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Variability and identity of the jackals *(Canis aureus)* of Dalmatia

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(With 7 figures)

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Abstract

15 jackals from Dalmatia were examined and compared with 28 jackals from other parts of the Balkan Peninsula, Asia Minor, the Caucasus and Africa. The jackals of Dalmatia differ significantly from their African counterparts in having a broader rostrum and narrower interorbital region. Morphological evidence does not support KÜHN's hypothesis of the African origin of Dalmatian jackals. Dalmatian jackals also differ from the Bulgarian ones, being closer to Pannonian jackals.

Zusammenfassung

Es wurden 15 Schakale aus Dalmatien untersucht und mit 28 Schakalen aus dem übrigen Teil der Balkanhalbinsel, Kleinasien, dem Kaukasus und Afrika verglichen. Die dalmatinischen Schakale unterscheiden sich von den afrikanischen durch ein breiteres Rostrum und eine engere interorbitale Region. Die morphologischen Beweise bestätigen nicht die Theorie von KÜHN von einem afrikanischen Ursprung der dalmatinischen Schakale. Die dalmatinischen Schakale unterscheiden sich auch von den bulgarischen, doch stehen sie den pannonischen näher.

Introduction

The jackal (*Canis aureus* LINNAEUS, 1758) reaches the northwesternmost limit of its distribution in Dalmatia (CORBET 1978, HEPTNER & NAUMOV 1967). Ever since 1491 when jackals were first mentioned as occuring in Dalmatia on the island of Korčula (JERIČEVIĆ 1952) they have been attracting the attention of European zoologists. This interest seems to have culminated at the beginning of this century with the organization of the so-called „Jackal expedition“ from which a monograph resulted (MORGAN 1906). In spite of this longlasting interest in the species, little information has been accumulated on the morphological properties and the variability of the jackal population of the Dalmatian coast and some of its islands. Skull measurements are to be found in the papers of NOACK (1907), EHIK (1938), SZUNYOGHY (1957), OBOUSSIER (1958) and KERSCHNER (1959). SZUNYOGHY (1957)

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and KERSCHNER (1959) published also a photograph of the skull. The data on its external dimensions can be found in the article of OBOUSSIER (1958).

The name *Canis aureus* was already used for Dalmatian jackals by FITZINGER (1830) and MICHAHELLES (1830). WAGNER (1841) later named it *Canis dalmatinus.* POCKOCK (1938), following KÜHN's (1935) suggestion that Dalmatian jackals had been introduced from North Africa, regarded *dalmatinus* as a probable synonym of *anthus.* ELLERMAN & MORRISON-SCOTT (1966) and CORBET (1978) put a question mark against it while DJULIĆ and MIRIĆ (1967) considered it synonymous with *moreoticus*.

The aim of the present article is to describe, as far as the material available permits, the external and skull characteristics of the Dalmatian jackal. By comparing it with jackals from the rest of the Balkan Peninsula, Asia Minor and North Africa we shall make an attempt to clarify its taxonomic (subspecific) position and presumed African origin. Since the distribution of jackals in Dalmatia (in the context of the whole of Yugoslavia) has been recently reviewed by MILENKOVIČ (1987) we are not dealing with it in this paper.

Material and Methods

15 skulls and 2 skins from Dalmatia and two skulls from neighbouring Bosnia were examined. For the purpose of comparison, additionally 27 skulls and 1 stuffed specimen from the Balkan Peninsula, Asia Minor, the Caucasus, North Africa and Ethiopia were studied (Fig. 1). The material is deposited in the collections of:

NNW – Naturhistorisches Museum Wien, Austria

PMS – Natural History Museum of Slovenia, Ljubljana, Yugoslavia.

HPM – Croatian Natural History Museum, Zagreb, Yugoslavia.

Four external measurements were taken by one of the authors on fresh animals before skinning (Table 1):

HB – head and body length, TL – tail length, HF – hind foot length, E – ear length.

Twenty one skull and dental measurements were taken by means of vernier callipers to the nearest 0.1 mm (Tables 2 and 3). Their definitions and symbols are as follows:

PL – profile length, CB – condylobasal length, ZB – zygomatic breadth, BB – braincase breadth, IC – interorbital constriction, PC – postorbital constriction, RC – rostral breadth over canines, RM – rostral breadth over molars, BD – braincase depth (crest excluded), NL – nasal length, ML – mandible length, MH – coronoid height of mandible, CM^2 – maxillary tooth row (from the canine to the last molar), P^1M^2 – maxillary tooth row (from the first premolar to the last molar), CM_3 – mandibular tooth row, P^4L, P^4B – length and breadth separately of the fourth upper premolar, M^1L, M^1B – length and breadth of the first upper molar, M_2L, M_2B – length and breadth of the second lower molar. All measurements are given in mm.

Adults were determined according to characters proposed by OSBORN & HELMY (1980) for *Canis aureus lupaster.* In addition, subadults (young adults) and

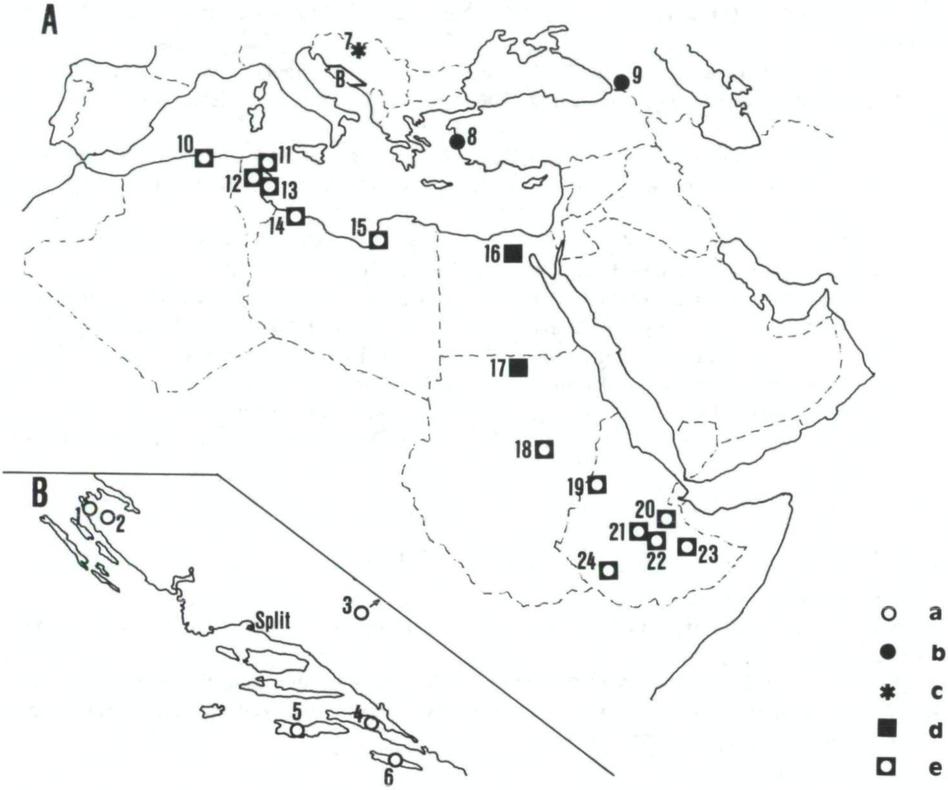

Fig. 1: Localities from where jackals *(Canis aureus)* have been examined. a – Dalmatian jackals; b – *C. a.* cf. *moreoticus;* c – *C. a. balcanicus;* d – *C. a. lupaster;* e – African jackals other than *C. a. lupaster*. Localities: 1. Zadar, Stanovi; Zaton; 2. Zadar, Bokanjačko blato; 3. Sarajevo; 4. Peljašac; 5. Korčula Is.; 6. Mljet Is.; 7. Valpovo, Nard; 8. Izmir; 9. Borzhomi; 10. Algers; 11. Tunis; 12. Gafsa; 13. El Haffay; 14, Tripoli; 15. Haniyah (Prov. Beida); 16. Schubra Shihab; 17. NE Sudan („Nubien"); 18. Khartoum; 19. Setit River; 20. Mt. Assabot (Prov. Harar); 21. Ginea (Prov. Arusi); 22. Ginir (Prov. Bale); 23. Ogaden; 24. Abera (Prov. Kefa).

juveniles (in the first year of their life with widely separated frontoparietal ridges) were also recognized. It should be noted that North African jackals other than *lupaster* frequently lack the crest also at a full adult stage.

