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Osteomorphological studies on the great sturgeon (*Huso huso* Brandt)

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ABSTRACT: Biometrical data on the overall size and bones from an individual of the great sturgeon are presented. The introduction of new osteological parameters is accompanied by a brief discussion over the sources of error implicit in predictive equations of size and weight of fishes based on isolated measurements of bones.

KEYWORDS: GREAT STURGEON, *HUSO HUSO*, SIZE, WEIGHT, MORPHOLOGY

RESUMEN: Se presenta información biométrica de huesos y tallas de un ejemplar de beluga capturado en Hungría. Además de incorporar nuevos parámetros osteológicos, el trabajo valora las fuentes de error implícitas en la confección de ecuaciones predictivas de longitud y peso corporal en peces a partir de medidas realizadas sobre los huesos.

PALABRAS CLAVE: BELUGA, *HUSO HUSO*, TALLA, PESO, MORFOLOGIA

INTRODUCTION

While the remains of large Acipenseridae are easy to recognize in archaeological sites due to their frequent recovery, size and peculiar morphology, the distinction between species within the genus *Acipenser* poses complex problems, even in living populations, because crossings between species occur quite frequently.

The reconstruction of total length for the European sturgeon (*Acipenser sturio* Linnaeus) was carried out by Lepiksaar & Heinrich (1977: 24) using the greatest width of the dentale. An osteological evaluation of Acipenseridae was published by Brinkhuizen (1986) who summarised information on this family for the purposes of archaeozoological research. In the same volume, Benecke (1986) presented an evaluation of sturgeon finds which included distribution of bony shields of various sizes.

In this paper metric information on the largest species in the Acipenseridae family, great sturgeon (*Huso huso* Brandt) is presented in the form of dissection data from one individual.

MATERIAL

At present, sturgeons are very uncommon in Hungary. Over the last century flood control projects and water transportation works resulted in a radical decline in this species both in the Danube and the Tisza rivers. The size of the individuals caught has also decreased quite dramatically (Figure 1). Since 1850, an 1.84 kg average yearly decrease in body weight has occurred as estimated using historical data published by Khin (1957: 18-23). Great sturgeon seems to have been considerably larger in the Danube than in the Tisza river. An adult female recently caught in the Danube near the town of Paks (arrow in Figure 1), weighting 181 kg, was transported to the Hungarian Agricultural Museum in 1987. This was the first individual ever dissected in the presence of an archaeozoologist (I.T.), so that its skeleton could be rescued for comparative purposes.

