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

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Fish anatomy

STUDIES ON ICHTHYOFAUNA FROM AN ARCHAEOLOGICAL EXCAVATION ON WOLIN-TOWN (SITE 1, PIT 6)

STUDIA NAD ICHTIOFAUNĄ Z WYKOPALISK ARCHEOLOGICZNYCH Z WOLINA-MIASTA (STANOWISKO l, WYKOP 6)

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In sixteen early medieval settlement layers of the Wolin-Town, which correspond chronologically to the period from 7th to mid 13th century, the occurrence of 16 463 bone remains of fishes was stated, of which 9 799 pieces were identified anatomically and their specific affiliation was determined.

These bones as well as scales found in the excavation belonged to 27 fish species. Amongst them were 13 cyprinid and 3 salmonid species. Based on the comparative study of the bones, a total of 4 645 fish were determined and their estimated weight amounted to 9 308 kg. The quantitative dominants were: *Stizostedion lucioperca* L. (31.6%), *Abramis brama* L. (26.2%), *Perca fluviatilis* (15.5%) and *Rutilus rutilus* L. (11.3%). The total weight dominants were: *Stizostedion lucioperca* L. (36.4%), *Acipenser sturio* L. (35.4%), and *Abramis brama* L. (14.8%).

INTRODUCTION

The localisation of the early medieval town of Wolin in the south-eastern part of the island by the same name, surrounded from south and west by the waters of the Szczecin Lagoon, form east by the Dziwna River, and from north by waters of the Baltic Sea, as well as abundance of fishes in those bodies of water promoted development of fisheries in those times. It is evidenced by the remains of different fishing gear found in the archaeological excavations in the town (Rulewicz and Zajdel-Szczyrska 1970; Rulewicz 1974) as well as numerous ichthyological remains. The first preliminary identification analyses of the bone remains from Wolin were conducted by Kaj (1952-1953). Much broader analyses, covering identification of the bone- and scale types, specific composition of the ichthyofauna and the individual weight of the fishes were published by Chełkowski et al. (1998) and Filipiak and Chełkowski (2000). Those studies were based on 182 collections of fish remains dated from 9th to 13th centuries and originating from the excavation explored within

1977-1985 in the area of the medieval port of Wolin (pit 8). Earlier, in the first half of the 1970s, the Institute of Archaeology and Ethnology of the Polish Academy of Sciences conducted archaeological exploration in the central part of the early medieval town of Wolin. Those excavations yielded very numerous ichthyological remains. The aim of the present study was to analyse those remains for their specific composition and the individual traits.

Localisation and characteristics of the excavation site

The analysed ichthyological remains originated from an archaeological excavation pit situated within the limits of the old town of Wolin—at the distance of about 130 m east of the present-day riverbank of the Dziwna (Fig. 1). The pit measuring 10 χ 10 m reached the bedrock at the depth of 5.3 m. It was situated on the lot No. 1660 and in archaeological nomenclature it has been referred to as site 1, pit 6. (During the exploration the surface of the pit was divided into squares and each of the squares was further divided into four parts.) The fish remains were found in 16 settlement layers marked with symbols from II to XVII. Those layers were dated from second half of 8th century to mid 13th century (Stanisławski 1999). Their thickness varied from 10-20 cm (IV) to 50-140 cm in the oldest XVII layer (Table 1)

Table 1

Sample location and number of the analysed archaeoichthyological samples from early medieval settlement layers of Wolin-Town (site 1, pit 6)

No.	Layer	Layer thickness (cm)	Layer dating (year, century)	Number of archaeoichthyological samples collections			
				Osseous	Osseous and scales	Scales	Total
1	II	10-55	—	4	—	—	4
2	III	—	—	5	4	—	9
3	IV	10-20	12th-13th	2	7	4	13
4	V	15-45	12th	25	39	—	64
5	VI	10-25	12th	4	1	—	5
6	VII	20-40	12th	24	6	1	31
7	VIII	20-60	2nd half of 11th	32	16	3	51
8	IX	10-45	1st half of 11th	11		—	11
9	X	10-40	10th	26	3	1	30
10	XI	20-55	965-966	45	13	2	60
11	XII	20-45	2nd half of 10th	50	5	—	55
12	XIII	12-45	1st half of 10th	27	6	—	33
13	XIV	5-40	9th	26	5	1	32
14	XV	10-25	9th	4	2	—	6
15	XVI	10-40	9th	19	10	—	29
16	XVII	50-130	end of 8th	19	12	—	31
17	Bredoc	—	—				
			Total	323	129	12	464

