is the high percentage of wild boar in the assemblages Z, EZ and LM, attributed to the Atlantic period. Wild boar is virtually absent from the pre-Atlantic assemblages, while its decrease in the assemblages LN and LN/Z, attributed to the Subboreal is marked. Other differences are less clear, but if we combine the assemblages into a Subboreal, an Atlantic and a pre-Atlantic assemblage, a clearer picture emerges, be it that the pre-Atlantic assemblage is very restricted and combines finds attributed to the Boreal and Preboreal, and a few older finds.

The high frequency of wild boar during the Atlantic period causes no surprise, as the animal prefers deciduous forest. The decline of the forest in the Subboreal accounts for the decrease of this game animal in this period. The frequency changes in the cervid group are explainable in terms of preferences for less or more dense woodland. One reads that roe deer, red deer and elk thrive in open forest, but the impression is that roe deer is better adapted to denser woodland. In the Mesolithic sequence of the Abri du Pape (Namur Province, Belgium), I observed an increase of wild boar and roe deer and a decrease of red deer comcomittant with a change towards more wooded conditions, which would have impeded the mobility and the feeding of red deer (Gautier 1999). In the pre-Atlantic assemblage elk appears to be decidedly more frequent than later; this may reflect the adaptations of this cervid to colder conditions.

In Table 5, the less well represented game groups have been added to the main game groups featuring in Table 4. The frequency changes of the latter are still discernable but less obvious. As to the lesser game groups the changes in frequency are generally small and no doubt in part aleatory. However, tortoise is well represented in the Atlanticum assemblage, but shows a marked decrease during the Subboreal. The small size of the pre-Atlantic assemblage does not allow any conclusion about the arrival and presence of the species in the earlier Holocene. Gumiński (1995: 27) has already drawn the attention to the fact that the European swamp tortoise may be a good indicator of climate. He refers to data in the literature, according to which the animal needs a minimum average summer temperature of 18°C for the three warmest months and dry summers for its reproduction. Apparently, swamp tortoises thrived at Dudka in Atlantic times.

Other frequency differences might also reflect climatic changes, causing the replacement of denser woodland with less dense woodland. Beaver is said to prefer light woodland and fox is a very adaptable canid, which may thrive well in lighter woodland, while wolf and the smaller carnivores do better in denser forest. Horse prefers open country and is indeed somewhat better represented in the Subboreal assemblage, but the hedgehog which would not like dense forest, is nevertheless more frequent in the Atlantic assemblage.

Summing up, it would seem that people exploited the game fauna of the site catchment of Dudka as available in accordance with the climate and vegetation. The finds and the persistence of hunting at Dudka indicate clearly that the region provided excellent opportunities for hunting and the few finds of sheep and goat are difficult to interpret. Late Neolithic people apparently did bring some small livestock to Dudka, but as already pointed out, whether Zedmar people did the same is open to question. The mixed nature of the LN/Z assemblage does not permit to attribute the few finds of sheep and goat.

6. SEASONALITY

Indicators of seasonal activities are provided by some remains of the major game animals and can be evaluated in relation to those provided by the fish and the birds. People fished at Dudka in spring and early summer (see e.g. Gumiński 1995: 29, Table 8; Dr. D.Makowiecki, Poznań, pers.

comm.). The very limited feathered game does not help much to establish seasonality. Most of the finds derive from water-and-marsh birds and most of the species identified belong to the modern breeding avifauna of NE-Poland. Some incompletely ossified remains of coot, *Fulica atra*, tawny owl, *Strix aluco* and unidentified duck-like and other birds indicate that the birds died in summer or autumn (Tomek & Gumiński 2003; Dr. T. Tomek, Cracow, pers. comm.). Hazelnuts were gathered in autumn, especially in the Late Boreal and Early Atlantic, and people may then have burned down the forest in particular areas to promote the growth of the light loving hazel (Gumiński & Michniewicz 2003).