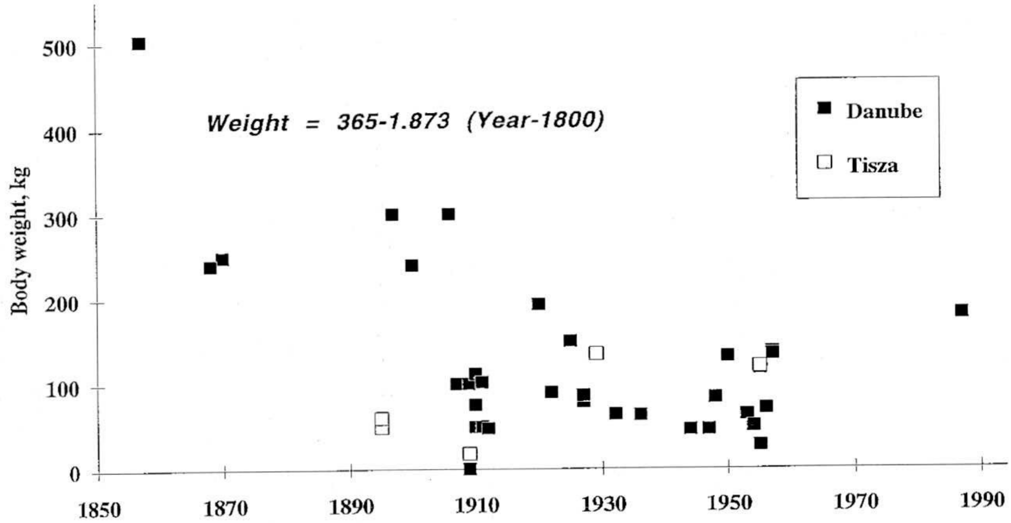
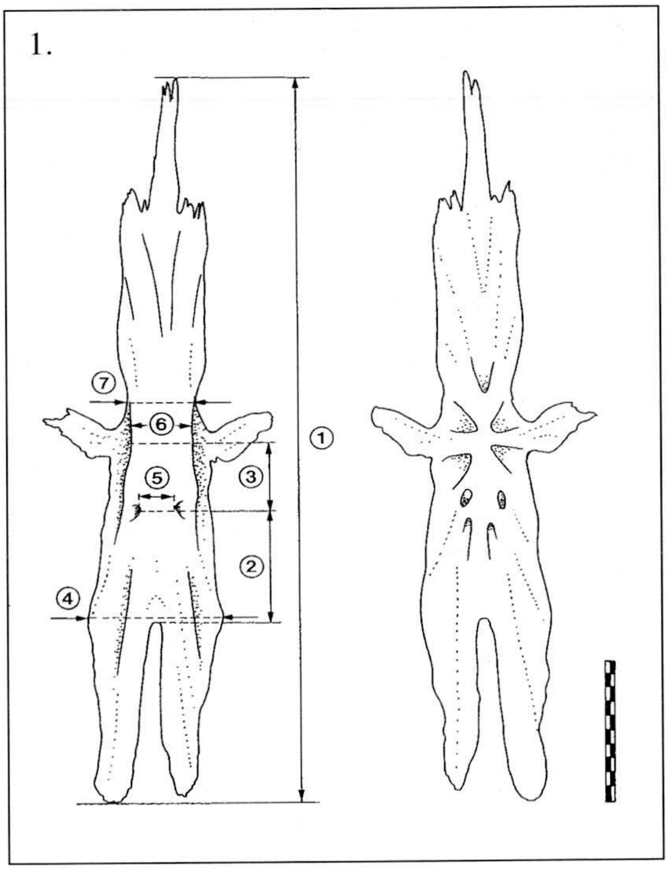


FIGURE 1
The decreasing tendency in the size of great sturgeon since 1850

METHODS

Measurements were taken both on the body as a whole (Table 1) and on the individual bones. This task was difficult due to the great variability in the appearance and state of preservation of the bones (even paired elements sometimes looked different from each other in this specimen). Thus, measurements defined in this paper were limited to a relatively few elements which survive more frequently in excavated samples and may be considered consistent in terms of shape (Figures 2-10). All widths are medio-lateral, while depths refer to cranio-caudal and dorso-ventral dimensions respectively, depending on the bone's position in the body.



Body weight data	kg	% of live weight
Live weight	181	100.0
Dead weight	174	96.1
Carcass weight (spine and meat)	100	55.2

TABLE 1
Overall weight data of the female great sturgeon caught near Paks, Hungary in 1987

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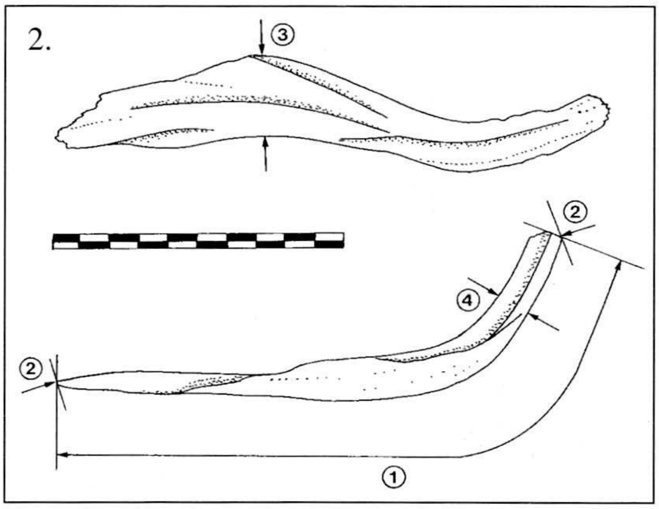