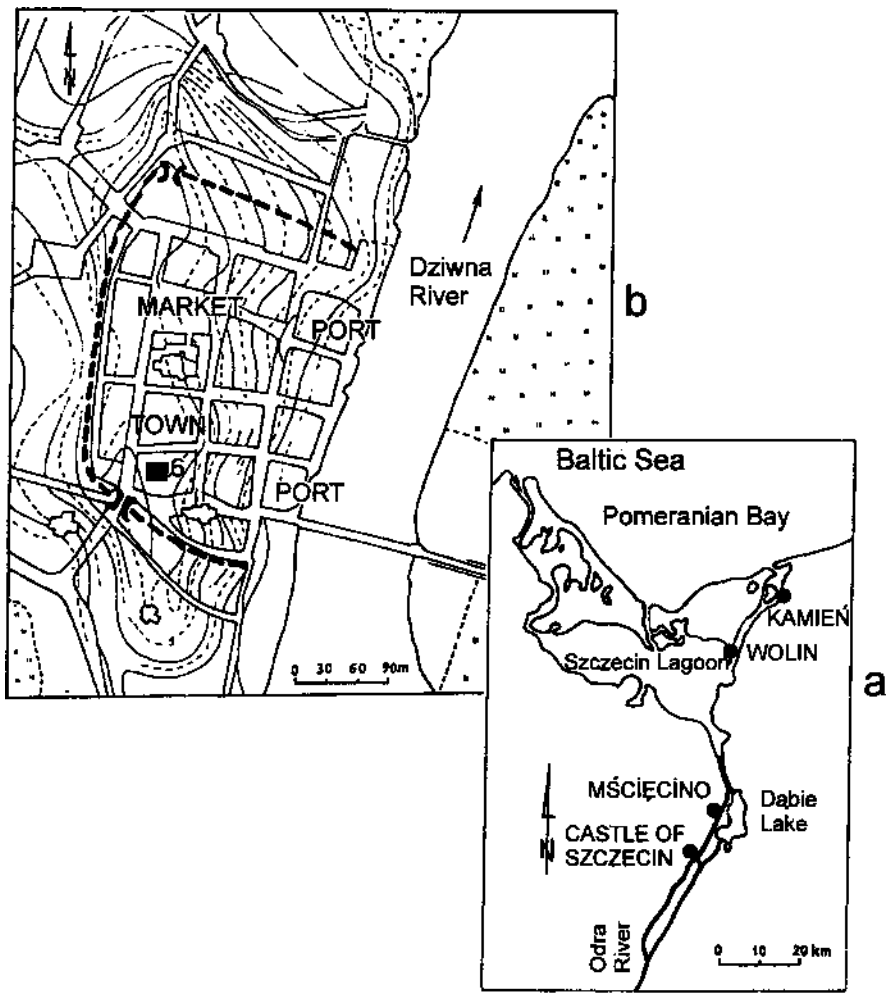

Fig. 1. Location of Wolin within the Odra River estuary (a) and the archeological site (site 1, pit 6) in Wolin-Town (b)

MATERIAL AND METHODS

The material for the present study was handed over to the present authors by the Archaeological Laboratory of the Institute of Archaeology and Ethnology of the Polish Academy of Sciences. It consisted of a collection of labelled ichthyological remains, acquired during the exploration conducted from 1970 to 1974. The collection consisted of 464 samples (collections). The individual settlement layers were represented by different numbers of the samples, ranging from 4 samples in layer II to 60 samples in layer XI (Table 1). Immediately after the extraction from the culture layers and detailed description of the finding place, the bone remains were mechanically cleaned, washed in water, dried, and stored in paper bags and boxes. The scale samples, though, were stored in paper bags without the above-mentioned procedure.

The morphological identity of individual ichthyological remains was determined macroscopically, based on a comparative material (Kaj 1957; Makowiecki 1993). The comparative material were skeletons and scales of the fish species presently inhabiting the Odra River estuary—deposited in our Department. In the second phase of the studies, the remains identified anatomically and assigned to individual species were again compared with lines of the same elements taken from the present-day fishes of a given species. This allowed estimating the smallest number of the fishes they represented, weight of individual specimens, and the overall weight of the fishes of a given species (Kaj 1957; Makowiecki 1993; Marciniak 1996). In the analysed samples the number of anatomically and specifically identified bones was registered, similarly as the number of unidentifiable bones without distinct traits.

The assessment of the weight of common sturgeons, whose remains were present in the analysed collections, was aided by three museum specimens of this fish. Two of them, measuring 193 cm and 281 cm and weighing 60 kg and 136 kg respectively are deposited in the Department of the Fish Systematic of the Agricultural University of Szczecin and the third (230 cm, 84 kg)—in the Museum of Fisheries in Świnoujście. Suggestions of Urbanowicz (1965)—regarding the thickness, colour, and surface structure of the shields covering in five rows the body of those fish—were also taken into consideration.

Only complete scales without signs of damage were used for identification of individual fish species. The scales were identified with the aid of a dissecting microscope under magnifications x12 or x24.

A number of published sources were used during the identification (Horoszewicz 1960; Grodziński 1961; Susłowska 1968; Ninua 1976; Susłowska and Urbanowicz 1984; Brylińska 1986; Bams and Oliva 1995; Janec-Suslowska 1995). The adopted taxonomic arrangement of the species listed in the present work in Tables 2, 3, 4, and 5 follows the system proposed by Brylińska (1986).

Table 2

Quantities of anatomically determined bonę- and scales remain of indiyidual fish species found in the settlement layers of Wolin-Town (site l, pit 6)

No.	Species	Setlement layer number																Total	%
		II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII		
1.	*Acipenser sturio*		1		12	2	5	24	1	14	15	5	17	8	2	11	9	126	1.28
2.	*Clupea harengus*				4		2	8	2	23	25	55	14	15		4	171	323	3.30
3.	*Alosafallcoc*				3			1	2		35	8	2	1	1	1	231	285	2.91
4.	*Alosa alosa*										1			1		1		3	0.03
5.	*Salmo salar*		1		1													2	0.02
6.	*Salmo trutta*				1													1	0.01
7.	*Coregonus lavaretus*									2								2	0.02
8.	*Esox lucius*				29	1	11	11	4	7	15	12	8	5	4	7	16	130	1.33
9.	*Rutilus rutilus*	3	8	9	236	20	61	29	1	15	46	55	33	49	8	48	43	664	6.78
10.	*Leuciscus idus*				10		5	4			1	1	2			4	1	28	0.29
11.	*Leuciscus cephalus*				10	1					3							14	0.14
12.	*Scardinius erytrophthalmus*				5		1			2								8	0.08
13.	*Aspius aspius*				13	2	1	2			2	4				3	3	30	0.31
14.	*Tinca tinca*	1		1	36	6	29	9		1	4	2						89	0.91
15.	*Gobio gobio*																		
16.	*Blicca bjoerkna*		1															1	0.01
17.	*Abramis brama*	5	20	19	652	70	303	199	28	87	154	163	152	187	73	219	301	2632	26.86
18.	*Abramis balerus*				2											3		5	0.05
19.	*Yimba vimba*				2	1	1	1								3	1	9	0.09
20.	*Pelecus cultratus*				1							2						3	0.03
21.	*Carassius carassius*							1										1	0.01
22.	*Silurus glanis*				1			1					3	3		3	5	16	0.16
23.	*Anguilla anguilla*	1	1	1	22		11	8	1	4	6	9	5	3	2	8	4	86	0.88
24.	*Lota lota*							3		1								4	0.04
25.	*Stizostedion lucioperca*	15	20	19	492	31	213	260	54	227	527	569	357	358	88	294	329	3853	39.32
26.	*Percaflwiatilis*	5	17	8	444	35	145	175	22	52	84	98	84	75	13	95	118	1470	15.00
27.	*Gymnocephalus cernuus*				2			1		1	2		3	2		2	1	14	0.14
Total number of bones determined		30	69	57	1978	169	788	737	115	436	920	983	680	706	190	706	1233	9799	100.00
Number of fish species*		6	8	6	21	10	13	17	9	13	15	13	12	12	8	16	14		
Number of fish species"		-	3	4	7	2	3	3	-	1	6	2	5	2	2	6	4		
Total number of fish species		6	8	6	21	10	13	18	9	13	18	13	13	12	8	17	14		

* Determined based on bones; ** Determined based on scales.

