Wickerwork Fish Traps from the Roman period in the Netherlands*

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Titel – **Korbreusen der Römerzeit in den Niederlanden**

Zusammenfassung – Aufgrund der Feuchtbodenerhaltung konnten niederländische Archäologen hervorragend erhaltene römerzeitliche Korbreusen bergen und untersuchen. Die Mehrzahl wurde in situ dokumentiert und in Vorberichten publiziert. An dieser Stelle wird erstmals ein vergleichender Überblick von 24 eisen- bis römerzeitlichen Reusen von acht Fundorten gegeben. Außerdem wird erörtert inwieweit vorrömische Traditionen bei der Herstellung und Nutzung von Reusen fortwirken könnten.

Untersucht werden im Vergleich zu Reusen aus ganz Europa die verwendeten Hölzer (Taxon, Alter), die Konstruktion, die Methoden zur Befestigung am Boden, deren Lagerung und Verwendung ebenso wie die bejagten Fischarten und ausgegrabene Fischreste aus den betreffenden Fundorten, die Rückschlüsse auf andere Methoden des Fischfangs geben.

Bis auf die an prähistorische Fallen erinnernde Reuse von Ellewoutsdijk (Typus 1), die wohl zum Fangen größerer Fische diente, gehören alle demselben zylindrischen bis glockenförmigen Typus 2 mit festem innerem Trichter und einer verschließbaren Öffnung zum Entnehmen des Fangs an.

Auf diesen liegt der Fokus der Untersuchung: Sie lassen sich aufgrund der inneren Trichteröffnung und der Außenmaße drei Subtypen zuweisen. Besondere Konstruktionen wie angespitzte Streben und die Kombination mit Netzen werden ebenso erörtert wie die Frage, ob etwa kontinuierliche Holzernten einen gezielten Anbau von Weiden anzeigen. Mit einer Ausnahme wurden die verwendeten Hölzer im Frühling geschnitten.

Schlüsselwörter – Eisenzeit, Römerzeit, Nordsee, Fischfang, Reusen, Gerätetypologie, Weide

Summary – Due to waterlogged conditions, the Netherlands have provided archaeologists with excellently preserved wickerwork fish traps from the Roman period. Most of them have been discovered in situ and are published in basic rapports. For the first time the authors provide an overview about the 24 Iron Age to Roman times fish traps from eight findspots and discuss them in respect to pre-Roman traditions.

The study focusses on the type of used wood (taxon, age), the technical construction, methods of mounting and the use of the traps, as well as the targeted fish species and excavated fish remains from relevant sites, that provide clues to other methods of catching fish.

With one exception (Ellewoutsdijk), all traps belong to the same type 2, a closely woven basket, cylindrical or bell-shaped, with a fixed internal tunnel or throat and a lockable opening to remove the catch. The trap from Ellewoutsdijk (type 1) brings to mind prehistoric traps, with an open wickerwork structure and is likely to have served catching larger fish.

The main emphasis lies on type 2 and its three subtypes. Special constructions as pointed stakes and the combination with nets are considered as well as the question of wood management. With one exception all wood has been harvested in springtime.

Key words – Iron Age, Roman Period, Fish Traps, Typology, wood management

1. Introduction

Due to waterlogged conditions, the Netherlands have provided archaeologists with excellently preserved organic materials from the past, materials which include bone and wood. In this paper the authors focus on wickerwork fish traps from the Roman period, that have been excavated during the last 30 years. Although many of these traps have been studied and published before as part of site reports, most of these publications are in Dutch. An overview of all known Roman fish traps was until now lacking. This paper provides this overview in relation to traps from the Iron Age. Discussed are the type of used wood (taxon, age), the technical construction and use of the traps, as well as the targeted fish species and excavated fish remains from the relevant sites.

2. The Roman presence in the Netherlands

The first Romans arrived in the Netherlands during the Augustan campaigns. Around 19 BC they set up a legionary camp in the east, at present-day Nijmegen[1]. After this three early forts (*castella*) were built, at Vechten, Velsen and Arnhem-Meinerswijk[2]. From the early forties AD onwards, a string of timber auxiliary forts and watchtowers were set up along the river Rhine, from the North Sea into what is now Germany[3]. These forts were occupied, in most cases, well into the third century, although their exact date of abandonment is currently under discussion[4].

Vici formed around the military forts, most from around AD 70 onwards, and are thought to have housed mainly people dependent on the soldiers' presence, such as relatives, craftspeople, innkeepers and so on. The river Rhine eventually became the *limes*, the northern border of the Roman empire. The *Classis Germanica*, headquartered at Köln-Alteburg (near Cologne, Germany),