The terms used to describe the colours are those given by Munsell (1975).

Material

Dalmatia (incl. Bosnia)

NMW 1097 – sex unknown; skull; leg. Dr. Bakis & L. von Führer. Serajevo (= Sarajevo), Bosnia.

NMW 1102 – sex unknown; skull; June 1899; leg. Desulović. Sabbioncello (= Pelješac), Dalmatia.

NMW 1897 – male; skull; Dec. 10, 1908. Dalmatia (no exact locality).

NMW 1898 – male; skull; Jan. 11, 1909. Dalmatia (no exact locality).

NMW 4756 L. J. (From L. JEITTELLES collection) – male; skull; April 1875. Meleda (= Mljet Is.), Dalmatia.

NMW 4849 – female; skull. June 17, 1907; leg. BURATOVIĆ. Curzola (= Korčula Is.), Dalmatia.

NMW 4854 – sex unknown; skull, leg. Dr. BAKIS & L. VON FÜHRER. Serajevo (= Sarajevo), Petala (not identified).

NMW without number – male; skull; April 2, 1907; leg. BURATOVIĆ. Curzola (= Korčula Is.)

NMW without number – sex unknown; skull; approx. 1890–1900; leg. Baron SCHILLING. Meleda (= Mljet Is.)

NMW 7153 – female; skull; April 24, 1907; leg. BURATOVIĆ. Curzola (= Korčula Is.).

NMW 37608 – male; skull; Feb. 15, 1984; leg. B. KRYŠTUFEK. Zaton, Zadar.

PMS 2883 – female; skin and skull; March 6, 1983; leg. B. KRYŠTUFEK. Zadar, Bokanjačko blato.

PMS 2884 – sex unknown; skull; March 20, 1983, leg. B. Kryštufek. Zadar, Bokanjačko blato.

PMS 3282 – male; skin and skull; Feb. 19, 1984; leg. B. KRYŠTUFEK. Stanovi, Zadar.

PMS 3511 – sex unknown; skull with skeleton; 1930. Dalmatia (no exact locality).

HPM 910 – male; skull; Nov. 1950; leg. K. IGALFFY. Dalmatia (probably Pelješac).

HPM 3701 NT – female; skull; Feb. 19, 1983, Leg. N. TVRTKOVIĆ. Zadar, Bokanjačko blato.

Comparative Material

Canis aureus balcanicus

NMW St 1247 – Holotype; male; stuffed; leg. PATZELT & MLAZOVSKI. Nard, Valpovo, Slavonija, Croatia.

Remark: According to the NMW catalogue and the book of acquisitions the date of collection is Sep. 7, 1879. MOJSISOVICS (1897) and after him BRUSINA (1892), as well as all later authors refer to Nov. 7, 1879.

Canis aureus cf. *moreoticus*

In applying the subspecific name *moreoticus* to the jackals of Asia Minor and the Caucasus we are following POCOCK (1938).

NMW 1350 – sex unknown; skull; 1903; leg. K. JÜTTNER). Borjom (= Borzhomi), Georgia.

NMW 4759 L. J. (from L. JEITTELES collection) – male; skull; 1874. Smyrna (= Izmir), Turkey.

NMW 4760 L. J. (from L. JEITTELES collection) – female; skull; 1874. Smyrna (= Izmir), Turkey.

Canis aureus lupaster

NMW 1133 – sex unknown; skull. Obtained in 1863 from the Zoological Garden Schönbrunn. Probably originates from Egypt.

NMW 4765 – sex unknown; skull; 1881; leg. E. HODEK. Egypt.

NMW 7152 – male; skull; 19th century; leg. Dr. C. TOLD. Nubien (= NE Sudan).

NMW 7154 – sex unknown; skull; leg. NEMEC. Nordafrika (= northern Africa).

NMW 7155 – male; skull; leg. NEMEC. Schubra bei Cairo (= Schubra Shihab).

Canis aureus sspp.

African material other than *C. a. lupaster*. According to MEESTER & SETZER (1971) up to four nominal subspecies can be incorporated (*algirensis, maroccanus, riparius* and *soudanicus*).

NMW 1083 (from SPATZ collection) – male; skull; May 1899. El Haffay, 55 km E of Gafsa, Tunisia.

NMW 1085 (from SPATZ collection) – male; skull; April 1, 1899. Gafsa, Tunisia.

NMW 1152 – sex unknown; skull; leg. REITZ. Probably from the surroundings of Khartoum, Sudan.

NMW 1738 – female; skull; 1907; leg. NEMEC. Setit River, Ethiopia.

NMW 1937 – female; skull; leg. NEMEC. Ogaden, Ethiopia.

NMW 3152 – sex unknown; skull; 1912; leg. A. WEIDHOLZ. Tunisia.

NMW 3341 – female; skull; May 28, 1900. Leg C. HILGERT (C. Freiherr VON ERLANGER expedition). Mt. Assabot, Prov. Harar, Ethiopia.

NMW 3343 – male; skull; Feb. 28, 1901; Leg. C. Freiherr VON ERLANGER. Ginea, Prov. Arusi, Ethiopia.

NMW 3345 – male; skull; Feb. 2, 1900; leg. C. Freiherr VON ERLANGER. Abera, Prov. Kefa, Ethiopia.

NMW 3347 – male; skull; March 14, 1901; leg. C. Freiherr VON ERLANGER. Ginir, Prov. Bale, Ethiopia.

NMW 4839 – Type of *gallaensis;* male; skull; Jan. 28, 1901; leg. C. Freiherr VON ERLANGER. Ginea, Prov. Arusi, Ethiopia.

NMW 4845 – male; skull. Obtained in 1817 from the Zoological Garden Schönbrunn. Originated from Tripoli, Libya.

NMW 7422 – sex unknown; skull; 1914; leg. A. WEIDHOLZ. Tunisia (no exact locality; probably from the surroundings of Tunis).

NMW 7423 – sex unknown; skull; 1912; leg. A. WEIDHOLZ. Tunis, Tunisia.

NMW 7424 – sex unknown; skull; 1912; leg. A. WEIDHOLZ. Tunis, Tunisia.

NMW 7425 – sex unknown; skull; 1912; leg. A. WEIDHOLZ. Tunis, Tunisia.

NMW 7426 – female; skull. Collected in Tunisia in 1912 by A. WEIDHOLZ, died in Zoological Garden Schönbrunn on Oct. 30. 1916.

NMW 7427 (from L. JEITTELES collection) – sex unknown; skull; 1883. „Algier“ (= Alger).

NMW 30266 – sex unknown; skull; Aug. 24, 1981; leg. F. SPITZENBERGER & al. Haniyah, Prov. Beida, Libya.

Description of Dalmatian Jackals

Abnormalities

One adult skull (NMW 4756 LJ) is pathologically deformed. All incisors, both P^2, M_2 and M_3, left M^2 and right P^1 are missing. Obviously they were lost ante mortem. Some of the sockets are completely obliterated (e. g. in the case of both I^1 and I^2), some are still visible. The bone on the buccal sides of the maxilla and the mandible is spongiosus and completely absorbed in the region of the carnassials. The right side appears to be more heavily affected (e. g. the roots of the right M^1 are visible from the side). Paradontal disease is obviously responsible for the deformations.

The remaining teeth are badly worn. Wear is particularly obvious on the mesial side of both lower canines and the posterior side of the lower carnassials. In the latter the talonid is missing so that the trigonid alone remains. One has the impression that the animal had been chewing hard objects for a longer period of time (e. g. metal bar or a chain). Such mechanical irritation could cause gingival tissue to become inflamed. Parodontal disease is more common in captive than wild animals (HILSON 1986). The history of our specimen is not known but it seems improbable that the animal with such severe tooth damage and injuries could survive in a natural environment. However, JOHNSON (1934) published evidence of a red fox shot in nature which had lost „. . . the lower incisors, one lower carnassial, all but one of the upper molars, and all except a small fragment of the upper carnassials.“

Due to its serious deformations, this specimen has been excluded from further discussion.

Colour

Two winter skins from northern Dalmatia were reddish yellow (7.5 YR 6/6) on the back, and yellowish red (5 YR 5/8) in the occipital area, on the shoulders and the thighs. The back and the tail were clouded with black. The underside was white (5 YR 8/1) to very pale brown (10 YR 8/3). Reddish tones are more markedly expressed in the male than the female.