Table 3

Quantities of individual fish species occurring in the settlement layers of Wolin-Town (site 1, pit 6)

No	Species	Settlement layer number																Total	%
		II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII		
1.	*Acipenser sturio*		1		9	2	4	18	1	9	9	4	10	8	2	8	8	93	2.00
2.	*Clupea harengus*				4		2	6	1	14	19	38	13	12		4	44	157	3.38
3.	*Alosa fallax*				2			1	1		19	5	2	1	1	1	28	61	1.31
4.	*Alosa alosa*										1			1		1		3	0.07
5.	*Salmo salar*		1		1													2	0.04
6.	*Salmo trutta*				1													1	0.02
7.	*Coregonus lavaretus*									2								2	0.04
8.	*Esox lucius*				26	1	10	8	4	6	11	10	8	4	4	7	14	113	2.43
9.	*Rutilus rutilus*	3	8	7	172	11	42	29	1	14	39	45	30	43	8	39	36	527	11.35
10.	*Leuciscm cephalus*				8	1					3							12	0.26
11.	*Leuciscus idus*				10		5	4			1	1	2			3	1	27	0.58
12.	*Scardinus erytrophthalmus*				5		1			2								8	0.17
13.	*Aspius aspius*				11	2	1	2			2	3				3	2	26	0.56
14.	*Tinea tinea*	1		1	32	6	24	9		1	4	2						80	1.72
15.	*Blicca bjoerkna*		1															1	0.02
16.	*Abramis brama*	5	13	9	244	21	106	95	20	53	105	114	90	100	30	102	112	1219	26.25
17.	*Abramis ballerm*				2											1		3	0.07
18.	*Vimba vimba*				2	1	1	1								3	1	9	0.19
19.	*Pelecus cultratus*				1							1						2	0.04
20.	*Carassius carassius*							1										1	0.02
21.	*Silurus glanis*				1			1					3	2		2	5	14	0.30
22.	*Anguilla anguilla*	1	1	1	18		9	8	1	4	5	9	5	3	2	8	4	79	1.70
23.	*Lota lota*							3		1								4	0.09
24.	*Stizostedion lucioperca*	7	11	13	190	11	72	117	27	92	192	209	139	135	28	108	117	1468	31.61
25.	*Perca fluviatilis*	4	7	4	175	12	60	92	13	42	51	54	49	50	9	53	44	719	15.48
26.	*Gymnocephalus cernuus*				2			1		1	2		3	2		2	1	14	0.30
	Total	21	43	35	916	68	337	396	69	241	463	495	354	361	84	345	417	4645	100.00

Table 4

Total weight (kg) of individual fish species occurring in the settlement layers of Wolin-Town (Site 1, pit 6)

No	Species	Setlement layer number																Total	%
		II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII		
1.	*Acipenser sturio*		25.0		290.0	60.0	115.0	650.0	15.0	270.0	295.0	115.0	415.0	320.0	115.0	320.0	280.0	3285.0	35.29
2.	*Clupea harengus*				0.4		0.2	0.6	0.1	1.4	1.9	3.6	1.0	1.2		0.2	4.4	15.0	0.16
3.	*Alosa fallax*				0.4			0.5	0.4		5.3	1.3	0.4	0.3	0.4	0.4	9.0	18.4	0.20
4.	*Alosa alosa*										1.2			1.2		0.6		3.0	0.03
5.	*Salmo salar*		18.0		13.0													31.0	0.33
6.	*Salmo trutta*				6.0													6.0	0.07
7.	*Coregonus lavaretus*									1.5								1.5	0.02
8.	*Esox lucius*				61.2	0.8	18.4	20.0	9.6	17.1	21.4	25.4	19.5	15.7	14.2	18.6	30.9	272.8	2.93
9.	*Rutilus rutilus*	2.1	3.1	2.7	53.3	3.4	14.6	9.4	0.2	5.3	10.5	18.6	10.9	14.0	2.7	11.8	10.9	173.5	1.86
10.	*Leuciscus cephalus*				6.7	1.0					2.1							9.8	0.11
11.	*Leuciscus idus*				9.3		3.6	4.9			1.5	0.8	1.6			4.5	0.7	26.9	0.29
12.	*Scardinius erytrophthalmus*				1.4		0.2			0.9								2.5	0.03
13,	*Aspius aspius*				23.4	3.0	2.2	7.5			10.0	10.5				1.6	3.0	61.2	0.66
14.	*Tinea tinea*	1.0		1.6	36.3	6.9	21.3	14.4		1.1	5.2	2.6						90.4	0.97
15.	*Blicca bjoerkna*		0.3															0.3	+
16.	*Abramis brama*	5.6	9.0	11.1	273.6	18.7	123.6	119.0	23.6	55.5	98.3	111.3	98.2	130.2	41.7	116.3	137.8	1373.5	14.76
17.	*Abramis ballerus*				1.7											1.1		2.8	0.03
18.	*Vimba vimba*				1.0	0.6	0.8	0.8								1.5	0.6	5.3	0.06
19.	*Pelecus cultratus*				0.2							0.3						0.5	+
20.	*Carassius carassius*							0.7										0.7	+
21.	*Silurus glanis*				1.5			37.0					4.4	1.7		24.0	47.0	115.6	1.24
22.	*Anguilla anguilla*	3.0	2.5	0.7	21.8		10.3	7.7	0.6	5.0	4.8	11.8	4.2	2.8	1.2	8.2	3.5	88.1	0.95
23.	*Lota lota*							2.8		0.5								3.3	0.04
24.	*Stizostedion lucioperca*	13.1	30.2	27.3	414.7	19.9	172.8	233.8	67.8	216.0	492.4	505.3	319.4	312.9	68.4	259.0	233.1	3386.1	36.38
25.	*Perca fluviatilis*	1.6	3.3	1.8	89.0	5.3	30.9	38.3	4.9	19.6	21.6	23.7	23.3	24.3	4.6	24.5	17.2	333.9	3.59
26.	*Gymnocephalus cernuus*				0.2			0.1		0.1	0.1		0.2	0.1		0.1	0.0	0.9	+
	Total (kg)	26.4	91.4	45.2	1305.1	119.6	513.9	1147.5	122.2	594.0	971.3	830.2	898.1	824.5	248.2	792.4	778.1	9308.1	100.00