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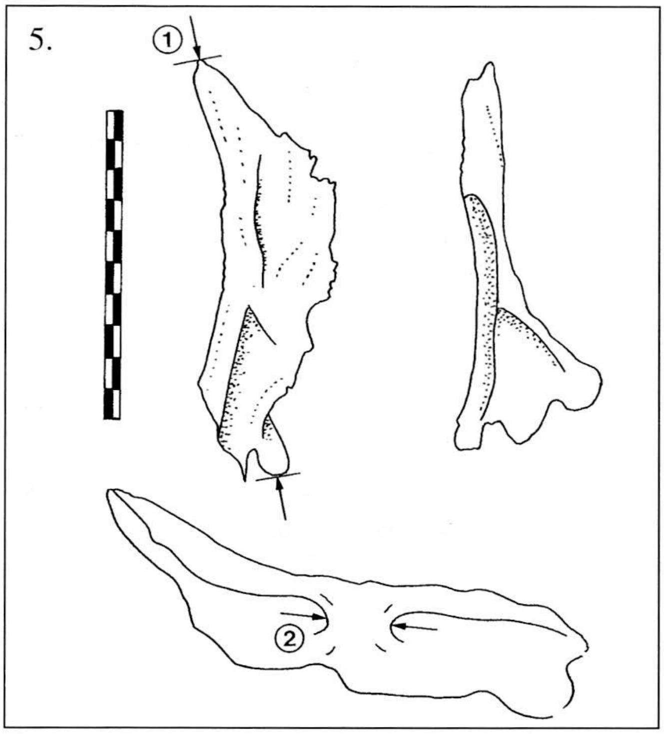

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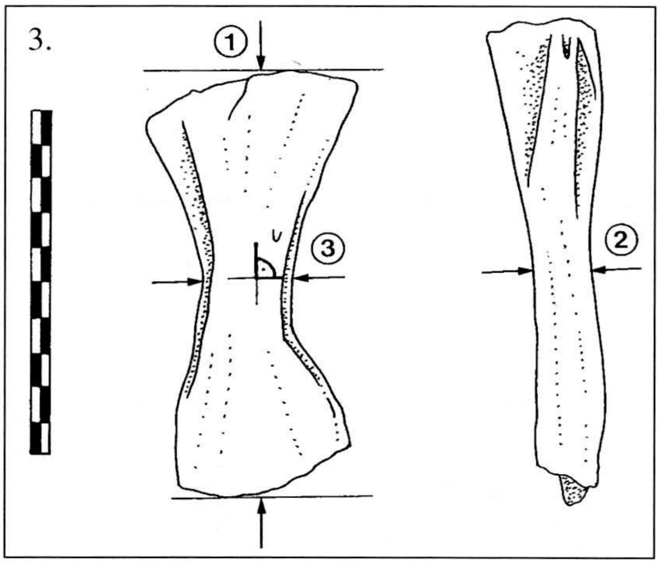

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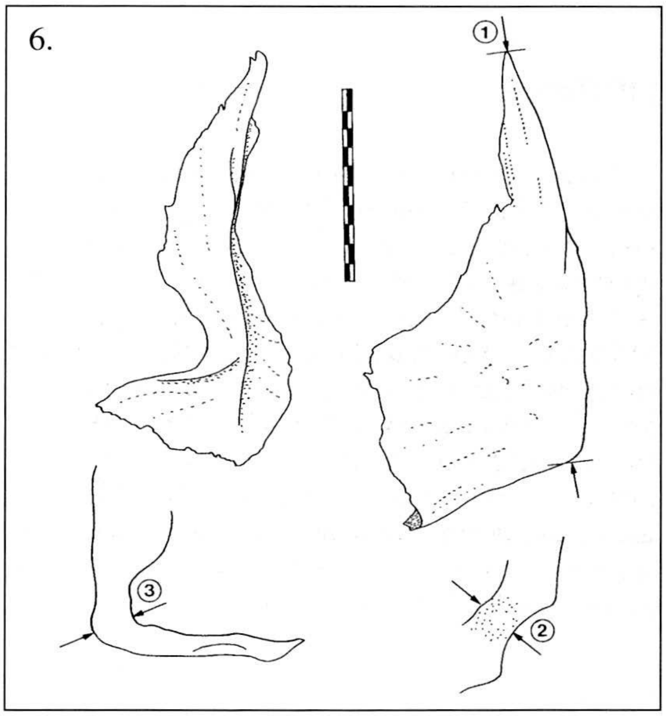