Sex Dimorphism

The material available does not permit the application of descriptive statistics in the comparison of dimensions of the two sexes. The largest specimen in our sample is a male (PMS 3282). It exceeds the dimensions of the largest female (HPM 3701 NT) by 1.4% (BB) to 8.5% (IC). Its skull is longer (CB) by 4.6% than that of the largest female. In the skull shape no differences can be observed between the sexes with the exception of a slightly larger relative height of the skull in two females (Table 4). Females may develop a sagittal crest of the same size as males.

Individual Variability

Individual variability is considerable. Frontoparietal ridges are normally fused into the sagittal crest in adult individuals. Its height was up to 3 mm measured on the frontoparietal suture. Formation of the crest is retarded in some specimens. In one adult male (HPM 910) with much worn teeth, the frontoparietal ridges were still some 3 mm apart (on the frontoparietal suture). Instead of a sharp narrow crest only a weak convexity could be seen.

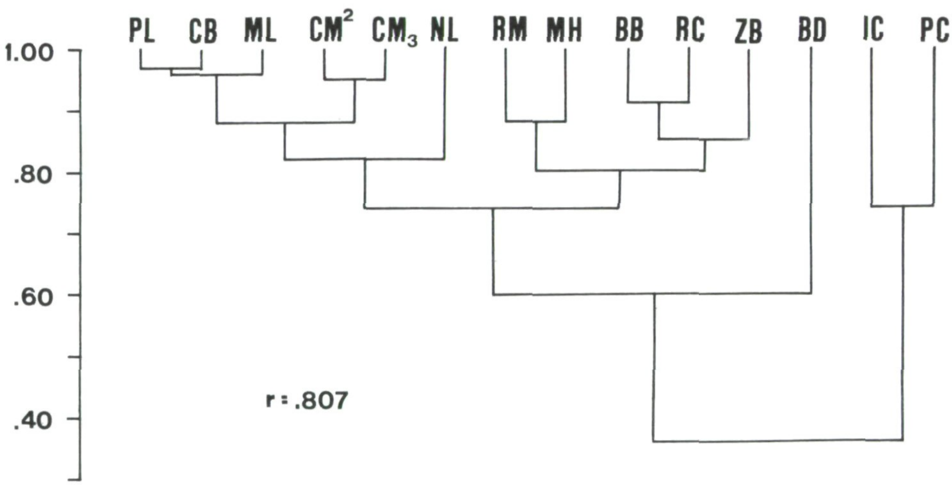

Fig. 2: Dendrogram constructed from correlation matrice of skull measurements of Dalmatian jackals. Cophenetic correlation coefficient = 0.807.

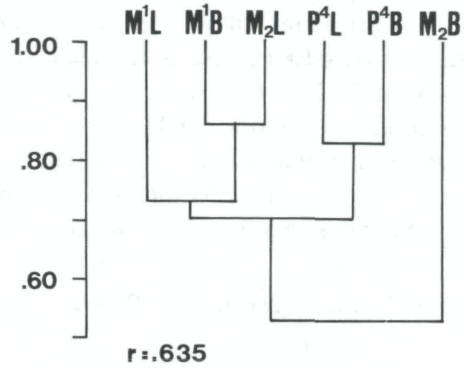

Fig. 3: Dendrogram constructed from correlation matrice of dental measurements of Dalmatian jackals. Cophenetic correlation coefficient = 0.635.

Dendrograms constructed from correlation matrices of skull (Table 5) and dental (Table 6) measurements are presented in Figs. 2 and 3. Within the skull, the interorbital region (IC, PC) and the braincase depth (BD) are responsible for most of the variability. Other skull measurements are grouped into two clusters (dependent pleiades sensu TERENTJEV 1943). One contains longitudinal measurements (PL, CB, NL, ML, CM^2, CM_3) and the other breadth characters (ZB, BB, RC, RM) and the height of the mandible (MH). This polarization between length and breadth characters suggests that the change in one longitudinal measurement affects other length characters to a greater extent than the breadth characters and vice versa.

Dental measurements are grouped into two clusters by the breadth of the second lower molar being responsible for most of the variability.

Comparison with African jackals

C. a. lupaster from Egypt and NE Sudan is larger than the Dalmatian jackal. The smallest *lupaster* in the NMW collection with CB of 167.3 mm is already larger than the largest Dalmatian jackal. For 13 *C. a. lupaster* from Egypt, OSBORN & HELMY (1980) reported the condyloincisive length to range from 173.5 to 196.0 mm, being 185.2 mm on the average. In eleven Dalmatian jackals the corresponding range is between 138.3 and 165.2 mm (average of 153.6 mm). There is obviously no overlapping in skull length between the two jackal populations.

Jackals from Tunisia, Algeria, Libya and Ethiopia are approximately of the same size as the Dalmatian ones. Although the former may attain slightly larger dimensions (the greatest CB measured is 170.6 mm for an unsexed adult from Tunisia). Differences were found in the skull shape. Zygomatic breadth presented 52 to 59.3% of condylobasal length ($\bar{x}$ = 55.9, n = 16) in African jackals while from 55.1 to 63.6% ($\bar{x}$ = 59.8, n = 11) in the Dalmatian ones. In this respect *C. a. lupaster* is closer to its smaller African relatives. In three specimens of *lupaster* the corresponding values were 52.5, 53.6 and 56.9% respectively ($\bar{x}$ = 54.3). Differences in skull shape are even more obvious in the relative rostral breadth. The scatter diagram where the rostral breadth over molars is plotted against the length of the maxillary tooth row (C–M²) permits a complete discrimination between African and Dalmatian jackals (Fig. 4). A greater range of variability in jackals from Tunisia, Libya, Algeria and Ethiopia could be ascribed to the fact that more than one single subspecies is incorporated in the material examined. *C. a. lupaster* is again closer to the other North African jackals (Fig. 4). Dalmatian jackals have also narrower interorbital regions than their African counterparts (Fig. 5).

Comparison with the jackals from the Balcan Peninsula and Asia Minor

Of the jackals from the Pannonian basin we examined only the type of *C. a. balcanicus*. It is a stuffed specimen in good condition. Since it has been exhibited for a number of years, it has become somewhat faded. It differs from Dalmatian jackals in a wider black dorsal strip which extends to the flanks. The tail is also darker, nearly perfectly black. Brown tones are less expressed, which may result from a long lasting exposure to light. The following measurements were obtained

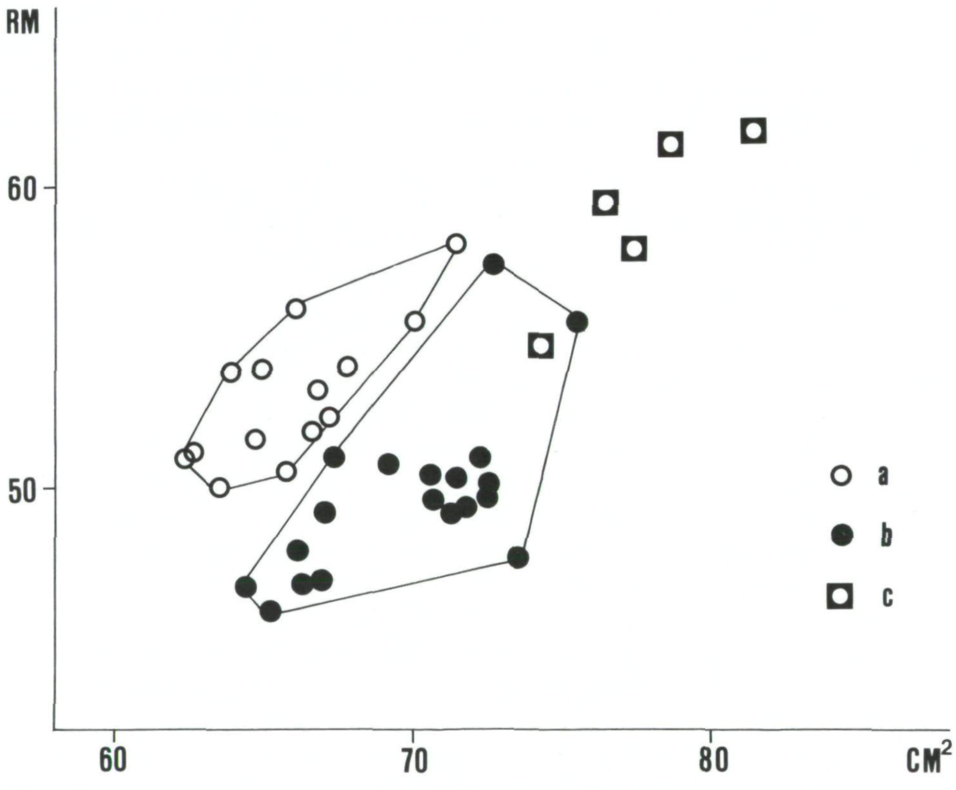

Fig. 4: Scatter diagram where the rostral breadth over molars (RM) is plotted against the length of the maxillary tooth row (CM²) for adult and subadult jackals.
a – Dalmatian jackals; b – African jackals (other than *C. a. lupaster*); c – *C. a. lupaster*.