Among the major game species typical seasonality indicators are the jaw remains of younger animals. Unfortunately such remains are limited in the Dudka collection, because of the marked fragmentation and only one fragmentary mandible of a young animal was noted among the many wild boar remains. The specimen derives from dog burial DVI-8 (Table 2) and represents an animal whose third permanent incisors and permanent canines are erupting. The age of the animal lies between 10 and 12 months (Mohr 1960: 32; Wagenknecht 1972: 90, figs. 35 and 92). It is said that wild boar have their young mainly in April; therefore the Dudka boar would have been killed in late winter or early spring. Whether the find is refuse not causally associated with the burial, or an intentional deposit in the grave, it may represent a kill during the early fishing season.

A few elk jaw remains provide further seasonality clues, but the data concerning tooth eruption and replacement of the elk are not very precise (Zarinov 1964; Heptner & Nasimowitsch 1974; Habermehl 1985; see also Legge & Rowley-Conwy 1988). These data suggest quite marked variation in the growth of elk due to genetic and ecological factors, but semantic imprecision as to what is meant by the term tooth eruption etc. also plays a role. In DII-B2, attributed to the Zedmar people, a juvenile elk jaw occurs with deciduous P3 and P4 still in place and in use. It obviously represents a calf of a few months. Since births occur in spring and M1 appears to erupt after about six months, the jaw may indicate a kill in late summer or early fall. Two early Mesolithic finds (DXII-L13) represent what is left of mandibles with dP2-dP4 M1-M2, M2 showing almost no wear. According to Zarinov (1964: 33, fig. 2) dP2-M2 indicates animals at most 9 months old, but the other authors cited place the eruption of M2 in the sixth to tenth month, the dP2 and dP3 being shed in the 14th to 16th month. In the first case, the killings would have occurred in winter, while the other data permit to place the killings in spring, if we assume that animals were about one year old. Anyhow, the presence of two mandibles with comparable eruption pattern suggests discrete age groups and hence seasonal killings.

Skull fragments of cervids with unshed antlers provide also some information. Several roe deer skull fragments with antlers still attached occur in the Zedmar samples (Pl. I, fig. 1) and two in the LN/Z assemblage. In present day Poland roe deer appear to shed their antlers in October or November; the new ones cease to grow in May. The finds recorded would hence represent summer or early fall kills. Two Zedmar skull fragments derive from red deer with antlers still on the head. Red deer shed their antlers in late winter or early spring; the new ones finish their growth at the end of the summer. The Dudka deer would hence have been killed in fall or winter. One fragmentary skull of a male elk was found together with part of its shed antlers in the Early Mesolithic assemblage DXII-L14; apparently the animal was in the process of