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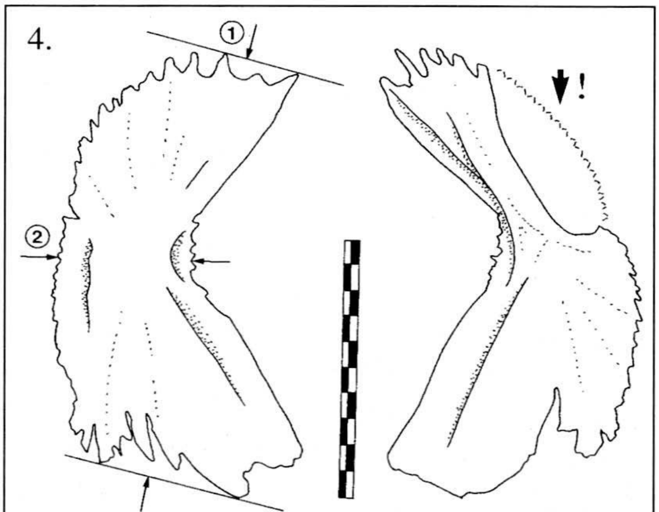
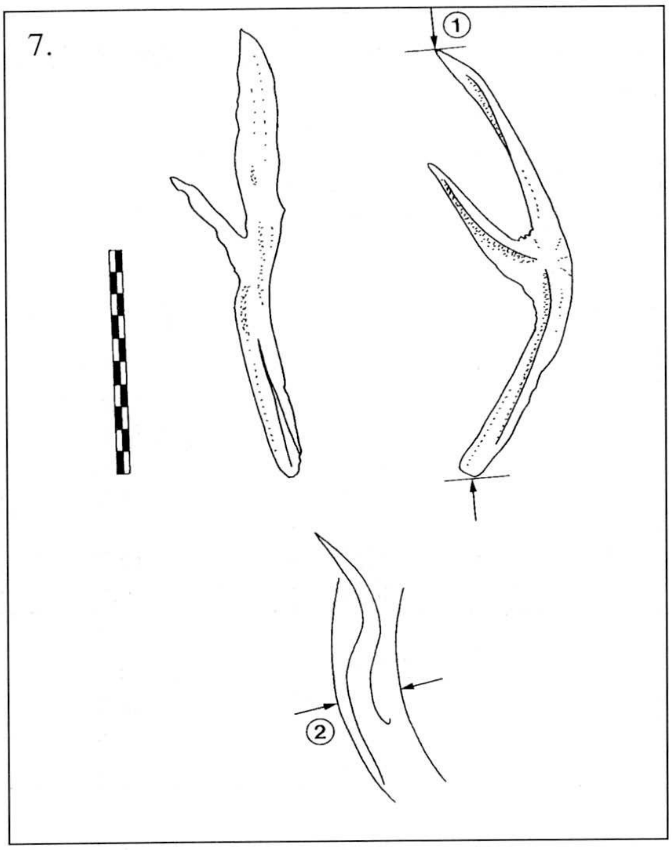