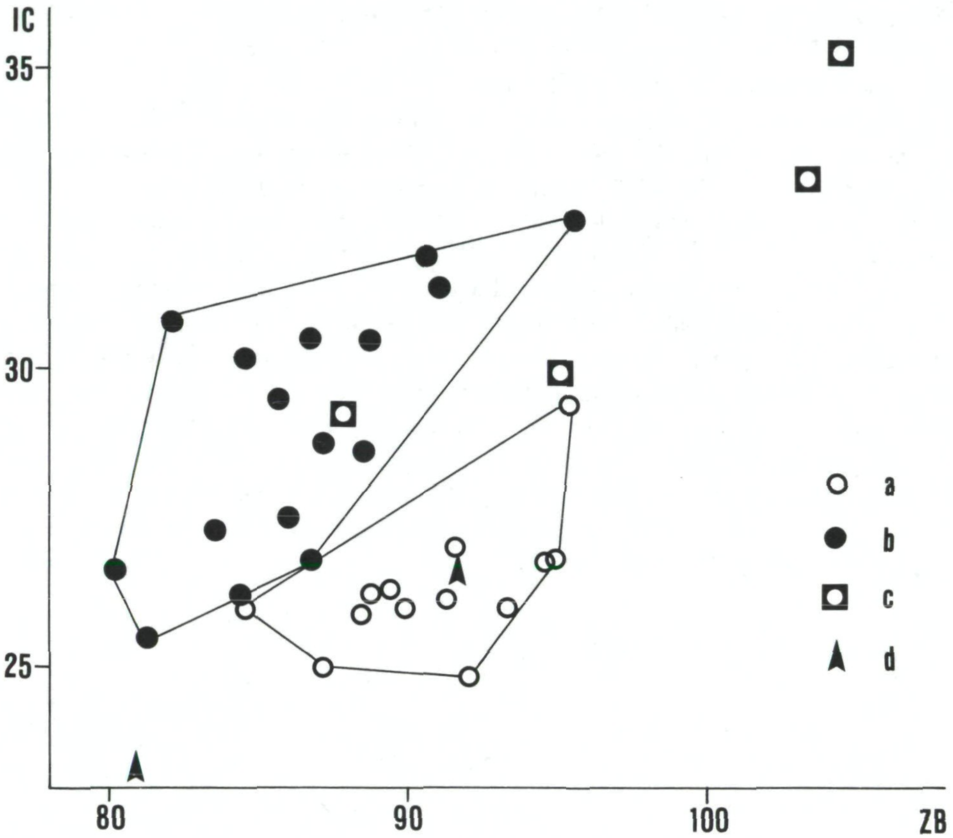

Fig. 5: Scatter diagram where the interorbital constriction (IC) is plotted against the zygomatic breadth (ZB) for adult and subadult jackals.
a – Dalmatian jackals; b – African jackals (other than *C. a. lupaster);* c – *C. a. lupaster;* d – *C. a.* cf. *moreoticus*.

from the stuffed animal: HB 82 cm, TL 24 cm, HF approx. 17 cm, E 67.6 mm (right), 68,5 mm (left). Of the skull measurements it was only possible to take the rostral breadth over the canines. It amounted to 31.5 mm, which means that it is within the known range for Dalmatian jackals (26.5–32.5 mm).

In this connection it is necessary to mention the nomenclature of the jackals from the Pannonian basin. The following names have been proposed: *minor* Mojsisovics, 1897, *balcanicus* Brusina, 1892, *hungaricus* Ehik, 1938 and *ecsedensis* Kretzoi, 1947. The oldest valid name is apparently *balcanicus* (see Ellerman & Morrison Scott 1966 for the nomenclatural question of Hungarian names) which, together with *dalmatinus,* Pocock (1938) incorrectly considered to be a synonym of *anthus.* As already mentioned, Pocock accepted Kühn's hypothesis (Kühn, 1935) about the African origin of *C. a. dalmatinus.* Since the type localities of *dalmatinus* and *balcanicus* are from Croatia, Pocock (1938) treated both in a similar way. As a matter of fact, the two originate from different geographic regions: *dalmatinus* was named from the Adriatic coast and *balcanicus* from the southern border of the Pannonian basin.

The taxonomic position of the jackals from Pannonia is not clear. When regarded as subspecifically independent the names *ecsedensis* (e. g. ELLERMANN & MORRISON SCOTT 1966, CORBET 1978), *minor* and *hungaricus* (CORBET 1978) or *balcanicus* (DJULIĆ & MJIRIĆ 1967) have been proposed for them. Some authors (e. g. SZUNYOGHY 1957) denied the validity of *hungaricus* as an independent subspecies.

According to the measurements published by SZUNYOGHY (1957) the type of *C. a. hungaricus* (adult male from Tyukod) fits in well with the range of Dalmatian jackals. It is also close to the Dalmatian population in its relative rostral breadth (Fig. 6). Although morphologically not perfectly identical, the jackals from Pannonia show no significant differences from their Dalmatian counterparts.

As evident from the dimensions published by ATANASSOV (1953), the jackals from Bulgaria are not identical with the Dalmatian ones. The skulls of the former

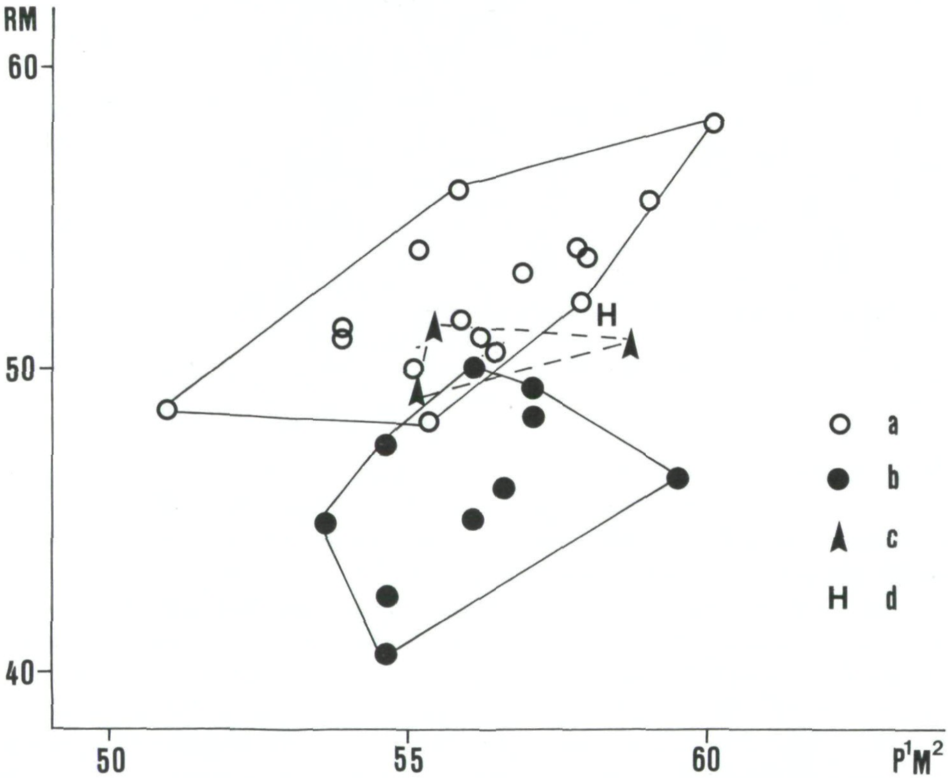

Fig. 6: Scatter diagram where the rostral breadth over molars (RM) is plotted against the length of the maxillary tooth row (P^1M^2) for adult and subadult jackals.
a – Dalmatian jackals (included were also two specimens from Šipan Is. whose measurements were published by SZUNYOGHY 1957); b – jackals from Bulgaria (according to ATANASSOV 1953); c – *C. a.* cf. *moreoticus;* d – Type of *C. a. hungaricus* (according to SZUNYOGHY 1957).

are narrower, as in African jackals (Fig. 6). An adult male from the vicinity of Negotin, NE Serbia, whose measurements were published by MILENKOVIĆ (1983) also has a relatively narrower skull as seen from the ZB/CB ratio (53.1%). In this respect it is closer to the Bulgarian sample, which is in accordance with its geographic origin.

