A C T A I C H T H Y O L O G I C A E T P I S C A T O R I A

Abbrev.: Acta Icht. Piscat. 30 (1): 135–150, Ann. 2000

Jarosław *FILIPIAK*, Zygmunt *CHEŁKOWSKI*

Fish anatomy

OSTEOLOGICAL CHARACTERISTICS OF FISH REMAINS FROM EARLY MEDIEVAL SEDIMENTARY LAYERS OF THE PORT IN THE TOWN OF WOLIN

CHARAKTERYSTYKA OSTEOLOGICZNA SZCZĄTKÓW RYB Z WCZESNOŚREDNIOWIECZNYCH WARSTW OSADNICZYCH PORTU W WOLINIE

Department of Fisheries in Inland Waters, Agricultural University of Szczecin, Poland

In seventeen early medieval sedimentary layers of the port of the town of Wolin, corresponding chronologically with the time period from the beginning of the 9th till the middle of the 13th century, the occurrence of 3 537 bone remains was stated, of which 2 784 pieces had their anatomy determined. In the identified archaeological material 33 types of bones were found, belonging to 15 species of teleost fishes, as well as 4 kinds of common sturgeon remains (*Acipenser sturio*). The bones of viscerocranium, mainly of zander (*Stizostedion lucioperca*), bream (*Abramis brama*), and perch (*Perca fluviatilis*), were dominant (57.23%).

INTRODUCTION

After World War II, a number of archaeological sites from the early medieval period, situated around the Szczecin Lagoon and in the city of Szczecin were explored. Fairly large amounts of fish remains were found there, in the form of bones and scales. For various reasons only an insignificant part of the ichthyological findings had been studied in the terms of anatomy and specific identity (Chełkowski 1959, 1960, 1965). The area of the town of Wolin and the grounds around it, at present as well as in the past, have been the terrain of long-term, intensive archaeological exploration, not only in the cognitive sense. The first preliminary information on the composition of ichthyofauna found in this area in early me-

dieval times was provided by Kaj (1952–1953). This information was limited only to two small archaeological sites, and Kaj analysed only 21samples delivered to him by archaeologists. Much of the later excavation work that encompass the area of the old town of Wolin, provided archaeologists with ichthyological material, which has not been hitherto studied in a broader sense by specialists even till the present. The extensive and, judging from the results, interesting excavation project in Wolin, which in the years of 1977–1985 was conducted by the Institute of Archaeology and Ethnology of the Polish Academy of Science. From the early medieval, sedimentary layers of one of the areas of exploration, defined in the archaeological nomenclature as: site No. 1, excavation No. 8 (port) many remains of material culture were recovered—ceramics (Stanisławski 1998), "amber items" (Wojtasik 1986), as well as the debris of plant and animal origin including some ichthyological debris in the form of bones, less often scales. The name "Port" had been assigned to this excavation site because of the wooden structures of the early medieval landing pier that was found in it (Filipowiak 1994).

The aim of this work was to present the study results concerning the composition of the anatomically identified bone remains of the fishes from different layers in excavation number 8, as well as to compare them with different areas of the Baltic region on which similar archaeological studies were conducted. It should be emphasised that the data pertaining to assignment of particular bones to respective fish species, the structure of the fish occurrence in the individual sedimentary layers, as well as other research aspects (e.g. relating to the weight of individual fishes) had been presented in a separate publication (Chełkowski et al. 1999).

Location and characteristics of the excavation site

The archaeological excavation from which the analysed fish remains were recovered, is situated on the Wolin Island, in the area of the old town of Wolin, in a distance of about 60 meters from the west bank of the Dziwna River (Fig 1). This river is one of the three outlet branches of the Odra River estuary to the Baltic Sea. The excavation covered an area of 100 m^2 (5 × 20 m) and stretched to the bedrock that lies on the depth of 7 m (Stanisławski 1998). The fish remains were extracted from 17 sedimentary layers labelled by symbols from III to XIX (Tab. 1). The total thickness of all of those layers was 5.58 m, and their individual thickness varied from 10 cm (VII) to 71 cm (XIX). These layers correspond chronologically with the time period from the mid 8^{th} century (layer III) to the beginning of the 9^{th} century (layer XIX) (Ważny and Ecstein 1987; Filipowiak 1994; Pazdur et al. 1994).