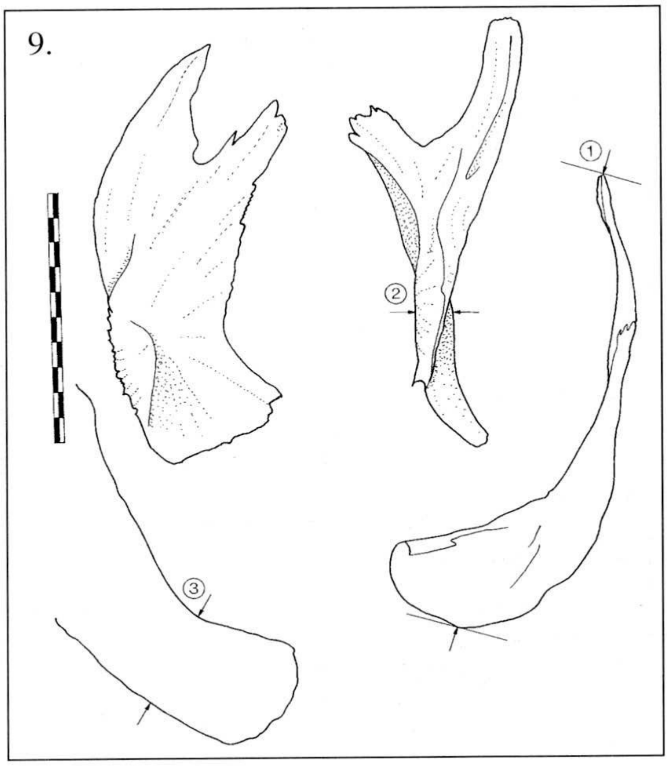
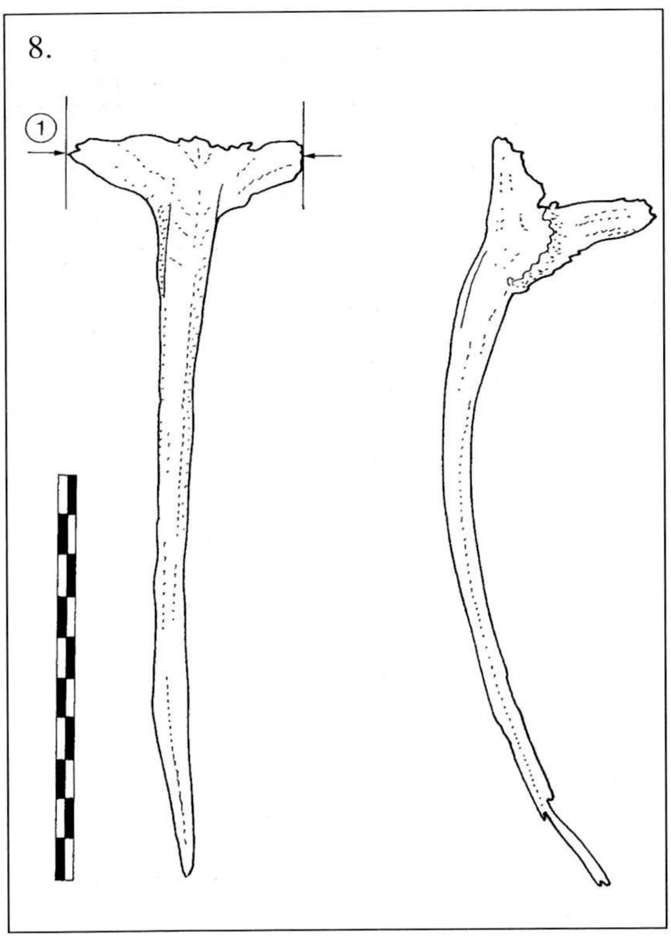


FIGURE 2 -10
For explanation see Table 2.



RESULTS

The measurements taken on the individual are summarized in Table 2. The definitions were developed using the relevant literature on the subject (i.e. Morales & Rosenlund, 1979) as well as through previous experience in studying skeletal elements of catfish (Takács, 1985, 1987). In addition to measurements, the applicability of each dimension is marked by an asterisk referring to the probability by which it occurs in a measurable state (** frequent, * available), and the proportion of these measurements to the individuals' total length (‰ expressed as a percentage).

While the data from a single specimen do not allow for more than the application of individual proportions in size reconstruction, they may be used as basic orientation concerning the size of animals represented in excavated materials. A few examples of this work are summarized in Table 3. Some additional, non-mensurable, elements are shown in Figures 11 and 12.

Measurement	Applicability	mm	‰ of total length
Total length		2800	1000.0
Standard length		2350	839. 3
1. Parasphenoideum			
1 Greatest length		480.0	171.4
2 Median distance between the oral end of aboral incision and the transversal line defined by the foramina	**	74.0	14.6
3 Median distance between the transversal lines defined by the foramina and protuberances respectively	**	45.0	16.1
4 Greatest width of corpus	*	89.0	31.8
5 Distance between the medial rim of foramina	*	21.0	7.5
6 Distance between the lateral points of protuberances	*	35.5	12.7
7 Smallest width of corpus	*	40.8	14.6
2. Dentale			
1 Length of the lateral arch	**	223.0	79.6
2 Greatest length	**	178.0	63.6
3 Depth of the corpus	**	27.5	9.8
4 Width of the corpus	**	14.0	5.0
3. Hyomandibulare			
1 Greatest length (perpendicular to «3»)	*	115.5	41.2
2 Midshaft width	**	15.0	5.3
3 Smallest depth	**	23.0	5.3
4. Suboperculare			
1 Greatest length	*	172.0	61.4
2 Greatest depth of the corpus	*	50.0	17.9
5. Praeoperculum			
1 Greatest length	*	122.5	43.8
2 Distance between incisions on median side	**	20.0	7.1
6. Cleithrum			
I Length to the ventral edge of tuber	*	185.0	66.1
2 Width of tuber	**	18.0	6.4
3 Depth of tuber	**	7.0	2.5
7. Praemaxillo-maxillare			
1 Greatest length	*	187.0	66.8
2 Greatest width of corpus perpendicular to arch	**	14.5	5.2
8. First pectoral spine (radiale)			
1 Greatest width of articular end	*	59.0	11.6
9. Palatopterygoideum			
1 Greatest length	*	62.0	57.9
2 Greatest depth of corpus	**	12.5	4.5
3 Smallest width of corpus	*	40.0	14.3