Table 5

Fish species recorded at different early medieval archaeological sites conducted in the Odra River estuary

Species	Archaeological sites						
	Wolin			Szczecin			Kamień Pomorski
	Pit 6 (1)	Pit8 (2)	Pit 2 and 4(3)	Market (4)	Castle (4)	Mścię-cino (5)	Subborugh (6)
Acipenser sturio	+	+	+	+	+	+	–
Clupea harengus	+	+	–	+	–	–	–
Alosa fallax	+	–	–	–	–	–	–
Alosa alosa	+	–	–	–	–	–	–
Salmo salar	+	–	+	–	–	–	–
Salmo trutta	+	+	–	–	–	–	–
Coregonus lavaretus	+	–	–	–	–	–	–
Esox lucius	+	+	+	+	+	+	+
Rutilus rutilus	+	+	+	+	+	+	+
Leuciscus cephalus	+	–	+	+	+	–	–
Leuciscus idus	+	+	+	+	+	–	–
Scardinius erytrophthalmus	+	+	–	+	+	+	–
Aspius aspius	+	+	+	+	+	+	–
Tinea tinea	+	+	+	+	+	+	+
Gobio gobio	+	–	–	–	–	–	–
Blicca bjoerkna	+	–	–	+	+	+	+
Abramis brama	+	+	+	+	+	+	+
Abramis ballerus	+	+	+	+	–	–	–
Vimba vimba	+	+	+	+	–	+	+
Pelecus cultratus	+	–	–	+	–	–	–
Carassius carassius	+	–	–	+	+	–	–
Silurus glanis	+	+	–	+	+	+	–
Anguilla anguilla	+	+	+	+	+	+	–
Lota lota	+	–	–	–	–	–	–
Stizostedion lucioperca	+	+	+	+	+	+	+
Perca fluviatilis	+	+	+	+	+	+	+
Gymnocephalus cernuus	+	+	+	+	–	–	–
Total (number)	27	17	15	20	15	13	8

(1) present study; (2) Chełkowski et al. 1998; (3) Kaj 1952-1953; (4) Rulewicz 1994; (5) Chełkowski 1959; (6) Chełkowski 1960

RESULTS

The present archaeoichthyological material, as mentioned earlier amounting to 464 samples, there were 323 samples containing bones only, 129 samples with both bones and scales, and 12 samples containing only scales (Table 1). A variable number of samples were recovered from the individual 16 settlement layers studied. It ranged from 4 samples

in layer II to 60 samples in layer V. It is worth mentioning that almost all layers (except for II and IX) contained the scales, preserved in various quantities and various state. A total of 16 463 bones were acquired from pit 6 and analysed. Of these, 9 799 bones (59.52%) (Table 2) were determined anatomically and assigned to the respective fish species. The presence of 27 fish species was stated in all settlement layers of pit 6, based on the bone and scale material. Based on the bones alone, a total of 14 fish species were identified. Based on the bone and scale remains—12 species, while the scales alone aided the identification a single species of gudgeon, *Gobio gobio* (Table 2). The most of the species were found in the settlement layers: V (21 species), VIII (18), and XI (18). The fewer species contained layers II and IV (6 in each). According to the data listed in Tab 2, regarding the number of bones assigned to individual species, the quantitative dominant were the remains of zander (81.18%), common bream, and perch (Detailed osteological characteristics of the presently discussed excavation will be presented in a separate publication). The comparative study demonstrated that all of the identified 9 799 bones came from 4 645 fishes and their combined estimated weight was 9 308 kg (Tables 3,4).

Characteristics of the fish species from early medieval settlement layers of Wolin-Town

Common sturgeon, *Acipenser sturio* L.

This species was present in fourteen settlement layers and was most abundant in layer VIII. In all, there were 126 sturgeon remains stated. They constituted only 1.28% of all identified bone remains (Table 2). It is evident from the comparative study that the analysed excavation yielded 93 specimens of the sturgeon. They were the most abundant (18) in layer VIII (Table 3). The weights of individual sturgeons, determined through comparative method ranged from 15 to 100 kg. The majority of the fish (73) weighed between 15 and 40 kg. The combined estimated weight of the sturgeons reached 3 285 kg, which constituted as many as 35.29% of the weight of all fishes from pit 6 (Table 4).

Herring, *Clupea harengus* L.

Herring bones were present in eleven settlement layers. A total of 323 bones were found, representing 13 bone types. The majority of the bones (171) were recovered from the oldest layer XVII. It is evident from the comparative study that all identified bones came from 157 specimens, weighing jointly 15.0 kg. Their individual weight ranged from 0.04 to 0.15 kg. The dominant were specimens of relatively high individual weight—0.1 kg.

Twaite shad, *Alosafallax* (Lacepede)

Twaite shad bones (285) occurring in 10 settlement layers were assigned to 10 bone types. Their share in the total number of the remains was relatively high and it amounted to 2.91%. All bones came from 61 specimens and their combined weight was 18.4 kg. The individual weights ranges from 0.15 to 0.45 kg. The dominant group (49) constituted the fish weighing 0.24 to 0.40 kg. Similarly as for the herring, the majority of twaite shad bones were found in the oldest—layer XVII. This species was also identified based on the scales found in layers XП and XIII. Surprisingly the scales were preserved in a very good condition till our times.

Allis shad, *Alosa alosa* (Lacepede)

Allis shad bones were found in three settlement layers only and were represented by one bone type—*dentale* (3 pieces). All of them represented three specimens of the individual weight ranging from 0.6 to 1.2 kg.

Atlantic salmon, *Salmo salar* L.

Bones of this species were represented by 2 vertebrae, found in two relatively young layers (III and V). The estimated individual weight of those two fish was 13 and 18 kg.

Migratory morphotype of the brown trout, *Salmo trutta* m. *trutta* L.

Only one vertebra found in layer V represented a trout weighing 6 kg.

White fish, *Coregonus lavaretus* L.

Was represented by two fish, weighing 0.75 and 0.8 kg respectively, identified based on two *operculum* bones found in layer X.

Pike, *Esox Indus* L.

Presence of this fish in the excavation was determined based on few scale remains and on 130 bones. The scales were present in only three settlement layers (V, XVI, and XVII), whereas the bone remains—in thirteen. The latter were the most abundant in layers V (29) and XVII (16). Eleven bone types were determined and they represented 113 specimens. The cumulative weight of pike was estimated for 272.8 kg (2.93% of the total weight of all fishes). The individual weight ranged from 0.25 to 8.5 kg. The quantitative dominant were specimens ranging from 1.5 to 2.5 kg. There were only 11 big pike weighing over 4.0 kg.