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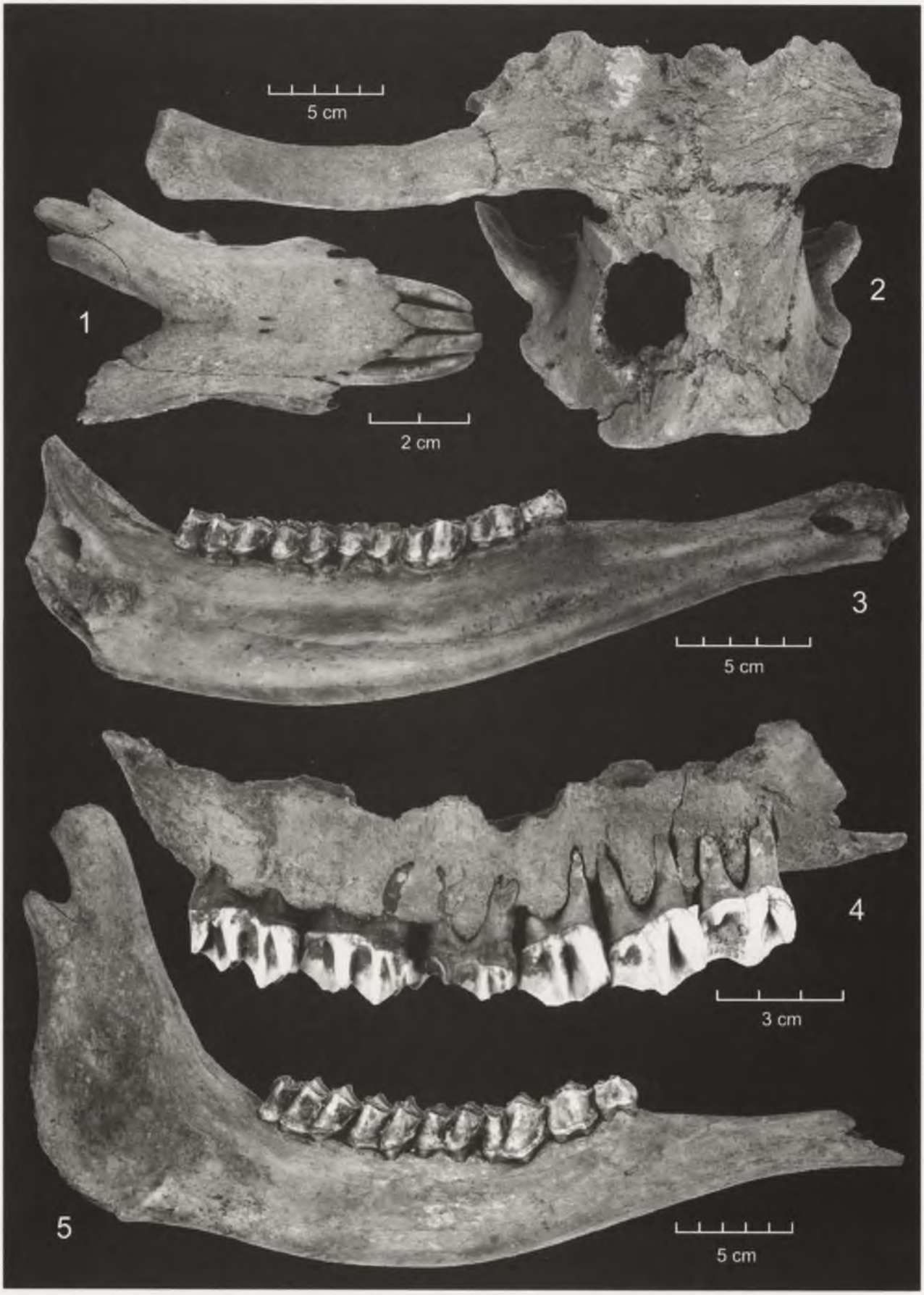
Plate I (Photographs by Marek Gmur, Institute of Archaeology and Ethnology, PAS, Warsaw).
Fig. 1 – worked antler of roe deer, *Capreolus capreolus*, with cutmark to detach the antler from the skull, DI-B3(Z); fig. 2 – mandibles and mandible fragments of hedgehog, *Erinaceus concolor*, dog grave VI-8 (EZ); fig. 3 – left mandible of otter, *Lutra lutra*, dog grave VI-8 (EZ); fig. 4 – ankylosis of calcaneum and astragalus of the dog, *Canis lupus* f. familiaris in dog grave VI-8 (EZ); fig. 5 – second phalanx of elk, *Alces alces*, with proximal traces of gnawing by a rodent (water vole, *Arvicola terrestris* ?), DI-B3 (Z); fig. 6 – left mandible of the dog in dog grave VI-8 (EZ); fig. 7 – first phalanx of red deer, *Cervus elaphus*, with cutmarks midway the plantar surface, DI-B3 (Z).


1
2
2 cm
3
4
2 cm
5
6
2 cm
7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shedding its antlers and these came off at the time of its demise (Pl. II, figs. 2 & 4). A kill in late fall could explain the find.

Several finds recorded from Zedmar and LN/Z context indicate that people collected shed antlers of roe deer and red deer, but establishing the period of the year for this activity is difficult. If we assume that people preferred antlers fresh enough for easy working, that is perhaps within six months after their shedding, they may have harvested antlers of roe deer from fall to spring, those of red deer from late winter to early fall. Maybe shed antlers were more easily found when the plant cover was still reduced in spring during the fishing season.