TABLE 2
Bone measurements of female great sturgeon caught in Hungary in 1987. (Bone codes correspond to the numbers in the upper left corners of Figures 2-10).

Site name and measurement	Bone measurement in mm	Estimated total length
Buda castle, Medieval		
8. First pectoral spine		
1 Greatest width of articular end	40	1.90 m
8. First pectoral spine		
1 Greatest width of articular end	50	2.37 m
Esztergom, Medieval		
6. Cleithrum		
2 Width of tuber	18.5	2.88 m
3 Depth of tuber	12	4.80 m
Mean value estimates:		**3.85 m**
KNJ, (Yugoslavia, Neolithic)		
Courtesy of Dr. Sándor Bökönyi		
1. Parasphenoideum		
3 Median distance between the transversal lines defined by the foramina and protuberances	40	2.48 m
5 Distance between the median rim of foramina	19.5	2.60 m
6 Distance between the lateral points of protuberances	45	2.21 m
Mean value estimates:		**2.43 m**

TABLE 3

Estimation of total length of sturgeon from archaeological bone assemblages.

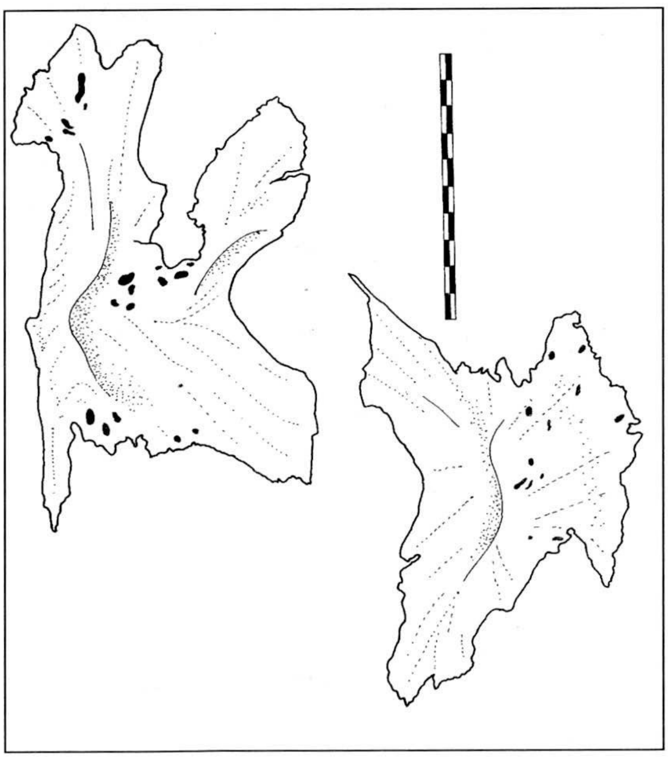


FIGURE 11

Claviculare.