Roach, *Rutilus rutilus* L.

This species was very abundant in all settlement layers and was represented by scales (found in 8 layers) and 664 bones. The latter elements constituted 6.78% of the overall collection of the fish remains. Their highest number (236 pieces) occurred in layer V. The roach was represented by 12 bone types. Their analysis resulted in separation of 527

specimens. This number was relatively high as it translated into 11.35% of the all fish specimens recovered. Individual weight of roach ranged from 0.07 to 1.25 kg (average weight was 0.33 kg. The estimated weight of roach was 173.5 kg, which constituted 1.86% of the weight of all fishes

Chub, *Leuciscus cephalus* L.

Only 14 bones of this species representing 12 specimens were identified. The estimated individual weight of chub ranged from 0.25 to 2.0 kg.

Ide, *Leuciscus idus* L.

Eight settlement layers yielded a total of 28 bones representing fish of this species. The bones found represented 27 specimens. Their individual weight ranged from 0.15 to 2.50 kg.

Rudd, *Scardinius erythrophthalmus* L.

Eight settlement layers of the pit studied yielded remains of 8 rudd specimens determined based on 9 bones and small number of scales. The individual weight of these fish was within 0.2-0.5 kg.

Asp, *Aspius aspius* L.

The presence of this species remains in eight settlement layers was determined based on 30 bones, representing 12 different skeleton parts. All bones found belonged to 26 specimens. Their individual weight ranged from 0.3 to 5.5 kg. The dominant group were 18 fish weighing up to 2.5 kg. The combined estimated weight of the asp (61.2 kg) constituted 0.66% of the total weight of all fishes studied.

Tench, *Tinea tinea* L.

A total of 89 tench bones, representing 7 bone types were found in nine settlement layers. Comparative study revealed that all anatomically determined bone remains represented 80 specimens. Their estimated individual weight ranged from 0.25 to 2.75 kg. The dominant group were 65 specimens weighing 0.5-1.5 kg. The combined estimated weight of all tench did not exceed 0.97% of the total weight of all fishes.

Gudgeon, *Gobio gobio* L.

These fish were determined solely based on the scales found in settlement layers VIII and XIII.

White bream, *Blicca bjoerkna* L.

This was one of the least abundant fishes in pit 6. A single specimen of this species, identified based on its *operculum*, was found in layer III. Also a few scales of this fish were found in layer XI.

Common bream, *Abramis brama* L.

Abundant skeleton parts of this fish were found in all layers of the studied archaeological pit. In addition to that, high amounts of scales occurred in fourteen layers. In all the anatomically determined material covered 2 632 bones, representing as many as 20 skeleton parts. The comparative study demonstrated that the above bones belonged to 1 219 specimens. It constituted 26.24% of all fishes, which makes the bream the second most numerous fish species after the zander. The individual weight of this species was 0.15-3.5 kg (1.12 kg in average). The total estimated weight of this species amounting to 1373.5 kg constituted 14.76% of the combined weight of all fishes.

Blue bream, *Abramis ballerus* L.

A few scales and 5 bones belonging to 3 specimens were found. Their estimated weight range was within 0.75-1.15 kg. The remains occurred in layers V and XVI.

Zanthe, *Vimba vimba* L.

The material studied yielded identifiable remains of 9 specimens of this fish. Their weight ranged from 0.2 to 0.85 kg. The identification was based on 9 pieces of bone remains and numerous scales. Zanthe was present in seven settlement layers.

Ziege, *Peleucus cultratus* L.

Two specimens of this fish were determined based on three bones found in layers V and XII. The estimated individual weights of these fish were 0.2 and 0.3 kg respectively.

Crucian carp, *Carassius carassius* L.

This species was represented by 1 bone *(operculum)* belonging to a specimen weighing 0.7 kg, found in layer VIII.

Wels, *Silurus glanis* L.

Only 16 bones were found in the studied material. They represented 6 bone types. The wels remains were found in six settlement layers, but they were more abundant in the older ones. The bones belonged to 14 specimens. Their estimated individual weight ranged from 0.7 to 37.0 kg. The dominant group (9 specimens) were small wels not exceeding 5kg.

European eel, *Anguilla anguilla* L.

This species was determined based on 86 bones found in all layers (except for layer VI. They were most abundant (22 pieces) in layer V. The comparative analysis of the material resulted in determination of 79 specimens. Their estimated individual weight ranged from 0.4 to 3.0 kg. There were two dominant groups: 0.5-1.0 kg and 1.1-1.5 kg. The former was represented by 38 eels, while the latter—by 17 specimens. Only six small specimens, weighing less than 0.5 kg were determined based on the bones. The combined

weight of the eels in the combined weight of all fishes was marginal and amounted to 0.95%.

Burbot, *Lota lota* L.

Only 4 bones of this fish, representing four specimens were recovered from layers VIII and X. The estimated individual weight of the fish ranged from 0.25 to 0.5 kg.

Zander, *Stizostedion lucioperca* L.

The remains of zander were the most numerous in the material studied. There were 3 853 bones, representing as much as 39.32% of all determined bones. They were present in all settlement layers and their numbers ranged from 15 in the layer II (the youngest) to 569 pieces in layer XII. Layers II, IV, V, and XII yielded also scales of this fish. As many as 34 skeleton parts of zander were determined. The bone remains represented 1 468 fish. This species was characterised by relatively wide range of the individual weight (0.2-9.0 kg) with the average of 2.3 kg. The combined estimated weight of zander amounting to 3 386.1 kg was the highest among all species. It constituted 36.38% of the combined weight of all fish species.

Perch, *Percafluviatilis* L.

The bone remains of perch in the present collection amounted to 1 474. They were found in all settlement layers. The bones were the most abundant (444 pieces) in one of the youngest—layer V. It must be emphasised that in relation to all anatomically determined bones the share represented by perch (15%) places this fish on the third position (after zander and common bream). Perch were determined based on 26 bone types and also on the scales found in seven settlement layers. The comparative analysis demonstrated that all identified bones belonged to 719 specimens. The perch were small and their estimated individual weight ranged from 0.05 to 1.5 kg, with the average of 0.46 kg). The collection contained remains of mostly small and medium specimens, so the combined estimated weight of all perch amounting to 333.9 kg constituted only 3.59% of the weight of all fish species.