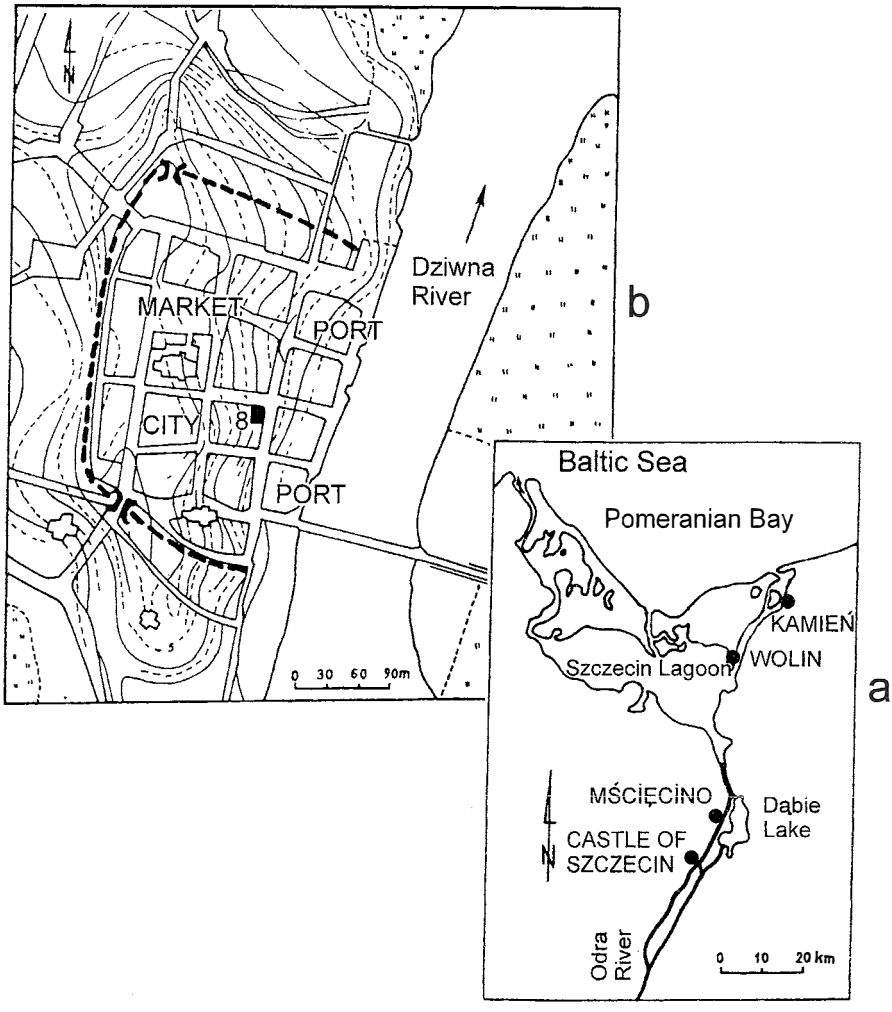

Fig. 1. Location of the city of Wolin within the Odra River estuary (a) and the archeological site (site 1, excavation 8) in the Wolin-Port (b)

Table 1

Characteristics of early medieval settlement layers and samples of ichthyological remains in Wolin-Port

No.	Layer	Layer thickness [cm]	Layer dating (year, century)	Quantities of archaeoichthyological items found			
				osseous	osseous and scales	scales	total
1	III	25	1253	2	1	—	3
2	IV	27	XIII	9	4	—	13
3	V	28		9	3	—	12
4	VI	19		7	1	1	9
5	VII	10		6	8	—	14
6	VIII	45		3	1	—	4
7	IX	36		11	6	1	18
8	X	19		8	5	1	14
9	XI	41		23	5	—	28
10	XII	27		14	4	—	18
11	XIII	27		7	5	—	12
12	XIV	37		10	—	—	10
13	XV	28		8	1	—	9
14	XVI	50		5	5	—	10
15	XVII	36	880-890	4	2	—	6
16	XVIII	32	IX	1	—	—	1
17	XIX	71	IX	1	—	—	1
Total				128	51	3	182
River mud							

MATERIAL AND METHODS

In 1998 the Archaeological Laboratory of the Institute of Archaeology and Ethnology (Polish Academy of Sciences) in Wolin made the ichthyological material which included 182 collections (in this number 128—consisting of bones alone, 58—constituting mixtures of bones and scales, and 3—composed of scales) accessible to the present authors. The number of collections in individual sedimentary layers was different and varied form 1 in the oldest layers (XVIII and XIX) to 28 (layer IX) (Tab. 1).

In anatomical respect, the identity of individual bones and their parts was determined with unaided eye or under magnification × 2.5. A comparative material consisting of several complete skeletons of fish species presently occurring in the Odra River estuary was used to facilitate the identification process. For most of these species a number (5–6) of skeletons was at the authors' disposal representing individuals of diversified individual weight. This in a significant way made the anatomical identification of a given bone easier. In the analysed collections of bone and bone remains the quantities of the anatomically and specifically identified bones were registered. Also the quantities of the undefined bone remains lacking distinct characteristics were recorded. Determination of the specific identity

of the remains of the common sturgeon (*Acipenser sturio*) was based on two museum specimens of this fish deposited in the Department of the Fish Systematics, Agricultural University of Szczecin. The identification process of the archaeological material was aided by many sources (Suvorov 1948; Janec-Susłowska 1957; Horoszewicz 1960; Grodziński 1961; Susłowska 1968; Baruš and Oliva 1995). The systematic arrangement of fishes used in this work follows that of Brylińska (1986).