The lesser game animals provide some more possible evidence of seasonality. As already pointed out Gumiński (1995: 28), swamp tortoises spend most of their life in the water and are very shy creatures. Most likely they were caught in early summer when they leave the water and bury their eggs in dry sand for incubation. Early summer would still be part of the fishing season. Hedgehogs hibernate in winter and are hence not available in that period, but the best period for catching hedgehogs would be autumn, when the animals are fattest (see discussion following Reyniers 1988: 204). Beavers remain in their aquatic domain in summer living mainly on waterplants. In autumn they are actively accumulating trees and branches for their winter food. The animals are then in very good condition. This and their high activity before winter establish fall as the best season for trapping or hunting beaver (see Smith 1975: 84-85). As to the carnivores, their furs are best in autumn and winter. We may add here that the traditional hunting season of larger game is also autumn, because these animals are then also in good condition; they may also more easily be tracked, approached and even attracted since they are engaged in their annual reproductive activities.

Summing up the available evidence, admittedly of varying significance, fall would have been the main hunting season. In spring people probably concentrated on fishing, adding turtle and occasionally some other game to their catch. Antlers may also have been collected mainly during the fishing season.

The Dudka fauna can be compared with the Paraneolithic assemblage from Chwalim, where we see the use of the site by Early Mesolithic and later Paraneolithic people. The latter probably combined fishing with opportunistic hunting in spring (Gautier 1993). The paper cited also refers to the "Mesolithic-neolithic" site 9 of Dąbki, where game is also predominant. Cattle and domestic pig are present, but acquire some importance only in the latest occupation phase. Fish is well represented and beaver occupies the first place in the game fauna, suggesting respectively occupation in spring and in fall.

7. DUDKA, AN ISLAND?

As stated in the introduction, I have problems seeing Dudka as an island site. The interskeletal distributions of the faunal remains indicate clearly butchering of complete animals, regardless of their size and bulk. This might mean that people hunted on the island, but the carrying capacity of Dudka was limited: the surface of the island has been estimated at some 12 Ha. It appeared therefore more likely that the Dudka people hunted on the mainland and hence transported complete carcasses of horse, aurochs, elk, red deer, etc. to the island, of which the shortest distance to the main land is about 0.5 Km. Such repeated transport is strange. Moreover, why would people cross the lake to Dudka

←

Plate II (Photographs by Marek Gmur, Institute of Archaeology and Ethnology, PAS, Warsaw).
Fig. 1 – anterior mandible of wild boar, *Sus scrofa*, dog grave VI-8 (EZ); fig. 2 – skull of elk, *Alces alces*, with detaching antler, DXII (EM); fig. 3 – adult right mandible of elk, *Alces alces*, DIII (LM); fig. 4 – adult maxilla of elk, *Alces alces*, same individual as in fig. 2, DXII (EM); fig. 5 – mandible of young adult elk, *Alces alces*, DXI (EM).

for fishing, good fishing grounds being no doubt available along the shores of the mainland (Dr. D. Makowiecki, Poznań, pers. comm.)?

The foregoing conundrum, if conundrum it is, led to the hypothesis that Dudka may have been connected with the mainland. Dudka peninsula, easily accessible for fishing and the gathering of hazelnuts, may also have provided good opportunities for hunting as a kind of cul-de-sac. The available, not yet published geological data (Dr. W. Gumiński, Warsaw, pers. comm.) allow to delimit Dudka as an island, but it was thought that remote sensing data might reveal evidence for Dudka as a cul-de-sac. Dr. R. Goossens (Ghent, pers. comm.) analysed U.S.A. satellite spy photographs of the Dudka region, but found no evidence of land connecting Dudka island with the mainland around the former lake, now Staświńskie Meadows.