In the jackals from Asia Minor and the Caucasus the zygomatic width ranges from 54.8 to 59.3% of the condylobasal length ($\bar{x} = 56.6 \pm 1.67$, $n = 6$; besides the skulls from NMW also the data of MILLER 1912 are included). Dalmatian skulls are still slightly broader ($\bar{x} = 59.8 \pm 2.43$, $n = 11$). The difference is statistically significant ($t = 2.86$, $p > 0.05$).

Of the jackals from the Peloponnesus (Peloponnisos, Greece) measurements are available for one single unsexed animal (MILLER 1912). This specimen, which is topotypical with *moreoticus,* corresponds in skull and dental measurements with the Dalmatian population, but its skull is narrower. Zygomatic width is 52.5% of condylobasal length instead of 55.1 to 63.3% as in Dalmatian jackals. In this respect the Peloponnesian specimen is obviously closer to the jackals from Bulgaria. Direct comparisons are difficult since ATANASSOV (1953) did not measure condylobasal length.

Discussion and Conclusions

On the basis of their broad skulls (Figs. 7 and 8) the jackals from Dalmatia appeared to be morphologically well distinct from their counterparts from the Balcan Peninsula and Africa. The greatest similarity is to the jackals from Asia Minor. Thus the morphological evidence does not support the theory of the African origin of the Dalmatian jackals.

KÜHN (1935) referred to the data from the archives of the city of Dubrovnik (Ragusa) according to which jackals had been introduced to the island of Korčula by the Venetian Republic in order to inflict damage on the Republic of Dubrovnik. Already in 1830 FITZINGER was acquainted with tales that jackals were imported to the Dalmatian islands from Africa („. . . daß sie von einem Paare abstammen, das einst ein Schiffscapitän aus Africa brachte; . . .“).

Although it is not improbable that in the past jackals imported from Africa should have been set free on an Adriatic island, it is non the less a poorly founded speculation to search for the origin of the entire Dalmatian population in northern Africa, as suggested by POCOCK (1938). As has been shown above, Dalmatian jackals are morphologically well-distinct from the African ones, showing more similarity to the specimens from Asia Minor. On the other hand, their presence in Dalmatia corresponds well with the Anatolian-Balkan type of distribution (sensu MATVEJEV 1961) and could be explained by the invasion of Europe via the Bosporus bridge at the end of the Pleistocene (HOSEY 1982). Such natural colonization is well in accordance with the morphological data.

The tales (including the official documents on which KÜHN's conclusions were based) that the jackals were imported could be explained by the relative scarcity of jackals in that period. In Dalmatia jackals were rare and local in distribution as late as the 20th century. They were confined to central Dalmatian islands (e. g. Mljet and Korčula) and the long and narrow Pelješac Peninsula. Our recent observations on the North Dalmatian jackal population suggest that competition with wolves might have an important influence on the jackal distribution. The progression of the jackal distribution, which has been observed recently in northwestern Yugoslavia (KRYŠTUFEK and TVRTKOVIĆ in preparation) could be connected with a reduction of the wolf population. Before that, competition with the wolf confined the jackal to places unsuitable for the larger of the two canids. Since wooded high mountain ridges run parallel with the narrow Dalmatian coast, the entire coastal area was under the, at least temporary, control of wolves. Jackals were driven out of it to the islands and remote coastal regions such as the Pelješac Peninsula. In 1348, for instance, when Split was attacked by plague, the wolves came down from the mountains and fell upon the plague-stricken city (ZIEGLER 1969). The jackals are not mentioned at all in this connection. Since the first mention of jackals in the 15th century they were practically reported only for the above regions right up until the 19th century.

Whenever a rare or an unknown animal species populates an area where it has not lived before, such an occurrence is explained by different speculations. If it is also harmful (as is the jackal to vineyards and small cattle), local people usually associate explanations with an accusation that thereby somebody wanted to cause damage to them. When in 1929 a male jackal appeared on Premuda Is., the islanders believed that „. . . a jackal was brought to this island out of a sheer malice." (JERIČEVIĆ 1952). This is doubtlessly an interesting parallel to five hundred years old records from the archives of the city of Dubrovnik from which KÜHN drew his (in our belief premature) conclusion that „Der Schakal ist in Dalmatien kein autochthones Tier, . . ." (KÜHN 1935).

The taxonomic relationship among jackal populations on the Balkan Peninsula are not clear. The area is obviously inhabited by two rather than one morphological types of jackals. However, this runs contrary to the recognition of two subspecies, *moreoticus* and *balcanicus (hungaricus* or *ecsedensis),* as usually suggested in the literature. Both forms are imperfectly known. The knowledge on *moreoticus* is based on one single specimen from Piraeus while the sample of the already extinct Pannonian jackal is insufficient for establishing individual variability.

The jackals from Bulgaria are morphologically distinct. If they are referred to by the name *moreoticus,* then the population from Dalmatia, characterized by a broad skull, should retain the name *dalmatinus.* The existence of at least two distinct jackal morphotypes on the Balkan Peninsula can be ascribed to historic changes in their distribution area. Competition with the wolf – the dominant canid of this area in the last centuries – confined the jackal to small geographically isolated populations. Since the jackal was regarded as a harmful animal, it was strongly persecuted. Thus, the first jackal hunt on Korčula Island was already organized in 1491. It was followed by two hunts in 1576, when the hunters believed to have completely exterminated the jackals on the island. However, in 1579 a new jackal hunt was undertaken (JERIČEVIĆ 1952). When empty or depopulated areas were repopulated, this was probably done by a small pack, a couple of animals or even by a single pregnant female. Because of restricted variance in the founding population their descendants might differ from the antecedent stock. As a result of the geographic limitation of the area populated by jackals in Dalmatia, local exterminations are likely to have alternated with recolonizations, which further intensified the effect of a founding population.

On the other hand, it is known that new selection pressure deriving from novel ecological conditions, may result in a swift change of the morphotype. Evolutionary changes in the morphology of mammals introduced to new habitats have been shown for *Ondatra zibethicus* introduced to Europe (RUPRECHT 1974) and *Trichosurus vulpecula,* introduced to New Zealand (YOM-TOV & al. 1986). Among canids, there is evidence of human intervention having resulted in great morphological variations in wolf populations in Ontario, Canada. The landscape change which was followed by a change of a large herbivore community resulted finally in a different wolf morphotype, best adapted to available prey (KOLENOSKY & STANDFIELD 1975).

Jackals of the Balkan Peninsula were doubtlessly exposed to changing ecological conditions dictated by human interventions in the environment. This applies particularly to the vegetation of the Mediterranean area which has been subject to greater changes (i. e. degradation) than any other biome in Europe. It should be noted, however, that the potential adaptive value of a broader skull in Dalmatian jackals is not clear. The differences observed between the jackals from Dalmatia and those from Bulgaria cannot be explained in this way.

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Table 1: External measurements of Dalmatian jackals. For abbreviations see "Material and Methods".

Coll.	No.	HB	TL	HF	E
NMW	37608	840	–	175	85
PMS	2883	910	240	153	72
PMS	3282	940	200	178	85
HPM	3701 NT	775	280	160	85

Table 2: Skull measurements of jackals from Dalmatia, Asia Minor, the Caucasus and Africa. For abbreviations see "Material and Methods".