RESULTS

Within the whole archaeological excavation analysed (No. 8, Port) a total of 3 537 osteological remains in different states of preservation was found and examined, of which 2 584 bones (73.06%) were identified anatomically and 953 (26.94%), because of considerable damage, were left undetermined. The later were not covered in the statistical analyses of this paper. It is evident from the data in Tabs. 2a and 2b that in the archaeological material studied a total of 33 anatomical types of teleost bones and 5 types of common sturgeon remains were identified. The teleost bones represented 15 fish species while common sturgeon remains represented two bones proper (*operculum* and *ossa cranium*) and 3 elements of the external skeleton (so called fulcra, *lepidotrichia*, and bone shields). Amongst 17 layers of Wolin port's sedimentary stratigraphy, the highest number of bones was determined in layer IV (648 of which 462 determined anatomically) and XIII (375 and 268 respectively). The lowest number of bones was recovered from two oldest layers: XVIII (5) and XIX (16). The former comprised 2 undetermined bones, while the latter—only 1. It is also worth mentioning that the bone shields of sturgeons appeared in all of the sedimentary layers, and their number was diverse and varied from 1 in layer IX to 40 in layer XI. From the remaining bones (belonging to teleost fishes) the highest frequency of occurrence was represented by *praeoperculum*, *cleithrum*, and *operculum* (not found only in the last layer), as well as *parasphenoideum* and *praeoperculum* (which did not occur in two layers). Also quite frequent findings (except for 3 layers) were *dentale*, *ectopterygoideum*, and *maxillare* (Tabs. 2a, 2b). Of the remaining bones the least frequent, because found only in one layer, was the *alisphenoideum* (IX) and *scapula* (XVI). *Coracoideum* and *interspinale* bones are very rare, and found only in three layers. Summing up: different sedimentary levels differed, in a significant way, in number of bones found (and fish species), as well as in frequency of the occurrence of different kinds of remains.

Table 2a

Occurrence frequency of anatomically determined fish bones
from early-medieval layers III–XI in Wolin-Port

Bone type	Settlement layers								
	III	IV	V	VI	VII	VIII	IX	X	XI
Alisphenoideum	—	—	—	—	—	—	2	—	—
Articulare	2	14	2	3	—	1	11	3	10
Ceratohyale	2	9	6	—	2	—	5	2	7
Cleithrum	9	60	14	12	8	4	27	32	24
Coracoideum	1	—	—	—	—	—	—	1	—
Costae	—	10	4	2	1	—	4	5	7
Dentale	1	24	8	5	4	—	11	14	15
Ectopterygoideum	1	5	4	2	2	3	4	7	6
Epihyale	1	—	1	—	—	—	—	—	—
Frontale	1	6	3	—	2	—	6	5	17
Hyomandibulare	—	12	1	—	2	—	8	—	1
Interoperculum	—	17	8	6	3	—	4	4	10
Interspinale	—	—	—	—	—	—	—	—	1
Lepidotrichia	2	15	6	—	2	—	10	15	7
Maxillare	1	18	3	1	5	—	8	6	10
Metapterygoideum	—	1	—	—	—	—	—	—	2
Operculum	2	84	19	9	6	2	13	12	16
Os pubis	—	2	1	—	—	—	1	1	1
Palatinum	1	—	—	—	—	—	1	—	2
Parasphenoideum	5	26	13	3	3	4	15	20	30
Pharyngeum	2	24	3	1	—	1	4	1	—
Postcleithrum	—	—	—	—	—	—	—	—	—
Posttemporale	—	2	—	1	—	—	—	—	1
Praemaxillare	—	8	—	1	1	3	1	7	3
Praeoperculum	6	97	22	7	7	1	31	25	36
Quadratum	1	6	—	—	—	—	2	2	2
Radii branchiostegi	3	1	1	—	3	—	5	4	7
Scapula	—	—	—	—	—	—	—	—	—
Suboperculum	—	10	—	1	2	—	2	1	1
Supracleithrale	—	—	—	—	—	—	—	—	—
Urohyale	—	3	2	—	—	—	—	1	2
Vertebrae	—	2	1	—	1	—	3	2	1
Vomer	—	2	—	—	—	—	—	1	—
Sturgeon remains									
Fulcra	—	—	—	—	—	3	1	7	—
Ossa cranium	—	2	5	—	1	3	—	6	2
Operculum	—	—	—	—	—	—	—	1	1
Lateral belt shields	2	2	5	2	5	3	1	21	40
Total	43	462	132	56	59	25	182	200	268

Table 2b

Occurrence frequency of anatomically determined fish bones
from early-medieval layers XII–XIX in Wolin-Port