The insular nature of Dudka being underscored by spy photographs, a possible solution to the supposed conundrum, not considered before the remote sensing data became available, is that people hunted on the island in an opportunistic way with respect to their seasonal activities on the island. Each season only a few animals were bagged, but the protracted and intensive use of the island creates the false impression of regular hunting on the main land. The excavations indicate indeed that Dudka was occupied for several millennia in various loci, but quantification of the original number of game killed is impossible, as minimum numbers of animals represent in most cases but a very small part of the real number of kills (Gautier 1984).

The explanation, protracted opportunistic hunting mainly on the island, does not however explain why people did cross the lake to fish and gather at Dudka. As said good fishing grounds were no doubt accessible on the shores of the mainland and why not stands of hazel? However, Dudka may have attracted people for reasons not reducible to mere problems of subsistence. For example, might people not have sought the relative safety of Dudka island in response to intensifying territoriality? European data have been evaluated and compared with North American data, indicating that Mesolithic people of the North European Plain practised mainly a form of generalized predation combined with low mobility, especially in forested country (Bower & Kobusiewicz 2002). Put simply, Dudka island may have been more than a seasonal occupation and we would ironically be forced to return to the scenario evoking regular hunting excursions to the mainland. Further research on pre-agricultural Holocene sites in the Northern European Plain may help to solve the questions posed in this section.

8. GENERAL CONCLUSION

Dudka island provides evidence for fishing in spring and collecting, especially of hazel nuts, in fall by Mesolithic, Zedmar and Late Neolithic people. Data derived from the terrestrial fauna confirm or do not contradict the seasonal use of the island. However, the scenario according to which people combined their seasonal activities on the island with hunting on the mainland, appears questionable to me. Perhaps people killed animals on the island in an opportunistic way during the fishing or gathering season, the protracted use of the island creating the false impression of intensive hunting. The animal spectrum in the game bag is comparable with that of other Holocene archaeofaunas in Poland and shows some quantitative shift reflecting changes in climate or vegetation, underscoring the opportunistic exploitation of the animal world. Domestic animals are represented by the dog and also sheep or goat, the latter as minor components of the Late Neolithic assemblage. The significance of these few remains of small livestock is difficult to access. Another problem may be the reason or reasons why people felt it necessary to leave the mainland for Dudka to fish and gather. Some inferences of minor importance about the relation between people and animals (dog in human burial, semi-herding of wild pig) based on preliminary identifications have to be withdrawn.

Acknowledgments

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Table 1. The faunal assemblages from Dudka (specimen counts). Part 1.

ASSEMBLAGE / ANIMAL GROUP	I-L3 : Z	I-L7 : LM	I-L13/14 : EM	I-B1 : Z/LN	I-B3 : Z	I-B5 : LM	I-B8 : EM	I-I1 : Z/LN	I-I3 : LM	II-I1/B1 : Z/LN	II-I2/B2/3 : Z	III-L1 : LN	III-L2 : Z/LN	III-L3 : Z	III-L4/5 : EZ	III-L6/9 : LM	III-L10/11 : MM
frog/toad (*Anura* spp.)				13	45	15	1	1	1								
swamp tortoise (*Emys orbicularis*)				12	28	5		1					1	4	9	3	
mole (*Talpa europaea*)				1				1					1				
eastern hedgehog (a)				14	32	8		3		1							
bat (*Chiroptera* sp.)																	
hare (*Lepus* sp(p.))		1		2													
water vole (*Arvicola terrestris*)			1	9	7			1									
root vole (*Microtus oeconomus*)				5		1											
mice (*Apodemus* spp.)						1											
Northern birch mouse (b)						1											
small rodents (*Rodentia* spp.)				+	+	+	+	+	+				+	+	+		
squirrel (*Sciurus vulgaris*)																	
beaver (*Castor fiber*)				10	10	1		1						2			
wolf (*Canis lupus*)				?	8	9						1					
fox (*Vulpes vulpes*)		2	1	2								1					
wild cat (*Felis sylvestris*)				?	2												
polecat (*Mustela putorius*)					3												
pine marten (*Martes martes*)				2	11	2								1			
badger (*Meles meles*)														?			
otter (*Lutra lutra*)				3	3	1											
small carnivores (Carnivora spp.)				7	11	4		1				1					
bear (*Ursus arctos*)				2	1				1								
wild boar (*Sus scrofa*)	2			28	121	8	1	2	1					1	6	3	
horse (*Equus ferus*)				9	5			1									
roe deer (*Capreolus capreolus*)				29	54	5	1		1	1			1	5	2		1
red deer (*Cervus elaphus*)	6		4	212	142	8	8	7		8	1	1		17	8	2	2
elk (*Alces alces*)			4	43	47	2	1	13			2			3		8	3
aurochs (*Bos primigenius*)				4	5									1	2	1	
dog (*Canis lupus* f. familiaris)				2	9	1									4		
sheep/goat (c)				2	1												
cattle (*Bos primigenius* f. taurus)																	
Total	8	3	10	411	545	72	12	32	4	10	3	4	3	34	31	17	6