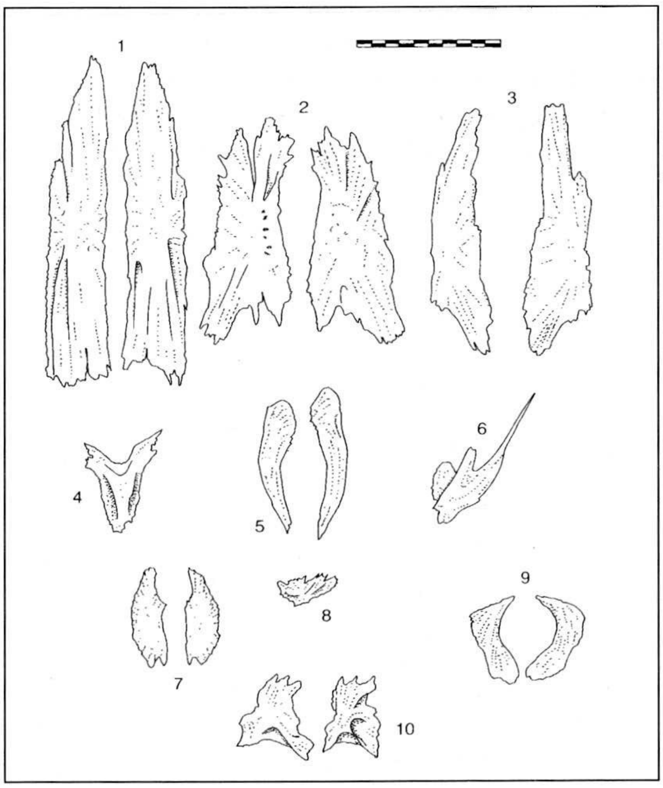


FIGURE 12

Skeletal elements not listed in Table 2. 1 = parietale, 2 = frontale, 3 = supratemporo-intertemporale, 4 = occipital lateral plate, 5 = postcleithrale, 6 = postemporale, 7 = articulare, 8 = infraorbitale, 9 = quadratojugale, 10 = branchyostegalia.

DISCUSSION

While metric traits observed on a single individual do not allow for a reliable reconstruction of size of great sturgeon in archaeozoological assemblages, our data might be better appreciated in the context of complementary observations.

If one looks at the relationship between body weight and total length of great sturgeon (record individuals listed by Khin in 1957) a faster relative growth seems evident (Figure 13). Such growth, however, is in fact slower than longitudinal growth if the dimensional difference between these two measurements is taken into consideration (a b<3 allometric coefficient was obtained).

The number of data points in Figure 13 was, nevertheless, too reduced to assume considerable sexual dimorphism in these gross descriptors of size. Such differences have not been mentioned in the literature either (Berinkey, 1966: 217; Maitland & Linsell, 1977: 28; Pintér, 1989: 24).

While the allometric growth of linear dimensions in fish is widely assumed to display isometry (b=1; Horn, 1976: 199), a number of exceptions might be expected. Aside from observations made on other species (Bartosiewicz, 1990), a comment made by Pintér (1989: 24) that the nasal part of the great sturgeon becomes relatively shorter with increasing age is particularly worth mentioning.

Finally, proportions published here should be applied with care due to a potential mathematical bias. Since almost all bone measurements recorded on this skeleton are, by definition, taken on small parts (which are expected to be better preserved; Binford & Bertram, 1977: 96), even in the case of a series of individuals, the regression between these and any of the gross size descriptors (live weight or body length) could be distorted. Small bone measurements, although normally distributed, would display different standard deviations since their growth is, by definition, proportionally smaller than the increase in body length. On the other hand, the difference between relative standard deviations (coefficients of variation) may be the reason behind the observations by Tsepkin & Sokolov (cited by Brinkhuizen, 1986: 21) that in the case of *Acipenser gueldenstaedti* body length could be better predicted by using the width of the pectoral spine's articular head than the length of the same bone. Thus, while proportions of bone measurements to body length published here may be used in reconstructing length to be later turned into live weight (in kilograms) using the relative growth curve shown in Figure 13, such results should be always taken with caution for inferential purposes.

Since the presentation of this paper, additional measurements have been defined on the bones of *Acipenser sturio* (L. 1758) by Desse-Berset (1994: 87-89).