Bone type	Settlement layers							
	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX
Alisphenoideum	—	—	—	—	—	—	—	—
Articulare	6	7	5	6	5	5	—	—
Ceratohyale	1	4	5	2	5	4	—	—
Cleithrum	16	33	30	8	26	20	1	—
Coracoideum	—	—	—	—	—	—	—	—
Costae	4	5	3	3	9	5	—	—
Dentale	9	19	9	6	11	9	—	—
Ectopterygoideum	4	7	3	—	6	1	—	—
Epihyale	—	3	1	—	4	2	—	—
Frontale	3	5	4	1	5	2	—	—
Hyomandibulare	2	3	5	1	3	1	—	—
Interoperculum	8	9	3	4	7	3	—	—
Interspinale	—	1	1	—	—	—	—	—
Lepidotrichia	15	7	5	—	3	2	—	—
Maxillare	4	10	9	2	3	3	—	—
Metapterygoideum	1	2	—	1	—	—	—	—
Operculum	20	35	24	5	12	12	—	1
Os pubis	1	2	3	—	—	—	—	—
Palatinum	2	1	2	—	—	1	—	—
Parasphenoideum	11	5	11	4	13	9	—	—
Pharyngeum	4	12	14	4	8	8	—	—
Postcleithrum	1	1	1	—	1	—	—	—
Posttemporale	1	—	—	—	1	1	—	—
Praemaxillare	3	3	4	4	2	4	—	—
Praeoperculum	21	51	22	17	30	13	—	—
Quadratum	2	2	—	2	4	—	—	1
Radii branchiostegi	9	5	3	2	8	5	—	—
Scapula	—	—	—	—	1	—	—	—
Suboperculum	2	8	1	—	5	3	—	—
Supracleithrale	1	—	—	—	1	—	—	—
Urohyale	1	3	—	3	4	4	—	—
Vertebrae	1	—	3	1	13	2	1	—
Vomer	1	1	—	—	—	—	—	
Sturgeon remains								
Fulcra	—	2	2	2	—	—	—	—
Ossa cranium	2	5	11	11	3	3	—	—
Operculum	—	—	2	—	—	—	—	—
Lateral belt shields	35	6	17	20	30	21	3	14
Total	191	267	203	107	225	143	5	16

Table 3

Quantities of respective bone groups of fishes from early-medieval layers of Wolin-Port

Fish species	Neuro-cranium bones	Viscero-cranium bones	Bones of pectoral girdle and pelvic girdle	Rema-ining items*	Total
Acipenser sturio	54	4	—	246	304
Clupea harengus	—	10	—	—	10
Salmo trutta m. *trutta*	—	—	—	2	2
Esox lucius	1	30	17	—	48
Rutilus rutilus	—	114	21	1	136
Leuciscus idus	—	8	—	—	8
Aspius aspius	—	8	2	1	11
Tinca tinca	—	6	5	—	11
Abramis brama	3	390	97	50	540
Abramis, ballerus	—	1	—	—	1
Vimba vimba	—	—	2	—	2
Silurus glanis	—	1	5	1	7
Anguilla anguilla	—	4	12	—	16
Stizostedion lucioperca	229	712	146	82	1 169
Perca fluviatilis	16	207	44	48	315
Acerina cernua	—	3	1	—	4
Total	303	1 498	352	431	2 584

* bony shields, *fulcra* and skull bones of sturgeon, *vertebrae*, *costae*, *interspinale*, and *lepidotrichia*

To better illustrate the structure of the bone material analysed, all identified items were divided into 4 general groups listed in Tab. 3. Of the total number of the anatomically determined osteological remains only 303 (11.7%) represented neurocranium. The dominant items of this group (consisting of 5 types of bones) were *parasphenoideum* (182 pieces) and *frontale* (60 pieces). A similar low share (13.6%) was stated in the second group of bones—making up the skeleton of the pectoral girdle (6 kinds of which were found) and pelvic girdle (only one kind was determined—*os pubis*). Amongst them the dominant one was *cleithrum* (324 pieces, which, in reference to the whole group amounted to 92.0%). The share of the bones referred to as "the remaining" (that make up the axial skeleton) was slightly higher and amounted to 16.7%, most of which (227 pieces) were identified as bone shields of sturgeon and *lepidotrichia* representing other fish species (Tab. 4). It should also be emphasised, that the majority of the bones in the osteological material from excavation No. 8 (1 498 pieces), as well as their anatomical types (17), came from viscerocranium. Amongst them dominated: *praeoperculum*, *operculum*, as well as *dentale*, which, along with *pharyngeum*, *interoperculum*, and *articulare* amounted to 41% of all anatomically determined elements of skeletons of 16 fish species from the archeologically explored area of the early medieval Wolin port (Tab. 4). It should also be emphasised that from the total number of 2 584 bones, only 709 (27.4%) belonged to 7 cypryniform fish species, particularly the common bream. The remaining 1 561 pieces (60.4%) were the bones of predatory fishes (also 7 species were

identified), among which the remains of zander were dominant (1 169 pieces). A total of 304 remains (11.8%) belonged to common sturgeon, and only 10 (0.03%) bones represented a single, typically marine species—the herring (Tab. 3).

DISCUSSION

Archaeozoology as a scientific field covering investigations on animal remains, especially their osteological remains, generates information on the subject of the species and the groups, enabling determination of the generally comprehended economical activity of humans pertaining to the breeding or the acquisition of animals, or allowing to assess the qualitative state of free-living species in the given region (Makowiecki 1993). The effectiveness of these studies is dependent above all on the precision of exploration of the given excavation site (e.g. the usage or lack of usage of technique of sieving layers), the state of preservation of the remains found. These factors in a significant way determine the percentage of anatomically determined remains and indirectly the number of species and quantities of specimens (Marciniak 1996). The archaeological identification of the fish bone remains, more difficult compared to warm-blooded animal remains (i.e. because of a higher level of their accumulation in a given site, the fragility of their structure, and decreased resistance to destruction) was in most cases aimed at determination the specific structure and the total weight of the fishes caught by the people of that time. This assumption is justified only when the archaeological excavation is situated in an adequate distance from the rim of the former body of water. In the case of the archaeological exploration conducted in the area where the land presently or previously met the water (e.g. in former ports), it is hard to state clearly, at what extent the specific composition of the ichthyofauna, determined based on the examination of the bone and scale remains found, represents the affect of the former "fishing" and trade human activity, and at what extent it shows the true picture of the old natural environment (i.e. the true structure of the fish population resulting above all from "natural" mortality of the fishes in the studied area. The archaeological excavation in Wolin covered the area of the old, early medieval port and the bone remains were found in typical cultural layers, in which a significant number of ceramic, plant- and animal origin remains, as well as the remains of the former wooden landing pier. Only the two oldest layers were made up of river mud (Stanisławski 1998). In the light of the above-mentioned observations, the ichthyological remains identified by us were not the effect of "natural mortality" but probably were the typical food remains of the former people.