(a) *Erinaceus concolor*

(b) *Sicista betulina*

(c) *Ovis ammon* f. aries/*Capra aegagrus* f. hircus

\+ present but not counted; ? perhaps present; (F) F (very) frequent

Table 1. The faunal assemblages from Dudka (specimen counts). Part 2.

ANIMAL GROUP / ASSEMBLAGE	III-B1 : LN	III-B2 : Z/LN	III-B3 : Z	III-B4 : EZ	III-B5 : LM	III-B6 : MM	III-I1 : LN	III-I2/2a : Z/LN	III-I2b/I3 : Z	XI-L1/2 : Z/LN	XI-L3/5 : Z	XI-L7 : LM	XI-L13/14 : EM	XI-L15/16 : LP	XII-L1 : LN	XII-L2 : Z/LN
frog/toad (*Anura* spp.)	2		13	13			3	8	5							
swamp tortoise (*Emys orbicularis*)	7	1	41	55			5	13	2		5				3	
mole (*Talpa europaea*)	1		7	2			1									
eastern hedgehog (a)		1	5	2	1		1	11	2						3	
bat (*Chiroptera* sp.)			1													
hare (*Lepus* sp(p.))		1	2	1	1	1	1	3	1							
water vole (*Arvicola terrestris*)	2		17	15	1		3	23	12	1						
root vole (*Microtus oeconomus*)	3		1	1			2								1	
mice (*Apodemus* spp.)			4	1					1							
Northern birch mouse (b)																
small rodents (*Rodentia* spp.)	+	+	+	+	+		+	+	+	+	+				+	
squirrel (*Sciurus vulgaris*)				1												
beaver (*Castor fiber*)	2	1	5	2		2	2	12	3						1	
wolf (*Canis lupus*)		2	5				1	5								
fox (*Vulpes vulpes*)	2				?		2	6			2					
wild cat (*Felis sylvestris*)			?													
polecat (*Mustela putorius*)			2					1								
pine marten (*Martes martes*)			4	1	1		1	2								
badger (*Meles meles*)																
otter (*Lutra lutra*)		1	3				1	2								
small carnivores (Carnivora spp.)	2		14	5			4	5								
bear (*Ursus arctos*)			1					1								
wild boar (*Sus scrofa*)	7	3	11	16	3		12	12	1	3	2				6	
horse (*Equus ferus*)			6				6	5								
roe deer (*Capreolus capreolus*)	10	2	19	18	1		9	16			1				5	1
red deer (*Cervus elaphus*)	23	5	81	37	14	5	37	66	8	4	12	1	3		36	
elk (*Alces alces*)	8		8	13	4	9	13	35		2	3		7	3	1	
aurochs (*Bos primigenius*)		1	2	3				6							1	
dog (*Canis lupus* f. familiaris)			6												1	
sheep/goat (c)	3	2	1				8	6							2	
cattle (*Bos primigenius* f. taurus)																
Total	72	20	259	186	26	17	112	238	35	10	25	1	10	3	60	1

(a) *Erinaceus concolor*
(b) *Sicista betulina*
(c) *Ovis ammon* f. aries/*Capra aegagrus* f. hircus
\+ present but not counted
? perhaps present
(F) F (very) frequent

Table 1. The faunal assemblages from Dudka (specimen counts). Part 3.