Coll.	No.	Age	PL	CB	ZB	BB	IC	PC	RC	RM	BD	NL	ML	MH	CM^2	P^{1}M^2	CM$_3$
Dalmatia																	
NMW	1097	ad.	155.5	149.3	82.3	51.4	23.4	28.0	26.6	50.6	50.3	51.8	116.4	41.2	65.7	56.4	73.8
NMW	1102	ad.	165.4	153.0	94.6	56.3	26.8	29.3	30.0	53.3	50.7	57.4	122.1	46.3	66.7	56.8	76.8
NMW	1897	sad.	151.6	145.8	± 84.5	54.4	26.0	31.0	± 27.4	51.6	49.6	56.0	113.3	43.1	64.7	55.8	73.4
NMW	1898	sad.	156.1	150.9	89.8	56.3	26.0	29.9	30.2	53.9	49.0	55.0	117.3	42.7	63.9	52.9	75.3
NMW	4756 LJ	ad.	± 150.4	143.2	–	53.3	27.8	–	30.0	53.8	49.5	± 56.2	–	45.4	65.0	55.0	71.4
NMW	4849	ad.	144.1	138.0	± 87.1	–	–	–	–	–	± 45.0	50.1	110.7	41.6	60.7	52.0	70.2
NMW	4854	ad.	152.0	146.0	88.8	53.8	26.2	29.9	29.0	51.2	50.2	54.8	116.1	42.2	62.6	53.9	72.9
NMW	Curzola	sad.	149.7	140.4	87.1	51.0	25.0	29.4	26.7	50.0	43.3	53.5	112.3	38.8	63.5	55.0	73.6
NMW	Meleda	juv.	–	–	–	–	21.3	30.7	17.6	51.1	–	45.9	96.0	33.1	56.6	48.0	64.4
NMW	7153	ad.	160.2	158.4	95.3	57.8	29.4	32.7	32.5	58.2	52.5	59.0	126.3	49.0	71.4	60.0	82.5
NMW	37608	ad.	165.1	156.1	91.1	55.8	26.1	30.8	30.5	56.0	49.7	59.0	123.3	46.7	66.0	55.7	75.1
PMS	2883	ad.	–	–	89.4	–	26.3	29.1	28.0	52.3	–	60.0	123.2	44.4	67.2	57.8	75.8
PMS	2884	ad.	167.7	157.7	93.3	56.3	26.0	30.0	29.8	54.0	52.3	57.1	125.8	44.4	67.7	57.8	77.7
PMS	3282	ad.	173.7	163.2	94.8	58.3	26.9	28.8	31.8	55.6	51.2	60.6	129.5	48.3	70.0	59.0	80.6
PMS	3511	ad.	148.1	139.1	88.4	53.9	25.9	30.6	26.5	51.0	50.2	51.6	113.5	43.4	62.3	53.9	70.5
HPM	910	ad.	162.3	155.4	91.6	55.8	27.0	30.5	29.7	50.9	48.9	59.3	119.9	42.9	66.5	56.2	78.5
HPM	3701 NT	ad.	166.9	155.9	92.0	57.5	24.8	27.6	31.1	54.0	50.1	58.6	120.5	44.4	64.9	55.1	75.0
Asia Minor, Caucasus																	
NMW	1350	ad.	165.7	161.7	91.6	55.0	26.3	26.0	29.6	50.9	51.7	63.9	123.7	44.5	68.4	58.7	77.3
NMW	4759	ad.	152.8	148.6	80.9	52.8	23.2	25.4	25.5	49.2	49.5	55.9	114.4	43.3	64.5	55.1	73.0
NMW	4760	ad.	–	–	–	–	22.3	–	26.8	51.5	–	–	–	–	64.5	55.3	–
Africa *(C. a. lupaster)*																	
NMW	1133	ad.	–	–	104.3	62.7	35.1	32.7	35.9	61.9	–	69.0	143.5	49.9	± 81.4	± 65.9	91.9
NMW	4765	ad.	181.4	167.3	87.8	56.4	29.1	31.3	30.8	55.7	± 52.6	–	129.9	48.4	74.2	63.4	84.8
NWM	7152	ad.	185.1	177.2	95.0	60.0	29.9	32.2	32.4	61.5	52.3	64.2	138.0	51.1	78.6	66.8	91.2
NMW	7154	ad.	195.2	182.0	103.5	64.2	33.4	33.1	35.1	59.5	55.8	72.4	–	–	76.4	–	–
NMW	7155	ad.	186.3	177.7	–	61.0	35.5	34.3	31.7	57.9	± 51.8	–	–	–	77.5	64.8	–

Table 2: Skull measurements of jackals from Dalmatia, Asia Minor, the Caucasus and Africa. For abbreviations see "Material and Methods" (cont.)

Coll.	No.	Age	PL	CB	ZB	BB	IC	PC	RC	RM	BD	NL	ML	MH	CM^2	P^1M^2	CM_3
Africa (other than *C. a. lupaster*)																	
NMW	1083	ad.	–	152.7	88.3	51.4	28.6	31.0	26.6	50.4	48.4	62.0	118.6	43.1	71.4	59.8	79.4
NMW	1085	ad.	168.9	160.6	83.5	53.3	27.3	28.8	26.7	47.6	49.9	61.3	–	–	73.6	62.5	–
NMW	1152	ad.	154.7	149.9	85.6	51.7	29.5	31.7	26.0	47.9	49.9	57.4	113.5	41.7	66.1	55.6	76.0
NMW	1738	juv.	141.3	134.0	81.2	49.6	27.8	33.3	24.2	44.4	44.0	46.5	106.8	38.5	61.9	52.5	69.0
NMW	1937	ad.	148.7	140.8	81.2	49.8	25.5	24.5	24.1	45.8	45.1	–	111.0	38.6	65.2	55.5	74.4
NMW	3152	ad.	176.3	170.6	95.5	60.0	32.4	31.8	31.2	55.7	53.8	62.6	135.5	50.6	75.6	64.0	86.4
NMW	3341	ad.	159.4	151.0	84.4	54.2	26.1	29.9	25.9	46.9	48.6	55.6	117.9	42.1	66.8	55.4	76.7
NMW	3343	ad.	167.0	157.8	87.1	53.6	28.8	32.2	27.9	49.3	51.3	61.6	120.4	45.2	71.6	60.0	81.5
NMW	3345	ad.	171.5	161.4	91.0	55.0	31.3	31.2	28.0	49.4	49.4	59.3	124.0	43.8	71.4	60.3	81.3
NMW	3347	ad.	161.0	153.0	85.9	51.0	27.5	26.3	–	49.1	47.3	56.8	117.4	44.0	67.1	57.2	74.7
NMW	4839	ad.	169.0	158.9	90.6	54.3	31.9	33.0	27.5	48.9	50.1	60.8	122.8	43.5	72.4	58.9	82.0
NMW	4845	ad.	–	–	–	58.1	32.1	32.1	–	57.5	–	–	–	50.6	72.6	61.8	83.7
NMW	7422	ad.	–	156.7	82.0	55.0	30.8	35.0	26.4	50.0	49.6	57.2	120.8	41.8	72.6	62.5	82.4
NMW	7423	ad.	164.7	162.9	88.7	56.9	30.4	34.2	27.6	51.1	49.5	61.0	128.5	45.8	72.2	61.7	83.4
NMW	7424	ad.	166.5	157.9	84.5	53.5	30.2	32.5	27.5	49.7	49.0	59.2	126.9	46.0	70.7	61.4	81.2
NMW	7425	sad.	160.8	155.6	80.1	55.0	26.7	29.7	26.9	50.3	50.5	56.8	–	43.2	70.5	61.0	80.0
NMW	7426	ad.	–	153.1	86.8	52.3	26.8	± 33.6	29.3	51.1	49.4	–	119.4	42.6	67.3	56.0	76.3
NMW	7427	ad.	155.4	146.4	86.8	52.1	30.5	32.7	25.7	46.8	50.8	54.3	112.3	43.0	64.3	53.3	73.6
NMW	30266	ad.	151.9	146.2	–	–	27.8	28.2	25.4	± 46.9	50.7	53.5	113.0	42.3	66.3	56.8	73.6

Table 3: Dental measurements of jackals from Dalmatia, Asia Minor, the Caucasus and Africa. For abbreviations see "Material and Methods".