Table 4

Occurrence frequency of anatomically determined fish bones found in Wolin-Port and in other archaeological sites

Bone type	Archeological sites							
	Wolin - Port		Gdańsk (Susłowska 1968)		Russia (Lebedev 1960)		Szczecin (Chełkowski 1959)	
	number	%	number	%	number	%	number	%
Alisphenoideum	2	0.09	—	—	—	—	—	—
Articulare	80	3.51	231	3.31	226	2.31	34	5.76
Basioccipitale	—	—	—		—		3	0.51
Ceratohyale	54	2.37	165	2.37	203	2.08	17	2.88
Cleithrum	324	14.21	1241	17.80	2046	20.96	106	17.97
Coracoideum	2	0.09	—	—	—		1	0.17
Costae	62	2.72	—	—	—		5	0.85
Dentale	145	6.36	550	7.89	834	8.54	59	10.00
Ectopterygoideum	55	2.41	172	2.47	107	1.10	13	2.20
Epihyale	12	0.53	—	—	—	—	—	
Frontale	60	2.63	97	1.39	124	1.27	10	1.69
Hyomandibulare	39	1.71	299	4.29	786	8.05	13	2.20
Interoperculum	86	3.77	386	5.54	789	8.08	6	1.02
Interspinane	3	0.13	—	—	—	—	5	0.85
Lepidotrichia	89	3.90	—	—	—	—	21	3.56
Maxillare	83	3.64	294	4.22	151	1.55	31	5.25
Metapterygoideum	7	0.31	17	0.24	—	—	2	0.34
Operculum	272	11.93	1249	17.92	1726	17.68	44	7.46
Os pubis	12	0.53	—	—	—	—	1	0.17
Palatinum	10	0.44	61	0.87	51	0.52	3	0.51
Parasphenoideum	182	7.98	319	4.58	211	2.16	48	8.14
Pharyngeum	86	3.77	153	2.20	71	0.73	18	3.05
Postcleithrum	4	0.17	—	—	—	—	—	—
Posttemporale	7	0.31	11	0.16	6	0.06	—	—
Praemaxillare	40	1.75	94	1.35	36	0.37	3	0.51
Praeoperculum	386	16.93	1370	19.65	2040	20.90	56	9.49
Quadratum	24	1.05	72	1.03	84	0.86	9	1.52
Radii branchiostegi	56	2.46	—	—	—	—	—	—
Scapula	1	0.04	—	—	—	—	—	—
Suboperculum	36	1.58	108	1.55	119	1.19	7	1.19
Supracleithrale	2	0.09	—	—	—	—	—	—
Urohyale	23	1.01	42	0.60	151	1.55	3	0.51
Vertebrae	31	1.36	—	—	—	—	71	12.03
Vomer	5	0.22	40	0.57	4	0.04	1	0.17
Total	2280	100.0	6971	100.00	9762	100.00	590	100.00
Lepidotrichia	8	2.63			?	?		
Fulcra	11	3.61	—	—	?	?	2	2.00
Ossa cranium	54	17.70	4994	—	?	?	53	53.00
Lateral belt shields	227	74.67	—	—	?	?	36	36.00
Other*	—	—	—	—	—	—	9	9.00
Total	304	100.00	4994	100.00	b.d.	b.d.	100	100.00

* *mesetmoideum* (1), *parietale* (2), *sphenoticum* (2), *pteroticum* (2), *prooticum* (2)

In the entire analysed osteological material from Wolin, the share of the anatomically determined fish remains was high and did not differ much from that observed in the early medieval sedimentary layers of Gdańsk—70% (Susłowska and Urbanowicz 1967), Wrocław—65.12% (Kozikowska 1974), Szczecin—73.48% (Chełkowski 1959), or the Kołobrzeg region—68.32% (Chełkowski and Chełkowska 1964). From the comparison of our own study, the results of earlier mentioned authors (Tab. 4), as well as the ones conducted in Russia by Lebedev (1960), it can be concluded that, regardless of the excavation site, the dominant components of the analysed osteological material of teleost fishes were: *praeoperculum*, *cleithrum*, and *operculum*, as well as in a smaller degree—*dentale* and *parasphenoideum*, thus mostly viscerocranial bones. Probably apart from the favourable environmental factors that enabled their survival in large numbers in the archaeological layers (e.g. the lack of oxygen and the close to neutral pH of the deposit). Some of structural characteristics of these bones, such as: the considerable solidity and density of the bone tissue, as well as their relative size, also had effect on that (Marciniak 1996). At the same time due to the very clear diagnosis characteristics, the identification of these bones even in the fragmentary state was fairly easy. This also undoubtedly had an influence on their significant share in relation to all of identified bone remains. It should be emphasised that in the analysed material a large number of ribs and vertebrae were found. For the reason of their significant level of destruction and the lack of clear, characteristic diagnosis traits (preventing the identification up to the species level) were mostly assigned to the undetermined group.