ANIMAL GROUP / ASSEMBLAGE	XII-L3/5,B3 : Z	XII-L7 : LM	XII-L13/14 : EM	XII-L15/16 : LP	IV-I1 : LN	IV-I2 : Z/LN	V : LN	VI-I1 : LN	VI-I1/2 : LN/Z	VI-I2/2a : Z/LN	VI-I2b/3 : Z	VII : Z/LN	VIII-I1/B1 : LN	VIII-I2b/B2 : Z/LN	IX-I1/2 : LN/ME	X-I1/2 : LN	Totals
frog/toad (*Anura* spp.)					2	3	4	3	4	6			2		FF	F	FF
swamp tortoise (*Emys orbicularis*)	1				3	3		32	3	12	3		7	4			263
mole (*Talpa europaea*)					3	4		2	1								24
eastern hedgehog (a)					1	2	1	16		13	1						118
bat (*Chiroptera* sp.)																	1
hare (*Lepus* sp(p.))								1		1			1		2	2	21
water vole (*Arvicola terrestris*)					2	3	2	5	1	6					1	1	113
root vole (*Microtus oeconomus*)								3		1					3	1	22
mice (*Apodemus* spp.)																	7
Northern birch mouse (b)																	1
small rodents (*Rodentia* spp.)					+	+	+	+	+	+	+	+	+	+	+	+	F
squirrel (*Sciurus vulgaris*)																	1
beaver (*Castor fiber*)	1		1	1	4	5	1	22	3	11			2		1		106
wolf (*Canis lupus*)								6		3							40
fox (*Vulpes vulpes*)						?	1	2		3	1		1				26
wild cat (*Felis sylvestris*)								?									2
polecat (*Mustela putorius*)								1		1							8
pine marten (*Martes martes*)					1			1		1							28
badger (*Meles meles*)								3		1							4
otter (*Lutra lutra*)					1		1	12		4							32
small carnivores (Carnivora spp.)	1					1		1		3	1						61
bear (*Ursus arctos*)								1	1	2							10
wild boar (*Sus scrofa*)	2				2	2	3	34		25	3	1	3	3			327
horse (*Equus ferus*)					1	1		4	5	2	3						48
roe deer (*Capreolus capreolus*)	4		2	1	4		5	32	1	26	1	1	6		5		270
red deer (*Cervus elaphus*)	16	1	23	1	24	15	7	322	38	117	11	5	11	2	8	1	1360
elk (*Alces alces*)	5		21	1	5	6	1	69	15	34	2	1		1			393
aurochs (*Bos primigenius*)	1				2	1		6	1	3					?		40
dog (*Canis lupus* f. familiaris)																	23
sheep/goat (c)								22	4	5						1	57
cattle (*Bos primigenius* f. taurus)															10		10
Total	31	1	47	4	55	46	26	600	77	280	26	8	33	10	30	6	3560

(a) *Erinaceus concolor*
(b) *Sicista betulina*
(c) *Ovis ammon* f. aries/*Capra aegagrus* f. hircus
\+ present but not counted
? perhaps present
(F) F (very) frequent

Table 2. Finds in the graves at Dudka, area VI (DVI) (a).