Coll.	No.	Age	P^4L	P^4B	M^1L	M^1B	M_2L	M_2B
Dalmatia								
NMW	1097	ad.	16.5	8.5	12.0	14.2	17.4	7.2
NMW	1102	ad.	16.9	8.9	12.1	16.0	18.2	7.5
NMW	1897	sad.	16.4	8.7	11.8	15.4	17.9	8.1
NMW	1898	sad.	17.4	9.1	11.7	15.7	19.6	7.9
NMW	4849	ad.	15.6	8.4	10.8	13.0	16.0	6.9
NMW	4854	ad.	16.3	8.0	11.5	14.2	17.8	7.8
NMW	Curzola	sad.	17.5	9.0	11.6	15.9	19.7	8.3
NMW	Meleda	juv.	15.4	7.5	11.3	14.2	17.7	7.1
NMW	7153	ad.	17.5	9.0	11.6	15.9	19.7	8.3
NMW	37608	ad.	17.7	9.1	11.9	16.6	19.5	7.6
PMS	2883	ad.	17.7	9.8	11.9	15.7	17.8	7.5
PMS	2884	ad.	18.7	9.8	12.4	16.2	19.1	7.6
PMS	3282	ad.	18.7	10.2	12.5	16.7	19.6	8.6
PMS	3511	ad.	16.7	8.9	11.4	14.5	17.6	7.1
HPM	910	ad.	16.5	8.9	11.7	15.3	17.6	7.6
HPM	3701 NT	ad.	17.0	9.8	11.7	15.6	18.5	7.6
Asia Minor, Caucasus								
NMW	1350	ad.	17.1	9.7	11.9	15.0	18.7	7.7
NMW	4759	ad.	17.9	8.5	11.6	15.0	17.6	8.2
NMW	4760	ad.	17.2	8.9	12.0	14.9	17.9	7.6
Africa (*C. a. lupaster*)								
NMW	1133	ad.	19.9	11.0	13.7	17.4	22.2	9.3
NMW	4765	ad.	18.4	9.8	13.3	16.5	21.3	8.4
NMW	7152	ad.	20.3	11.0	13.2	19.0	23.3	9.6
NMW	7154	ad.	19.0	10.0	13.9	17.0	–	–
NMW	7155	ad.	18.0	9.9	12.6	16.9	21.1	8.0
Africa (other than *C. a. lupaster*)								
NMW	1083	ad.	16.7	7.7	11.0	14.7	17.5	7.4
NMW	1085	ad.	17.8	8.4	12.6	15.5	–	–
NMW	1152	ad.	15.7	7.4	10.5	13.0	17.7	7.0
NMW	1738	juv.	15.3	7.4	10.2	13.5	16.7	6.3
NMW	1937	ad.	17.0	7.6	12.2	14.9	18.3	7.0
NMW	3152	ad.	18.9	9.3	12.8	18.0	21.0	7.9
NMW	3341	ad.	16.0	8.8	11.6	15.4	17.6	6.9
NMW	3343	ad.	17.0	8.4	11.7	15.5	19.0	7.3
NMW	3345	ad.	17.2	8.3	11.9	15.3	19.7	7.3
NMW	3347	ad.	15.2	7.7	11.2	13.8	17.1	6.6
NMW	4839	ad.	16.6	8.7	11.7	14.8	18.3	7.2
NMW	4845	ad.	20.6	11.4	13.6	17.4	22.5	8.7
NMW	7422	ad.	18.5	9.0	13.3	16.1	20.8	7.7
NMW	7423	ad.	18.4	8.6	12.6	15.7	19.6	7.8
NMW	7424	ad.	18.3	9.2	12.6	16.2	19.6	7.9
NMW	7425	sad.	18.3	9.8	13.1	16.5	20.6	8.2
NMW	7426	ad.	16.7	8.8	11.4	15.3	18.3	7.0
NMW	7427	ad.	16.5	8.2	11.9	15.7	18.8	7.0
NMW	30266	ad.	16.3	8.5	11.3	14.7	18.8	7.2

Table 4: Relative values of skull measurements expressed as percentages against condylobasal length to show sex dimorphism in jackal skull. For abbreviations see "Material and Methods".

	Females (n = 2)	Males (n = 4)
ZB	60.2, 59.0	58.1 – 62.0
BB	36.5, 36.9	35.7 – 36.3
IC	18.6, 15.1	16.5 – 17.8
PC	20.6, 17.7	17.6 – 20.9
RC	20.5, 19.9	19.0 – 19.5
RM	36.7, 34.6	32.8 – 35.9
BD	33.1, 32.1	30.8 – 31.8

Table 5: Correlation matrice of skull measurements in Dalmatian jackals. Coefficients of correlation which are significant at p>0.05 are printed in heavy type. See also Fig. 2. For abbreviations see "Material and Methods".

	CB	ZB	BB	IC	PC	RC	RM	BD	NL	ML	MH	CM^2	CM_3
PL	**.97**	**.78**	**.81**	.39	−.11	**.85**	**.74**	**.66**	**.89**	**.96**	**.78**	**.85**	**.84**
CB		**.72**	**.81**	.42	−.23	**.87**	**.76**	**.69**	**.89**	**.95**	**.76**	**.87**	**.88**
ZB			**.85**	**.71**	.22	**.85**	**.73**	.48	**.70**	**.80**	**.78**	**.64**	**.75**
BB				**.64**	.18	**.91**	**.81**	**.63**	**.83**	**.80**	**.84**	**.64**	**.70**
IC					**.74**	**.63**	**.63**	.40	**.57**	**.53**	**.70**	**.61**	**.70**
PC						.19	.36	.19	.11	.50	.32	.23	.27
RC							**.87**	.52	**.74**	**.79**	**.79**	**.66**	**.80**
RM								**.58**	**.62**	**.79**	**.88**	**.73**	**.72**
BD									**.53**	**.72**	**.73**	**.65**	**.55**
NL										**.83**	**.70**	**.77**	**.79**
ML											**.84**	**.90**	**.87**
MH												**.77**	.72
CM^2													**.95**

Table 6: Correlation matrice of dental measurements in Dalmatian jackals. Coefficients of correlation which are significant at p>0.05 are printed in heavy type. See also Fig. 3. For abbreviations see "Material and Methods".

	P^4B	M^1L	M^1B	M_2L	M_2B
P^4L	**.83**	**.75**	**.84**	**.80**	**.54**
P^4B		**.56**	**.72**	**.54**	.38
M^1L			**.71**	**.59**	.48
M^1B				**.86**	**.65**
M_2L					**.74**

References

ATANASSOV, N. (1953): Izsledvanija vrhu schakala (*Canis aureus* L.) v Blgariji (Untersuchungen über die Schakale (*Canis aureus* L.) in Bulgarien). – Bull. Inst. Zool. Acad. Sci. Bulg., Sofija; **2**: 189–273.

BRUSINA, S. (1892): Čagalj balkanski (*Canis aureus balcanicus* BRUS. n. form.) iz Slavonije. – Glasnik Hrvat. Naravoslovnog društva; **7**: 316–317.

CORBET, G. B. (1978): The Mammals of the Palaearctic Region: A taxonomic review. – British Museum (Nat. Hist.); London (Cornell Univ. Press).

DULIĆ, B. & MIRIĆ, D. (1967): Catalogus Faunae Jugoslaviae. IV/4 Mammalia. – Cons. Acad. Sci. SFRJ, Ljubljana.

EHIK, G. (1938): Sakal vagy nadifarkas Hazankoi (Jackal or Reed-wolf from Hungary). – Ann. Mus. Nat. Hung., Pars Zoologica, Budapest; **30**: 11–15.

ELLERMANN, J. R. & MORRISON SCOTT, T. C. S. (1966): Checklist of Palaearctic and Indian Mammals, 1758 to 1946. London (British Museum (Nat. Hist.))

FITZINGER, L. J. (1830): Ueber den Schakal Dalmatiens. – Isis; **1830**: 372–375.

HEPTNER, V. G. & NAUMOV, N. P. (1967): Mlekopitajoschie Sovetskogo Sojoza. II. Morskie korovi i hischnie. Moskva (Visschaja schola).

HILSON, S. (1986): Teeth. – Cambridge Manuals in Archeology. Cambridge (Cambridge Univ. Press).

HOSEY, G. R. (1982): The Bosporous Land-Bridge and Mammal Distributions in Asia Minor and the Balkans. – Säugetierk. Mitt.; **30**: 53–62.

JERIČEVIĆ, I. (1952): Čagalj (The Jackal). Savez lovačkih društava N. R. Hrvatske, Zagreb; pp. 5–31.

JOHNSON, C. E. (1934): Porcupine quills in a fox skull. – J. Mammal.; **15** (4): 319.

KERSCHNER, T. (1959): Der „Rohrwolf" von Erhagen bei Enns. – Jahrbuch des Österr. Arbeitskreises für Waldtierforsch.; **1959**: 40–46.