An interesting fact observed in our own study from Wolin, as well as in the ones published by other authors, was infrequent presence in the excavations of bones representing the Atlantic salmon and brown trout. This is very peculiar, because there is a common perception that both of these fish species were very abundant in the waters of the Odra River estuary, particularly numerously in the spawning season. Their considerable quantities should be reflected in the size of the catches and also in the number of the remains of these fishes in the excavations. Susłowska and Urbanowicz (1967) suggested that these fishes are valuable, and were passed by fishermen in the form of tribute, to the ruler. This is why their remains are very seldom found in the course of archaeological explorations of the early medieval settlements. Probably after smoking, the fish become also very valuable export merchandise. Perhaps salmon and trout, as suggested by Kaj (1957) in reference to the eel, were not the subject of the fishery because they could had been regarded cult fishes. The most probable hypothesis suggesting the reasons for a limited number of these fishes in the discussed excavations applies to their delicate bone structure, not resistant to the time factor. Unlike the bones of zander, perch, or bream, they contain a lot of soft cartilage, have a porous and fragile osteoblast structure. Also the environment, in which they oc-

curred, undoubtedly encouraged the decay of the bones of these fishes. In effect, a small number of these bones were preserved to the present day, but most often the vertebra of trout and salmon were found. Unfortunately in respect to external appearance these bones do not have a characteristic structure. They can be properly identified as for the species. From this it can be concluded that in some archaeological publications, the vertebra of other fish, e.g. the pike or zander were improperly assigned as belonging to trout or salmon.

Also the relatively small number of bones of neurocranium of different fish species, in the Wolin port, can be explained by their low level of resistance to so called primary damage (they have a porous structure, and are fairly intensely fat, which undoubtedly facilitates self-destructive processes. Kozikowska (1974) suggests also, that during the consumption of the brain by different consumers (i.e. secondary damage), bones of this part of the skull could be damaged.

The common sturgeon remains found in all of the sedimentary layers of the Wolin port represent a totally different group. They were mostly bony shields of lateral belts. A small number (11) of fulcra—bony elements present in upper part of heterocercal caudal fin—were found (Chełkowski et al. 1998). Despite their occasional, significant damage, due to their size and characteristic structure and shape, the remains of this fish are easily identified in early medieval osteoarchaeological materials, even though not always and not in all of the sedimentary layers (Iwaszkiewicz 1980; Rulewicz 1994). In some of the excavations situated near lagoons or bigger rivers, their share in respect to the total number of fish bones can be significant, and sometimes even dominant (Urbanowicz 1965; Makowiecki 1999). A fairly big share of 11.76% of sturgeon remains found in sedimentary layers of Wolin port, is not something untypical. For most of these big, anadromous fishes the Dziwna River, Kamień Lagoon, and the Szczecin Lagoon, constituted a spawning trail up the Odra River. A similarly high share of sturgeon remains was reported by Chełkowski (1959) in the area of the early medieval Szczecin settlement—Mścięcino. This shows that in this time period, in the entire Odra estuary, a large number of these fishes was caught. It should also be brought to attention, that some bigger bony shields from Wolin Port show signs of craftsman activity (they were probably used as tools for scraping of fish or animal skin).

CONCLUSIONS

1. Seventeen early medieval settlement layers of the Wolin Port contained a fairly large amount of identified archaeoichthyological remains (2584). Among them, 33 types of bones belonging to 15 species of teleost fishes were identified anatomically, as well as 5 types of common sturgeon remains.
2. In the studied osteological material the prevailing items were bones composing viscerocranium (57.23%). Among them were 17 kinds identified anatomically. The majority belonged to *praeoperculum, operculum, dentale*, and *pharyngeum* and most of them represented zander, bream, and perch.
3. In the osteological material, a high share of one bone of pectoral girdle—*cleithrum* was stated (14.21%), belonging in most cases to zander and bream.
4. In all settlement layers the remains of common sturgeon were found. Their share in all of the anatomically identified osteological material totalled 11.76%.

ACKNOWLEDGEMENTS

This work has been conducted in the frames of research project No. 1 H01H021 15 financed by the State Committee for Scientific Research (Komitet Badań Naukowych).

REFERENCES

Baruš V., O. Oliva, 1995: Mihulovci a ryby [Cyclostomes and fishes].Wyd. Akademia Česke Republiky, Praha. (In Czech).

Brylińska M. (red.), 1986: Ryby słodkowodne Polski [Freshwater fishes of Poland]. PWN, Warszawa. (In Polish).