Ruffe, *Gymnocephalus cernuus* L.

This species was identified based on the scales found only in layer XI and a few (14) bones found in eight settlement layers. There were two bone types representing 14 specimens weighing 0.02-0.1 kg.

DISCUSSION

Bone- and scale remains found among the material culture remains from different historical periods gives evidence on the specific composition of the fish fauna acquired

from a given body of water or of from trade. This in turn can tell us a lot about feeding preferences of people of those days. The analysed material was very abundant in bones of three clupeid fishes, in this number—rarely caught presently—allis shad. The occurrence of this fish is particularly interesting in view of the fact, that its remains had not been previously recorded from the early medieval settlements located on the banks of the Odra River estuary (Chełkowski 1959, 1960, 1965), nor in the vicinity of Kołobrzeg (Chełkowski and Chełkowska 1964). Very general information on the scarcity of clupeid fishes in the excavations from this period conducted in Gdańsk was provided by Susłowska (1966) and Susłowska and Urbanowicz (1967). The above authors did not identify the clupeids up to the species level. They suggested however that a few bones in their material represented probably a rare species—allis shad. It is interesting that in the excavation works carried out in the Netherlands, the bone remains of the allis shad were found in very old layers (3500 BC-1000 AD) whereas in the younger layers (1000-1700 AD) this fish was not present (Brinkhuizen 1979). Although the allis shad was present also in three older layers of Wolin-Town—no remains of this species (and no remains of twaite shad) were recorded from the excavation of Wolin-Port. Similarly no shads were found in the same-period cultural layers explored on the island of Rügen, Mecklenburg Bay and Kiel Bay (Prummel 1986). The dominant species at the above-mentioned sites was herring. Also in Wolin-Town, substantial amounts of herring bones were stated, particularly in the oldest layer dated from 2nd half of VIII century—the time when the Wolin settlement was formed. It is interesting that quantitatively the herring took up a high, 5th place among all identified species. Abundant remains of this fish in more than half of the layers of the pit 6 suggest that it was frequently acquired by the Wolin citizens of those times. Taking into account the fact that as recently as in the 1950s these fish were caught in the northern part of the Szczecin Lagoon—it is very likely, that it was also caught some thousand years ago. According to Gąsowska (1962), herring can enter the Szczecin Lagoon through the Dziwna River carried by the brackish water inflows from the Baltic Sea. Therefore it is possible that they could have been caught by the people of Wolin of those times in the waters adjacent to the island of Wolin from south and east. Early medieval Wolin citizen could have also acquired herring from barter or directly from the Pomeranian Bay. In early spring the latter area of water is abundant with substantial spawning concentrations of these fish. At that time the fishing is possible even with very simple hand gear—like for instance dip-nets. The herring could have been caught also with the aid of small-mesh (2 x 2 cm) nets made of plant-origin material. Remains of a similar net were found in Wolin-Town (site 4) in a settlement layer dated from 2nd half of 11th century. Also small net needles found at the same place (dated from 9th and 10th century) indicate that they were used for manufacturing and mending of such nets (Rulewicz 1974).

The fishermen from the settlements situated in the estuaries of rivers flowing into the Baltic Sea also quite often captured common sturgeons. Evidence for that is given by the bony shields, characteristic for this fish and frequently found in the settlement layers from 8^{th}-13^{th} centuries (Dąbczewski 1952; Susłowska 1966; Rulewicz 1994; Makowiecki 1999). The sturgeons were also recorded, although less frequently in the excavations carried out in the interior of the country, e.g. in Gniezno, Poznań (Lubicz-Niezabitowski 1948), Ostrów Lednicki, Lubin near Leszno, Nieszawka on Vistula (Prof. Iwaszkiewicz—personal communication). They could get there through barter trade, although it is more likely, that the reason for their presence there were their spawning migrations. The latter hypothesis was raised by Urbanowicz (1967), based on the size of the bone remains of sturgeons excavated in Gdańsk. The numerous bony shields found as well as other remains belonged in most cases to big specimens—as suggested by the above author—"most probably being on their way to rivers, to spawn there". A similar suggestion can be made in relation to the Wolin excavations. There in pit No. 8 (Chełkowski et al. 1998) and in pit No. 6, no juvenile stages were recorded. The quantitative dominant were specimens weighing 15-40 kg each. Also remains of very large sturgeons weighing 70-100 kg were found in both above-mentioned sites.

In addition to the representatives of the families Clupeidae and Acipenseridae, the determined fish remains found in pit 6 belonged to seven families. Considering the number of species the dominant was the family Cyprinidae. Some cyprinid species were represented by single specimens or very few specimens: silver bream, gudgeon, crucian carp, ziege, and blue bream, Such rare occurrence of these fishes, stated also in other excavations conducted in the Odra River estuary (Table 5) suggests existence of very small populations of those fishes in the waters of this area. Also presently the three latter species are almost absent in the waters of the Szczecin Lagoon and the Dziwna River. A similar conclusion can be drawn in relation to rudd, zanthe, chub, ide, and asp. Their combined share in the total number of fishes from pit 6 (including also five earlier mentioned species) was 1.90%. Small quantities of those fishes, stated not only in the Wolin excavations but also in Szczecin and Kamień Pomorski can be an evidence of their small populations sustaining themselves in the Odra estuary. It can be also an evidence of small popularity of those species in the diet of early medieval Wolinians. The tench, roach, and the common bream in particular dominated not only while compared with the above-mentioned fishes representing the family Cyprinidae, but also in relation to the entire archaeoichthyological material from Wolin. A similar domination structure was noted in other excavations explored in the Odra estuary (Table 5), but also in other sites situated far from the sea (Chełkowski and Chełkowska 1964; Iwaszkiewicz 1975, 1979, 1980; Rulewicz 1994). The roach and common bream always have been the most common fishes found in our inland waters. There-

fore it is not surprising that they were abundant in the diet of early medieval citizens of our country. As early as at that time, however, despite their abundance in the catches they were treated as less valuable. An evidence for that can be, among others, documents from Gdańsk (12th and 13th centuries). Those documents do not list the roach and bream in the privileges conferred by Dukes (Lega 1956).