KOLENOSKY, G. B. & STANDFIELD, R. O. (1975): Morphological and ecological variation among gray wolves (*Canis lupus*) of Ontario, Canada. In: FOX, M. W. (Ed.): The wild canids. Their systematics, Behaviour, Ecology and Evolution. Behaviour Science Series. New York (Van Nostrand Reinhold Comp.) pp. 62–72.

KÜHN, W. (1935): Die dalmatinischen Schakale. – Z. Säugetierk.; **10** (3): 144–146.

MATVEJEV, S. (1961): Biogeografija Jugoslavije (Biogeography of Yugoslavia). Biol. institut N. R. Srbije, Beograd.

MEESTER, J. & SETZER, H. W. (1971): The Mammals of Africa. An identification manual. Washington, D. C. (Smithsonian Inst. Press).

MICHAHELLES, –. (1830): Ueber einige Dalmatinische Vertebraten, die zugleich im westlichen Asien vorkommen. – Isis; **1830**: 808–820.

MILENKOVIĆ, M. (1983): Jackal, *Canis aureus* LINNAEUS, 1758 (Mammalia, Canidae) in Eastern Serbia. – Proc. Fauna of S. R. Serbia, Beograd; **2**: 257–262.

— (1987): Rasprostranjenje šakala *Canis aureus* LINNAEUS, 1758 (Mammalia, Canidae) u Jugoslaviji. – Proc. Fauna of S. R. Serbia, Beograd; **4**: 233–248.

MILLER, G. S. (1912): Catalogue of the Mammals of Western Europe. London (British Museum (Nat. Hist.).

MOJSISOVICS, A. (1897): Das Thierleben der österreichisch-ungarischen Tiefebenen. Wien.

MORGAN, C. (1906): Der Schakal Dalmatiens. Eine Monographie. Wien.

MUNSELL SOIL COLOUR CHARTS (1975): Mackbeth Division of Kollmorgen Corp., Baltimore.

NOACK, T. (1907): Wölfe, Schakale, vorgeschichtliche und neuzeitliche Haushunde. – Zool. Anzeiger; **31**: 660–695.

OBOUSSIER, H. (1958): Zur Kenntnis der Wuchsform von Wolf und Schakal im Vergleich zum Hund. – Morpholog. Jahrb.; **99** (1): 65–108.

OSBORN, D. J. & HELMY, I. (1980): The contemporary land mammals of Egypt (including Sinai). – Field. Zool.; **5**: 1–579.

POCOCK, R. I. (1938): The jackals of S. W. Asia and S. E. Europe. – Proc. Zool. Soc., London; **108**: 37–39.

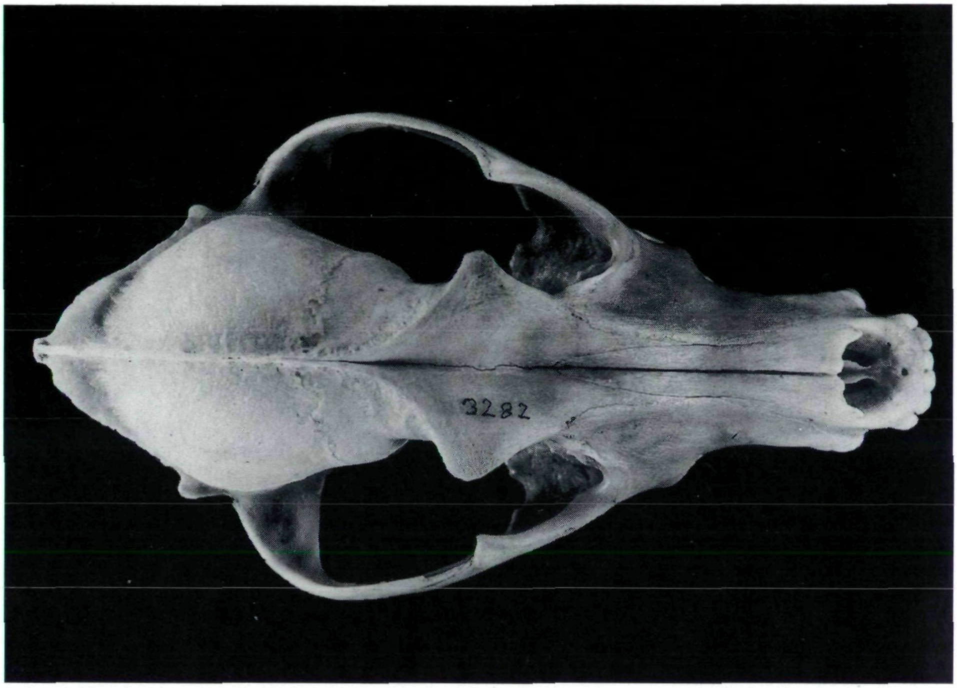

Fig. 7: Skull (in Norma dorsalis) of a male Dalmatian jackal (PMS 3282).

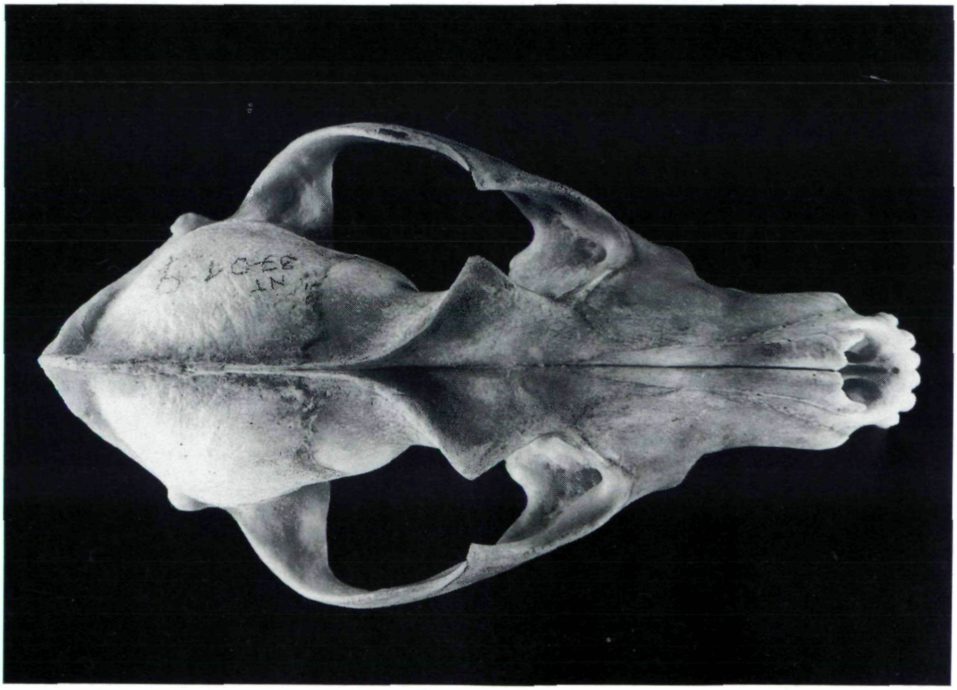

Fig. 8: Skull (in Norma dorsalis) of a female Dalmatian jackal (HPM 3701 NT).

RUPRECHT, A. L. (1974): Craniometric Variations in Central European Populations of *Ondatra zibethica* (LINNAEUS, 1766). – Acta theriol.; **19** (31): 463–507.

SZUNYOGHY, J. (1957): Systematische Revision des ungarländischen Schakals, gleichzeitig eine Bemerkung über das Rohrwolf-Problem. – Ann. Hist.-Nat. Mus. Nat. Hung.; **8**: 425–433.

TERENTJEV, P. V. (1943): Korrelacii indeksov ozernoj ljagoski *Rana ridibunda* PALL. – Zool. Zh.; **22** (5): 267–273.

WAGNER, J. A. (1841): Die Raubthiere. – Supplementum to: SCHREBER, J. Ch. D.: Die Säugetiere in Abbildung nach der Natur mit Beschreibungen. Erlangen.

ZIEGLER, P. (1969): The Black Death. Middlesex (Penguin Books), pp. 9–331.

YOM-TOV, Y. & GREEN, W. O. & COLEMAN, J. D. (1986): Morphological trends in the Common brushtail possum, *Trichosurus vulpecula,* in New Zealand. – J. Zool., London; (A) **208**: 583–593.

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