Chełkowski Z., 1959: Szczątki ryb w materiale wykopaliskowym z osady wczesnośredniowiecznej Szczecin-Mścięcino [Fish remains in excavation material from early medieval settlement Szczecin-Mścięcino]. Mat. Zachodniopomorskie, **5**: 165–192. (In Polish).

Chełkowski Z., 1960: Wczesnośredniowieczne pozostałości ryb z Kamienia Pomorskiego [Early medieval fish remains from Kamień Pomorski]. Mat. Zachodniopomorskie, **6**: 245–264. (In Polish).

Chełkowski Z., 1965: Pozostałości ichtiologiczne z badań wykopaliskowych na grodzisku wczesnośredniowiecznym w Szczecinie[Ichthyological remains from excavations conducted on early medieval city of Szczecin]. Mat. Zachodniopomorskie, **11**: 551–561. (In Polish).

Chełkowski Z., B. Chełkowska, 1964: Pozostałości ryb z grodziska i osady wczesnośredniowiecznej w Kędrzynie, pow. Kołobrzeg [Fish remains from medieval city and settlement in Kędrzyn, county of Kołobrzeg]. Mat. Zachodniopomorskie, **10**: 343–365 (In Polish).

Chełkowski Z., J. Filipiak, B. Chełkowska, 1998: Występowanie i charakterystyka ichtiofauny we wczesnośredniowiecznych warstwach osadniczych portu w Wolinie [Description of ichthyofauna found in early medieval layers of the port of Wolin]. Mat. Zachodniopomorskie, (in print). (In Polish).

Filipowiak W., 1994: Wolin i żegluga u ujścia Odry w świetle chronologii radiowęglowej [Wolin and navigation in the estuary of the Odra River in the light of radioisotope carbon dating]. Zesz. Nauk. Politechniki Śląskiej. Ser. Mat –Fiz., 70, Geochronometria, **9**: 113–125. (In Polish).

Grodziński Z., 1961: Anatomia i embriologia ryb [Anatomy and embryology of fishes]. PWRiL, Warszawa. (In Polish).

Horoszewicz L., 1960: Wartości kości gardłowych dolnych (*ossa pharyngea interiora*) jako kryterium gatunkowego oznaczania ryb karpiowatych (Cyprynidae) [Importance of lower pharyngeal bones (*ossa pharyngea interiora*) as a criterion for specific identification of cyprinid fishes (Cyprinidae)]. Rocz. Nauk. Roln., 75, B-2,: 237–258. (In Polish).

Iwaszkiewicz M., 1980: Szczątki ryb z grodzisk nad jeziorami Szczytno i Charzykowskim [Fish remains from medieval cities on lakes Szczytno and Charzykowskie]. Rocz. Nauk. Rol. Poznań, CXXI: 3–6. (In Polish).

Janec-Susłowska W., 1957: Osteologia szczupaka [Osteology of pike]. PWN, Warszawa (In Polish).

Kaj J., 1952-1953: Próbki ichtiologiczne wykopaliskowe. Wolin – rok 1952 – stanowisko 2, Wolin – rok 1953 – stanowisko 4 [Ichthyological excavation samples. Wolin—1952—site 2, Wolin—1953—site 4]. Manuscripts—Archaeological Section IAiE PAN Wolin. (In Polish).

Kaj J., 1957: Możliwości poznawcze badań ichtiologicznych w archeologii i metodyka badań [Cognitive potential ichthyological studies in archaeology; methodology]. Archeol. Pol., Warszawa–Wrocław, **1**: 116–125. (In Polish).

Kozikowska Z., 1974. Ryby w pokarmie średniowiecznych (X–XIV w.) mieszkańców Wrocławia na Ostrowie Tumskim jako wskaźnik gatunków ryb łowionych na wodach danych okolic lub docierających tam drogą handlu [Fishes in the food of medieval (10 to 14th century) citizens of Wrocław at Ostrów Tumski as indication of species caught in the local waters or imported from elsewhere]. Acta Univ. Vratisl., 233: 3–14. (In Polish).

Lebedev V.D., 1960: Presnovodnaja četviertičnaja ichtiofauna evropejskoj časti SSSR [Quaternary freshwater ichthyofauna of the European part of the USSR]. Izd. Moskovskogo. Univ., Moskva. (In Russian).

Makowiecki D., 1993: O możliwościach poznawczych i niektórych problemach metodycznych archeozoologii polskiej [Cognitive potential and selected methodological problems of Polish archaeozoology]. Archeol. Pol., **38** (1): 37–49. (In Polish).

Makowiecki D., 1999: Some aspects of studies on the evolution of fish fauna and fishing in prehistoric and historic times in Poland. In: The Holocene History of the European Vertebrate Fauna – Workshop 6–9.04.1998, Berlin. Ed. Benecke N. Verlag Marie Leidorf, 6 : 171-184.

Marciniak A., 1996: Archeologia i jej źródła. Materiały faunistyczne w praktyce badawczej archeologii [Archaeology and its roots. Faunistic materials in archaeological research practice]. PWN, Warszawa–Poznań. (In Polish).