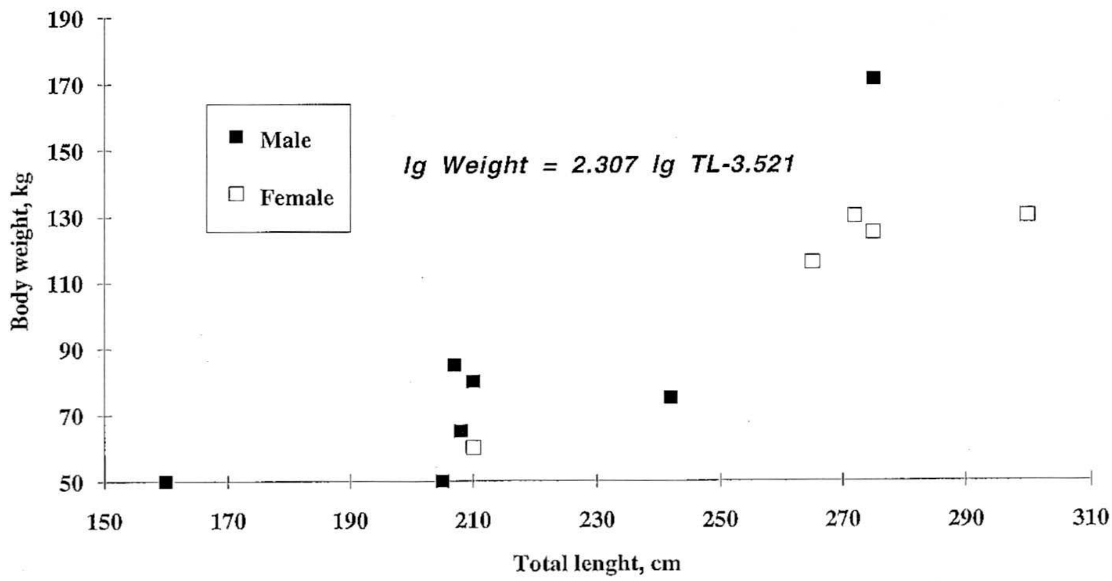


FIGURE 13
Sexual dimorphism in body dimensions.

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REFERENCES

BARTOSIEWICZ, L. 1990: Allometric investigations on the skeleton of pike (*Esox lucius* L.1758). *Aquacultura Hungarica* VI: 25-34.

BENECKE, N. 1986: Some remarks on sturgeon fishing in the southern Baltic region in Medieval times. In: Brinkhuizen, D.C. & Clason, A.T. (eds.): *Fish and Archaeology*: 9-10. B.A.R. (International Series) 294, Oxford.

BERINKEY, L. 1966: *Fish - Pisces* (in Hungarian). Fauna Hungariae XX/2, Akadémiai Kiadó, Budapest.

BINFORD, L. R. & BERTRAM, J. B. 1977: Bone frequencies and attritional processes. In: Binford, R.L. (ed.): *Background studies for theory building in Archaeology*: 77-153. Academic Press, New York.

BRINKHUIZEN, D. C. 1986: Features observed on the skeletons of some recent European Acipenseridae: their importance for the study of excavated remains of sturgeon. In: Brinkhuizen, D.C. & Clason, A.T. (eds.): *Fish and Archaeology*: 18-33. B.A.R. (International Series) 294, Oxford.

DESSE-BERSET, N. 1994: Sturgeons of the Rhône during Protohistory in Arles (6th - 2nd century B.C.). In: van Neer, W. (ed.): *Fish Exploitation in the Past*: 81-90. *Annales du Musée Royal de l'Afrique Centrale, Sciences Zoologiques* 274, Tervuren.

HORN, A. 1976: *Animal Breeding* 1. (in Hungarian). Mezögazdasági Kiadó, Budapest.

KHIN, A. 1957: *The history of great sturgeon in Hungary* (in Hungarian). Mezögazdasági Muzeum Füzetei 2, Budapest.

LEPIKSAAR, J. & HEINRICH, D. 1977: *Untersuchungen an Fischresten aus der frühmittelalterlichen Siedlung Haithabu.* Berichte über die Ausgrabungen in Haithabu 10, Neumünster.

MAITLAND, P. S. & LINSELL, K. 1977: *The Hamlyn Guide to the Freshwater Fishes of Britain and Europe.* Hamlyn, London.

MORALES, A. & ROSENLUND, K. 1979: Fish Bone Measurements. *Steenstrupia*, Copenhagen.

PINTÉR, K. 1989: *The Fishes of Hungary* (in Hungarian). Akadémiai Kiadó, Budapest.

TAKÁCS, I. 1985: Studies on the skeleton of catfish (*Silurus glanis* L.) (in Hungarian). *A Magyar Mezögazdasági Múzeum Közleményei* 1984-1985: 45-77.

TAKÁCS, I. 1987: Aid to the estimation of size from commonly occurring subfossil elements of catfish (in Hungarian). *A Magyar Mezögazdasági Múzeum Közleményei* 1986-1987: 105-126.