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VELSEN-1: INDICATIONS FOR WATER-POLLUTION IN THE HARBOUR OF A ROMAN CASTELLUM IN THE NETHERLANDS

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ABSTRACT: The provisional results of the investigation of the fish-remains from the excavation Velsen-1 are discussed with accent on the possibility to make use of fish-data to get any idea about the influence of the activities of the occupants of this Roman castellum on the water-quality. Crucial for such approach is the excavation-method, not only to obtain the fish-remains themselves, but also to get information about the moment of the formation (sedimentation) of the geological layers in which these remains are found. The preliminary conclusion is that the water of the harbour was growing worse in the course of time. The hypothesis that algae-blossoming caused the shift in the fish-population in favour of the Cyprinidae is entertained.

KEYWORDS: ROMAN CASTELLUM, 1st CENTURY A.D., HARBOUR, FISH-REMAINS, ALGAE-BLOSSOMING, WATER-POLLUTION

RESUMEN: Los resultados preliminares del análisis llevado a cabo con los restos de peces del yacimiento de Velsen-1 se valoran enfatizando la posibilidad de utilizar esta información para evaluar el impacto de las actividades humanas de este campamento romano sobre la calidad de las aguas. Clave para tal análisis es el método de excavación, no sólo para asegurar la recuperación de restos de peces sino también para informar acerca del momento de formación (sedimentación) de los estratos geológicos en donde aparecen tales huesos. La conclusión preliminar es que, con el tiempo, empeoró la calidad del agua. Se especula con la posibilidad de que sucesivas proliferaciones de algas unicelulares hayan potenciado un reemplazo de las poblaciones ícticas en favor de los ciprínidos.

PALABRAS CLAVE: CAMPAMENTO ROMANO, PRIMER SIGLO D.C., PUERTO, RESTOS DE PECES, PROLIFERACION DE ALGAS, CONTAMINACION DEL AGUA

ARCHAEOLOGICAL EVIDENCE

Velsen-1 is the name given to a Roman castellum close to Ijmuiden, the seaport of Amsterdam, the Netherlands. The excavation of the site by the Albert Egges van Giffen Institute for Prae- and Protohistory, University of Amsterdam, is still under progress.

Besides pottery and metal objects, a huge quantity of very well preserved organic materials have been found in the harbour of the castellum. Remainders of wharf-activities can be found mainly in an up to 15 cm-thick layer of wood chips, together with leathercuttings, parts of military foot-wear and many, many bones. Most of these bones are from domestic animals and evidence traces of butchering. It is generally accepted that they are refuse from the military kitchen. There are also bones of watergame, poultry and fish. Though these hardly show any cutmarks, it is assumed that at least part of them constitute food refuse as well.

Velsen-1 has been dated by coins, pottery-types, the design of the carved stones and dendrochronology. The castellum was in use from 16 AD to about 28 AD. On account of the features of the soil-record it was possible to detect two habitation-phases. Though the fort of the first phase had a triangular perimeter, it got a trapezoid shape after reconstruction in the second phase. The reason why the fort had to be reconstructed is unknown. Perhaps the nature of the Roman occupation shifted and the Frisian natives became hostile after a period of cooperative coexistence, so it was necessary to enlarge the defensive facilities of the fort.

In the harbour-area there was another reason for reconstruction of the harbour-works. It became evident during the first occupation stage that the original massive moles accelerated sedimentation. To neutralize its effects, dredging-works were executed, by which the spoil was drawn to the deeper parts of the harbour. These activities took place several times and the result was a mixture of habitation-refuse, sedimentation materials and the firm bottom spread over the riverbed, sometimes separated from each other by sandy layers. During the second phase the massive moles were reconstructed and partly replaced by open jetties, so there was no need for any more dredging. It was during this period that there was a steady accumulation of habitation-refuse on the bottom of the harbour at the top of the dredge-layers. This top-layer is characterized by a tightly-packed deposit of woodchips. Because it was first recognized as a deposit of Roman origin, it is called the 'Roman layer', in contrast with the so-called 'dredge layer', which is of Roman origin as well.

The excavator maintains that dredging stopped one or more years before the second stage of the castellum came about. It is, thus, possible to set boundaries for the two separate layers, which are effectivily sealed off by a sterile clay. The dredge layer came into being between approximately 16 and 22 AD, and the Roman layer around 22 and 28 AD.

Both layers can be considered as an accumulation with great diversity of materials during six years of occupation. They reflect a part of the history of both the castellum and the water environment surrounding it.

THE FISH-BONES OF THE HARBOUR

More than 900 fish-bones were identified by means of the comparison collection of the eco-archaeological department of the Albert Egges van Giffen Institute for Prae- and Protohistory at the University of Amsterdam. These bones were collected in units of one square meter each and the remains of each layer were set apart. Although there was no use of a sieve, the attention for small objects was high for the very reason that troweling in the chiplayer required attentiveness. This resulted in the retrieval of not only small bones, but of isolated scales as well.

The information on the species and their presence is used to reconstruct the natural environment of the harbour-area. Because the possibility existed that fish had been transported from elsewhere to the fort, information about molluscs and seeds from the harbour was also taken into account in the palaeoenvironmental analysis.

The conclusion was that the harbour was the broadening of a slowly running freshwater stream flowing from the Older Dunes into the northern branch of the river Rhine. The riverside was covered with alder (*Alnus*. sp.) and rush (*Scirpus* sp. & *Heleocharis* sp.). The strength of the current -depending on the seasons- was low and often dead, so the oxygen content fluctuated. The salinity was subject to seasonality too, as the westerly gales arrived in Autumn, transporting sand and salt from the nearby coast inwards, or during summertime when brackish water, percolating from the older salting in which the brook had cut away, got the overhand. The water-vegetation was flourishing and the oligohaline water made an intensive processing of dead organic material by bacteria possible. These circumstances and the muddy bottoms constitute an ideal environment for Cyprinids. As a matter of fact, the possibility of a well developed eco-system with the Cyprinids as main fish taxa and pike (*Esox lucius*) and perch (*Perca fluviatilis*) as predators is probably a quite good hypothesis concerning that former ichthyocenosis on account of all previously cited information.