Pazdur M.F., R. Awsiuk, T. Gosler, A. Pazdur, 1994: Chronologia radiowęglowa początków osadnictwa w Wolinie i żeglugi u ujścia Odry [Radioisotope carbon dating of early settlements in Wolin and of the Odra estuary navigation]. Zesz. Nauk. Politechniki Śląskiej. Ser. Mat –Fiz., 70, Geochronometria, **9**: 127–195. (In Polish).

Rulewicz M., 1994: Rybołówstwo Gdańska na tle ośrodków miejskich Pomorza od IX do XIII wieku [Fishing of the city of Gdańsk in relation to the other urban centres of Pomerania from 9th to 13th century]. Wyd. Ossolineum, Wrocław. (In Polish).

Stanisławski B., 1998: Wczesnośredniowieczna ceramika słowiańska z Wolina – Portu a procesy dystrybucji naczyń [Early medieval Slavonic ceramics from Wolin-Port in view of the processes of pottery distribution]. Mat. Zachodniopomorskie, **43**: 159–192. (In Polish).

Susłowska W., 1968: The morphology od osseous remants of cyprinidae fishes excavated in the main Gdańsk stand. Zool. Pol., **18**, 2: 171–210.

Susłowska W., K. Urbanowicz, 1967: Szczątki kostne ryb z wczesno-średniowiecznego Gdańska (X–XIII w.) [Osseous remnants of fishes from early medieval Gdańsk (10–13th century)]. Gdańsk Wczesnośredniowieczny, **6**: 53–65. (In Polish).

Suvorov B.K., 1948: Osnovy ichtiologii [Fundamentals of ichthyology]. Soviecka Nauka, Moskva. (In Russian).

Urbanowicz K., 1965: Połowy jesiotra zachodniego *Acipenser sturio* L. we wczesnośredniowiecznym Gdańsku w świetle materiałów wykopaliskowych [Catches of common sturgeon, *Acipenser sturio* L. in early medieval Gdańsk in view of the excavation materials]. Przegl. Zool., **9**, 4: 372–377. (In Polish).

Ważny T., D. Eckstein, 1986: Dendrologiczne datowanie wczesno-średniowiecznej słowiańskiej osady Wolin [Dendrological dating of early medieval Slavonic settlement of Wolin]. Mat. Zachodniopomorskie, **33**: 147–164. (In Polish).

Wojtasik J., 1986: Materiały bursztynowe z Wolina – Starego Miasta (stanowisko 1, wykop 7 i 8) [Amber items from Wolin Old City (Site 1, excavations 7 and 8)]. Mat. Zachodniopomorskie, **37**: 63–96. (In Polish).

Jarosław *FILIPIAK*, Zygmunt *CHEŁKOWSKI*

CHARAKTERYSTYKA OSTEOLOGICZNA SZCZĄTKÓW RYB Z WCZESNOŚREDNIOWIECZNYCH WARSTW OSADNICZYCH PORTU W WOLINIE

STRESZCZENIE

Podczas prowadzonej w latach 1977–1985 eksploracji w wykopie archeologicznym znajdującym się w obszarze starego portu w mieście Wolinie znaleziono 3 537 sztuk szczątków ichtiologicznych, które do tej pory nie były przebadane. Szczątki te w różnej liczebności zalegały w 17 wczesnośredniowiecznych warstwach osadniczych, obejmujących okres od IX do XIII wieku. Badania porównawcze, podczas których wykorzystywano kilkadziesiąt szkieletów współcześnie bytujących na Zalewie Szczecińskim ryb, pozwoliły na określenie co do nazwy anatomicznej i gatunkowej 2 584 sztuk kości. W tym materiale archeoichtiologicznym stwierdzono 33 rodzaje kości należące do 15 gatunków ryb kostnoszkieletowych oraz 4 rodzaje szczątków jesiotrów zachodnich (ten ostatni jako jedyny gatunek występował we wszystkich 17 warstwach osadniczych). Z kości należących do ryb kostnoszkieletowych największą częstotliwość występowania stwierdzono w przypadku *cleithrum*, *operculum* (w 16 warstwach), *parasphenoideum* i *praeoperculum* (w 15 warstwach), natomiast najrzadziej, bo tylko w jednej warstwie stwierdzono *alisphenoideum* i *scapula*. Zdecydowanie najwięcej kości (1 478 szt.) jak i ich rodzajów (17) pochodziło z trzewioczaszki. Wśród nich dominowały *praeoperculum*, *operculum*, *dentale,* oraz *pharyngeum*, należące najczęściej do sandaczy, leszczy i okoni. Razem z *interoperculum* i *articulare* stanowiły one 41% wszystkich kości. Udział innych części szkieletu, należących do mózgoczaszki, oraz pasów barkowego i miednicowego ograniczał się odpowiednio do 323 szt. (12,5% – dominowała *parasphenoideum*) oraz 352 szt. (13,6% – zdecydowanie przeważała *cleithrum*). Udział szczątków jesiotra zachodniego, wśród których dominowały tarcze kostne, był stosunkowo wysoki i wyniósł 11,6% wszystkich oznaczonych anatomicznie kości.

Received: 4 November 1999

Author's address:

Jarosław Filipiak PhD DSc
Department of Fiheries Management in Inland Waters
Agricultural University of Szczecin
Kazimierza Królewicza 4, 71-550 Szczecin, Poland