Among the predatory fishes from pit 6 the least abundant was burbot and also Atlantic salmon and brown trout (burbot have been rarely found in excavations in our country). A puzzling fact is that very few remains of the salmon and trout were found not only on the southern coast of the Baltic Sea but also on the shores of the North Sea (Brinkhuizen 1979; Prummel 1986). We could expect that anadromous salmon and trout could have been captured by early medieval fishermen, in particular during the spawning migrations from sea to rivers. According to Susłowska and Urbanowicz (1967) "in old written sources we can find information that the salmon fishing right was a valuable privilege of a defined group of people". Those fishes, because of their taste value, constituted probably—similarly as furs, wax, honey, tar or lumber—an "export product" of those times (Labuda 1985). Consequently the outcome of the "export activity" could be the scarcity of the salmonid remains found in the excavations. Also another hypothesis seems to be justified—low time resistance of fat fish bones. Such hypothesis was proposed by Lepiskar and Heinrich (1977, after Prummel 1986) in relation to Eel, which remains were scarcely represented in the excavations from Haitabu, situated at the base of the Jutland Peninsula in a big Viking settlement. Haitabu was known to keep intensive trade ties with early medieval Wolin (Labuda 1985). Earlier mentioned authors insist that in the process of decomposition of fat fish tissue, some aggressive fatty acids can contribute to a quick and complete autolysis of the majority of bones. Taking into account that except for the eel also the salmon and trout are considered fat fishes—the hypothesis of slow decomposition of their bones seems possible, although difficult to confirm. It must be also emphasised that unlike the other teleost fishes, the salmonids have more fragile bones. Unlike the common bream, zander, or perch, the salmonid skull contains much more soft cartilage and it is made of porous bones. Both those factors had adverse effect on the preservation of those bones to the present times.

As mentioned earlier, the most abundant (number of bones and number of identified specimens) species in the Wolin excavations was the zander. Jointly with the perch—the third most numerous species—it constituted more than a half of the total number of fishes determined in pit No. 6 (town) and No. 8 (port). It suggests that, similarly as in the present times both those species had been very abundant in the waters surrounding the island of Wolin. The zander and perch (similarly as the common bream and pike) were often encountered in both very "old" excavations (Mesolithic, Neolithic, and Bronze Age) and younger (Roman times or medieval) situated on the south coasts of the Baltic and the North

Seas (Roselund 1976; Brinkhuizen 1979; Prummel 1986; Makowiecki 1999). The earlier mentioned fishes, jointly with the roach and tench constituted the group of six species, which were present in all archaeological sites listed in Tab 5. Their exceptional frequency of occurrence suggests, that in early medieval times they constituted a distinct dominant in the fish fauna of all water bodies, which was reflected by the catches and diet of the Pomeranian people of those times.

CONCLUSIONS

1. Identified ichthyoarchaeological remains excavated from Wolin-Town yielded a total of 27 fish species. Their quantities found in sixteen early medieval settlement layers varied extensively.
2. The quantitative remains were: zander, common bream, roach, and herring, whereas the combined estimated weight was the highest for zander, common sturgeon, common bream, and perch.
3. Four of the species recovered from the excavation do not occur in the ichthyofauna of the present-day Odra River estuary: the common sturgeon, allis shad, twaite shad, and the ziege.

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REFERENCES

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

Brinkhuizen D.C., 1979: Preliminary notes on fish remains from archeological notices in the Netherlands. Palaeohistoria, 21: 83-90.

Brylińska M. (ed.), 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]. Mater. Zachodniopomor., 5: 165-185.(In Polish).

Chełkowski Z., 1960: Wczesnośredniowieczne pozostałości ryb z Kamienia Pomorskiego [Early medieval fish remains from the town of Kamień Pomorski]. Mater. Zachodniopomor., 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]. Mater. Zachodniopomor., 11: 551-561. (In Polish).

Chełkowski Z., Chełkowska B., 1964: Pozostałości ryb z grodziska i osady wczesnośredniowiecznej w Kędrzynie, pow. Kołobrzeg [Fish remains from medieval fortified town and settlement in Kędrzyn, county of Kołobrzeg]. Mater. Zachodniopomor., 10: 343-365. (In Polish).

Chełkowski Z., Filipiak J., Chełkowska B., 1998: Występowanie i charakterystyka ichtiofauny we wczesnośredniowiecznych warstwach osadniczych portu w Wolinie [Occurrence and description offish remains in early medieval settlement layers of the port of Wolin]. Mater. Zachodniopomor., 44: 223-246. (In Polish).

Dąbczewski Z., 1952: Szczątki rybie z grodu gdańskiego z XIII w. [Fish remains from the medieval fortified city of Gdańsk in 13th century]. Studia wczesnośredniowieczne. Wyd. Ossolineum, Wrocław: 93-95. (In Polish).

Filipiak J., Z. Chełkowski, 2000: Osteological characteristics of fish remains from early medieval sedimentary layers of the port in the town of Wolin. Acta Ichthyol. Piscat., 20, 1: 135-150.

Gąsowska M. (ed.), 1962: Klucze do oznaczania kręgowców Polski [Polish vertebrates identification key]. PWN, Warszawa. (In Polish).

Grodzinski 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. Rol., Ser. B, 75, 2: 237-258. (In Polish).

Iwaszkiewicz M., 1975: Szczątki ryb z wczesnośredniowiecznego grodziska w Ujściu — powiat Chodzież [Fish remains from early medieval fortified town of Ujście, county of Chodzież]. Rocz. Akad. Rol. Pozn., 76: 93-94.(In Polish).

Iwaszkiewicz M., 1979:, Pozostałości ichtiologiczne z grodziska wklęsłego w Bninie, pow. Śremski [Ichthyological remains from a concave fortified settlement at Bnin, county of Śrem]. Mat. Stud. Archeol. Poznań: 199-200. (In Polish).

Iwaszkiewicz M., 1980: Szczątki ryb z grodzisk nad jeziorami Szczytno i Charzykowskim [Fish remains from early medieval fortified settlements on lakes Szczytno and Charzykowskie]. Rocz. Nauk Roi. Poznań, 121: 3-6. (In Polish).

Janec-Suslowska 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. Ewolin-1952-site 2, Wolin-1953-site 4] Manuscript 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]. Pol. Archeol., Warszawa-Wrocław, 1: 116-125. (In Polish).

Labuda G., 1985: Dzieje Szczecina, wiek X-1805 [History of Szczecin, 10th century-1805]. PWN, Warszawa. (In Polish).