When we take the two earlier mentioned layers into consideration, it must be possible to establish shifts in the ecological circumstances during these twelve years, and, in that case, speculate on how the new situation would exert influence on different species.

Taxonomic identification of the not-migratory fresh-water species

	DREDGE LAYER			ROMAN LAYER		
	n° of elements	relative frequency +catfish	-catfish	n° of elements	relative frequency +catfish	-catfish
Pike	46	25.1	32.5	42	11.5	22.7
Cyprinidae	2	1.1	1.4	31	8.5	16.8
Bream	34	18.6	23.9	59	16.2	31.9
White bream	34	18.6	23.9	17	4.7	9.2
Ide	-	-	-	1	0.3	0.5
Roach	1	0.5	0.7	3	complete	skeletons
Rudd	2	1.1	1.4	3	0.8	1.6
Catfish	41	22.4	-	179	49.2	-
Perch	23	12.6	16.2	32	8.8	17.3
Total NR of fish	183	100%	100%	364	100%	100%
All cyprinids	73	40%	51%	124	31%	60%

TABLE 1.

In Table 1 each identified element represents one individual. Because the finding of three complete skeletons of the roach whould have lead to an over-representation of this species, these have been omitted from the table.

In the older period [the 'dredge layer'] Cyprinids are well represented, as are the pike, the catfish and the perch. If we think in terms of an optimal food-web with the Cyprinids in the bottom and pike and perch at the top, the conclusion could be that the water was clean indeed.

The bottom of the river had soft and muddy sediments and was covered with waterplants, thus a good environment for catfish to flourish as well. Both pike and perch depend on clean water to be able to catch their prey. Pike lies always in ambush, hidden among the submerged vegetation awaiting its prey, while perch is more active and normally swims after its food.

During the later 'Roman layer-period' we detect a negative shift for all species except catfish. Catfish is, moreover, the only species with clear cutmarks on the bones. The scattering of these bones is limited to the west-jetty and fits in a pattern that is undoubtedly the result of a refuse-regulation system. This fish is living for the most part of the year in solitary occupying a rather wide territory. We therefore think that catfish had been caught elsewhere and their abundance in the harbour midden is not natural. For this reason, we have set Siluris glanis apart from the remainder of the ichthyocenosis, bearing in mind that some individuals should have still existed in the harbour area nevertheless.

When catfish are excluded from the local sample, we find a remarkable increase with time of Cyprinids. Roach, a species that was hardly represented in the dredge layer, is also found. Remarkable as well is the reduction of the relative frequency of pike from 32% to 22%. If we look for an explanation, then two possibilities invoking either a natural or a human cause come to mind.

Even if we contend that the bones are the result of the practice of throwing left-overs into the harbour, it is not possible to explain such a considerable reduction in number of remains simply in terms of shifting eating practices, although the flesh of pike was held lower than that of catfish by the Romans themselves. We have to realize that the castellum was located in a borderland with few possibilities to deliver good-quality foods and that only a few true Romans by birth are thought to have been living there as members of the garrison. Most of the occupants were probably of German or Illyrian origin and would not have any aversion to eat pike. So even in the case that the bones in the harbour are the result of the practice of dispatching garbage or refuse into the water, the drop in pike remains is not sensible for there was always a permanent need for food; a natural cause, therefore, seems to be a more likely alternative.

Hence we think that one has here an indication for the alteration of the natural environment around the fort. This change had a negative effect on the presence of pike, and the Cyprinids took advantage of such contingency. The origin of this shift in the fish populations might be a growing intransparency of the water, most likely caused by the blossoming of algae. In such a situation it could have been impossible for pike to spot its prey and the species diminished drastically.

It is known that perch is more resistant under such circumstances and can even survive in an environment with critical oxygen concentrations, just as the roach does. It could, then, be no coincidence that we find a proportional increase of perch, which can be a consequence of a competitive displacement caused by the retreat of pike from the scene.

Summarizing, we can conclude, that there are indications for a degradation of the water-environment around Velsen-1. When we look for an explanation, the following causes can possibly have played a part:

1) The disposal of garbage and left-overs into the harbour. This caused an increase in the amount of nutrients favouring algal and plant growth.

2) The negative effects on the water-quality caused by the production of leather and lead. (A huge quantity of leathercuttings as well as lead-drops and -slags have been retrieved).

3) Disturbance of the waters by harbour-activities such as mooring and pooling of ships.

4) The activities of the Cyprinids themselves, rooting up their meals in the soft bottom of the harbour.

Although a combination of all these agents is possible, we believe the refuse disposal-system of Velsen-1 to be mostly responsible for the changes detected. At any rate, we seen to have evidence for environmental pollution during Roman times in the Netherlands.

The presumption of environmental pollution should be analyzed by an investigation of diatoms from the layers, but such study is still in progress. In any case environmental pollution can give the clues of why so many water-wells are found both in- and outside the fort. Altogether there are 28 wells of different types and depth. Some of them probably served for industrial use, but the very deep ones undoubtedly provided the garrison with freshwater, for the soldiers obviously could not obtain it from the nearby river. Thus the investigation of the fish-bones, in combination with the possibilities offered by the excavation-strategy selected have paved, the way for a more holistic interpretation of Velsen-1.

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