	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
tortoise	-	-	-	-	1	1	-	1	-	-	-	1	-	-	-
hedgehog	1	-	-	-	-	1	3	1	1	3	-	1	-	1	-
water vole	1	-	-	-	-	-	-	-	-	-	-	2	-	-	-
small rodents	+	-	-	-	-	-	-	-	-	+	-	-	-	-	-
beaver	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-
wild cat	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
polecat	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
pine marten	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
otter	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
bear	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
wild boar	1	-	2	3	-	1	3	-	-	-	-	-	-	-	-
roe deer	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1
red deer	1	1	-	1	-	-	-	-	-	1	1	-	2	-	-
elk	1	-	-	1	-	-	-	-	-	-		1	-	-	4
aurochs	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
dog	-	-	-	-	-	-	S	-	-	-	-	-	-	S	-

(a) for Latin names of the animals encountered see Table 1; grave 13: Z, grave 3: Z?, others not dated; S: skeleton; numbers are specimen counts.

Table 3. The game bag and livestock of the Dudka people (a).

	LN	LN/Z	Z	EZ	LM	MM	EM	LP	Totals
tortoise	57	51	83	64	8	-	-	-	263
hedgehog	22	45	40	2	9	-	-	-	118
hare	7	7	3	1	2	1	-	-	21
beaver	35	43	21	2	1	2	1	1	106
wolf	8	11	13	-	9	-	-	-	41
fox	9	12	3	-	3	-	1	-	28
small carnivores (b)	31	40	56	6	7	-	-	-	140
bear	1	7	3	-	1	-	-	-	12
wild boar	67	80	143	22	15	-	1	-	328
horse	16	18	14	-	-	-	-	-	48
roe deer	76	78	84	20	7	1	3	1	270
red deer	470	509	294	45	26	7	38	1	1390
elk	97	150	70	13	14	12	33	4	393
aurochs	9	15	10	5	1	-	-	-	40
total game	905	1066	837	180	103	23	77	7	3198
sheep/goat	36	19	2	-	-	-	-	-	57

(a) specimen counts
(b) cat and mustelids

Table 4. Relative frequencies of the major game species in the subsequent periodes at Dudka (a).

	LN	LN/Z	SB (b)	Z	EZ	LM	AT (c)	MM	EM	LP	pre-AT (d)	Totals
wild boar	9.5	9.8	9.7	24.2	22.0	24.2	23.9	-	1.3	-	1.0	13.8
roe deer	10.4	9.5	9.9	14.2	20.0	11.3	14.7	5.0	4.0	16.7	5.0	11.3
red deer	66.3	62.3	64.1	49.7	45.0	41.9	48.5	35.0	50.7	16.7	45.5	58.4
elk	13.8	18.4	16.3	11.8	13.0	22.6	12.9	60.0	44.0	66.6	48.5	16.5

(a) based on specimen counts;
(b) SB: Subboreal assemblages LN and LN/Z;
(c) AT: Atlantic assemblages Z, EZ and LM;
(d) pre-AT: pre-Atlantic assemblages MM, EM and LP.

Table 5: Absolute and relative frequencies of game in the subsequent periods at Dudka (a).

	Subboreal		Atlanticum		pre-Atlanticum		Totals	
	N	%	N	%	N	%	N	%
tortoise	108	5.5	155	13.8	-	-	263	8.2
hedgehog	67	3.4	51	4.6	-	-	118	3.7
hare	14	0.6	6	0.5	1	0.9	21	0.7
beaver	78	4.0	24	2.1	4	3.7	106	3.3
wolf	19	1.0	22	2.0	-	-	41	1.3
fox	21	1.1	6	0.5	1	0.9	28	0.9
small carnivores (b)	71	3.6	69	6.2	-	-	140	4.4
bear	8	0.4	4	0.4	-	-	12	0.4
wild boar	147	7.5	180	16.1	1	0.9	328	10.3
horse	34	1.7	14	1.2	-	-	48	1.5
roe deer	154	7.8	111	9.9	5	4.7	270	8.4
red deer	979	49.7	365	32.6	46	43.0	1390	43.5
elk	247	12.5	97	8.7	49	45.8	393	12.3
aurochs	24	1.2	16	1.4	-	-	40	1.2
totals	1971	-	1120	-	107	-	3198	-

(a) specimen counts; same assemblages as SB, AT and pre-AT in Table 4; (b) wild cat and mustelids.

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