Lubicz-Niezabitowski E., 1948: Hodowla zwierząt, łowiectwo i rybactwo u mieszkańców Polski zachodniej w okresie halsztackim (r. 700-400 przed Chr.) i wczesnohistorycznym (r. 600-1100 po Chr.) [Animal culturing, hunting, and fisheries of the people of western Poland in the Halstadt period (600-1100 AD)]. Wiad. Archeolog., **16:** 164-177. (In Polish).

Łęga W., 1956: Społeczeństwo i państwo gdańsko-pomorskie w XII i XIII w. [The Gdańsk-Pomeranian State and its society in 12th and 13th centuries]. Prace Inst. Zach., Poznań: 1-309. (In Polish).

Makowiecki D., 1993: O Możliwościach poznawczych i niektórych problemat metodycznych archeozoologii polskiej [Cognitive potential and selected methodological problems of Polish archaeozoology]. Archeol. Poi., **38**, l: 37-49. (In Polish).

Makowiecki D., 1999: Some aspects of studies on the evolution of fish faunas and fishing in prehistorie and historie times in Poland. Mat. of Workshops „Ten holocene history of the European Yertebrate Fauna. Berlin 6-9 April 1998: 171-184. M. Leidorf GmbH.

Marciniak A., 1996: Archeologia i jej źródła. Materiały faunistyczne w praktyce badawczej archeologii [Archaeology and its sources. Faunistic materials in archaeological practice]. Wyd. Nauk. PAN Warszawa-Poznań. (In Polish).

Ninua N. **Sh.,** 1976: Atlantic sturgeon of the Rioni River. Akad. Nauk. Gruzinskoj SSR, Metsnieveba, Tbilisi.

Prummel W., 1986: The presence of bones of eel, *Anguilla anguilla,* in relation to taphonomic processes, cultural factors and the abundance of eel. Fish and Archeology, 294: 114-122.

Rosenlund K., 1976: Calalogue of subfossil Danish vertebraters - fishes. Zool. Museum of Copenhagen: 1-108

Rulewicz M., 1974: Ze studiów nad rybołówstwem we wczesnośredniowiecznych miastach przy ujściu Odry [A contribution to the knowledge on fishing in early medieval towns in the Odra River estuary]. Archeol. Poi., **19**, 2: 387-482. (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 13 th century]. Gdańskie Tow. Nauk., Ossolineum, Wrocław-Warszawa-Kraków. (In Polish).

Rulewicz M., Zajdel-Szczyrska L., 1970: Materiały do wczesnośredniowiecznego rybołówstwa w Wolinie [Studies of early medieval fishing at Wolin]. Mater. Zachodniopomor., **16**: 325-382. (In Polish).

Stanisławski B., 1999: Ceramika wczesnośredniowiecznego Wolina na tle południowo-zachodniej strefy Bałtyku [Ceramics of early medieval Wolin in relation to the south-western żonę of the Baltic]. Mater. Zachodniopomor., (In Poiish) (In press).

Susłowska W., 1966: Wykopaliskowe szczątki ryb z dzielnicy książęcej w Gdańsku [Archaeological fish remains from the prince's quarter of the city of Gdańsk]. Prz. Zool., **10**, 2: 198-203. (In Polish).

Susłowska W., 1968: The morphology of osseous remnants of cyprinidae fishes excavated in the main Gdańsk stand. Zool. Poi., **18**, 2: 171-210.

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

Susłowska W., Urbanowicz K., 1984: Wartość diagnostyczna łusek krajowych gatunków ryb karpiowatych (Cyprinidae) [Diagnostic value of the scales of Polish cyprinid fish species]. Ann. Zool., **38**, 5: 111-130. (In Polish).

Urbanowicz K., 1965: Połowy jesiotra zachodniego *Acipenser sturio* L. we wczesnośredniowiecznym Gdańsku w świetle materiałów wykopaliskowych [Catches of the cominon sturgeon, *Acipenser sturio* L. in early medieval Gdańsk in view of the excavation materiał. Prz. Zool. **9**, 4: 372-377/In Polish).

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STUDIA NAD ICHTIOFAUNĄ Z WYKOPALISK ARCHEOLOGICZNYCH Z WOLINA - MIASTA (STANOWISKO l, WYKOP 6)

STRESZCZENIE

W badaniach archeologicznych prowadzonych w latach 1970-1974 przez Instytut Archeologii i Etnologii Polskiej Akademii Nauk, w obszarze wczesnośredniowiecznego miasta Wolina (stanowisko l, wykop 6), pozyskano liczne szczątki ryb. Wystąpiły one w 16 warstw osadniczych, chronologicznie odpowiadających okresowi od końca połowy VIII do drugiej połowy XIII w. Z ogólnej liczby szczątków kostnych wynoszącej 16 463 szt., pod względem anatomicznym i gatunkowym zidentyfikowano 9 799 szt. Dalsze badania porównawcze kości pozwoliły na określenie 4 645 osobników ryb należących do 26 gatunków. Jeden gatunek *Gobio gobio* L. określono tylko na podstawie znalezionych łusek. W całym wykopalisku pod względem liczebności dominowały: *Stizostedion lucioperca* L. (31,6%), *Abramis brama* L. (26,2%), *Perca fluviatilis* L., (15,5%) oraz *Rutilus rutilus* L. (11,3%). Badania wykazały niewielką (opartą na znalezionych pojedynczych szczątkach kostnych), liczebność w wykopalisku *Salmo trutta* L., *Salmo salar* L., *Blicca bjoerkna* L., *Carassius carassius* L., *Pecelcus cultratus* L. oraz *Abramis ballerus* L. i *Lota lota* L. Interesujący jest fakt występowania stosunkowo dużej liczebności *Clupea harengus* L. (157 szt.) oraz rzadkiej w naszych wodach *Alosafallax* Lacépéde (61 szt.). Po raz pierwszy w wykopaliskach w naszym kraju stwierdzono występowanie kilku osobników *Alosa alosa* Lacepede W eksplorowanym wykopie znalezione dość liczne szczątki *Acipenser sturio* L.. Liczebność tej ryby określono na 93 szt., wśród których dominowały (73 szt.) osobniki o masie 15-40 kg. Stwierdzono również szczątki należące do kilkunastu jesiotrów o masie dochodzącej do 75-100 kg. Całkowitą, szacunkową masę tego gatunku ustalono na 3 285 kg. Podobną masę (3 386 kg) określono dla sandacza, który łącznie z jesiotrem stanowiły blisko 72% masy wszystkich ryb pozyskanych w analizowanym wykopie archeologicznym.

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