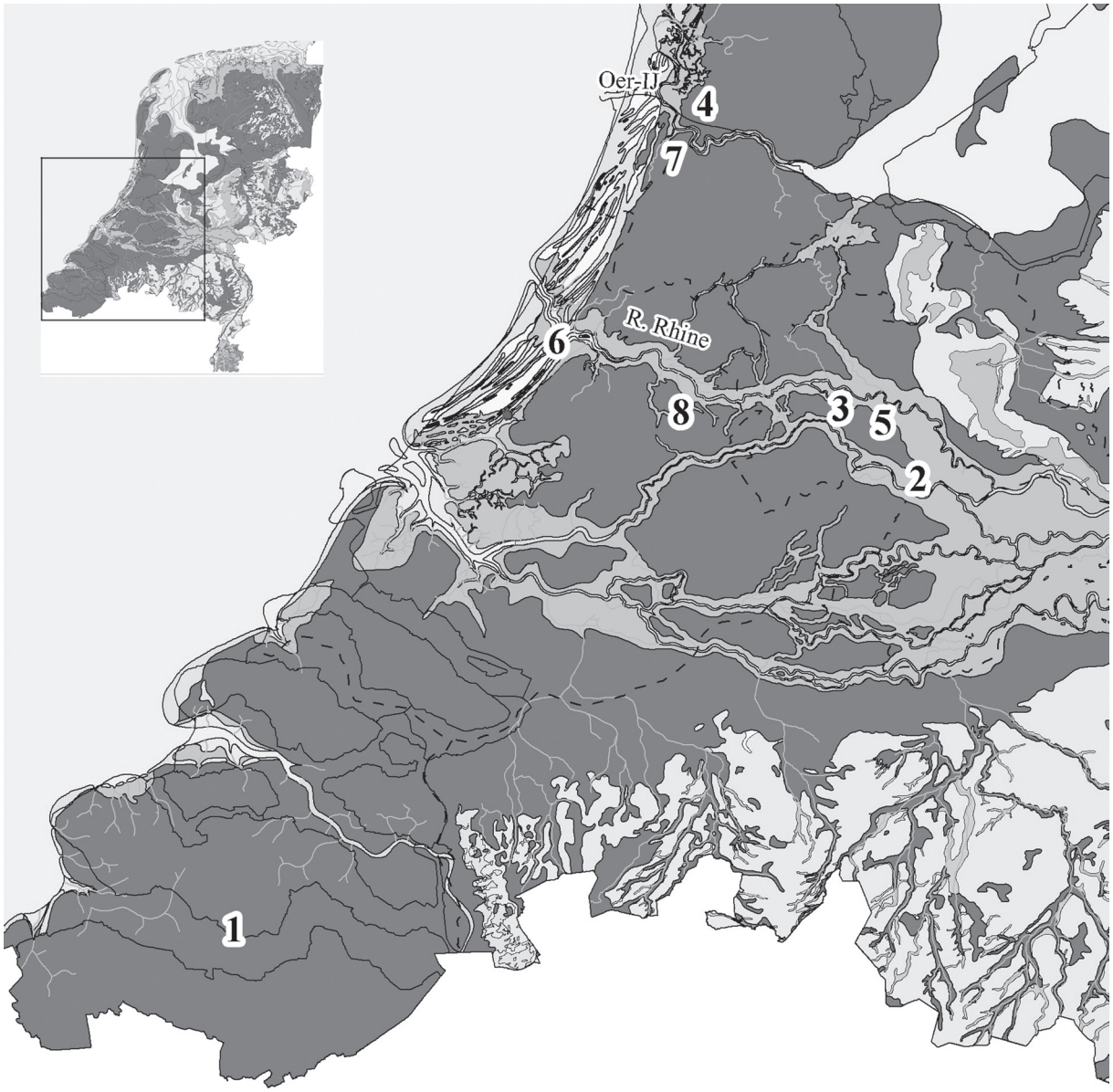

Fig. 1 The palaeo-geographic situation of the Netherlands AD 100 and the sites mentioned in the text: 1= Ellewoutsdijk, 2= Houten-Castellum, 3= De Meern and Leidsche Rijn area, 4= Uitgeest, 5= Utrecht, 6= Valkenburg (ZH), 7= Velsen, 8= Zwammerdam.

patrolled both the Rhine and North Sea coasts. The *Classis Germanica* is thought to have had small fleet stations in other areas south of the river Rhine as well, such as Naaldwijk, from the mid-second century onwards. Other forts and military centres were later set up in the coastal area of the Netherlands such as Ockenburg[5] and Aardenburg[6]. Only two urban centres from the Roman period are known in the Netherlands: *Ulpia Noviomagus* (today Nijmegen) and *Forum Hadriani* (today Voorburg-Arentsburg)[7].

Most of the local population south of the river Rhine continued to live as before, in farmsteads comprising one or two houses that are thought to have housed an extended family[8]. Their lives must have thoroughly changed, being now an integral part of the Roman Empire. In the archaeological record, we find indications for an intensified agriculture and surplus production[9]. From the third century onwards, a gradual decline of the Roman supremacy in the area set in, with the final fall of the provincial centre Cologne in the early fifth century.

3. Fish and fishing in the past in the Netherlands

Fishing can be attested to by the presence of fish bones on archaeological sites, although such bone assemblages may only point to a consumers' site with the fishing being carried out elsewhere, and possibly by others. The presence of fishing gear such as traps and hooks on sites, however, can be taken as direct evidence of fishing activities carried out by individuals or groups with a direct link to the site. For the Netherlands, fishing and fish consumption have been attested to by finds from archaeological sites from the Palaeolithic onwards[10].

Several well preserved fish traps have been found on archaeological sites dating from the Mesolithic onwards[11]. No less than 20 fish traps from the Roman period have been found in the Netherlands. All belong to the same type of wickerwork trap, with one exception from the site of Ellewoutsdijk (see below). The traps were found in 8 different archaeological sites and areas which will be described briefly in the next paragraph in alphabetical order (see **fig. 1**).

3.1. Sites with fish traps from the Roman period

1. Ellewoutsdijk
Ellewoutsdijk, in today's province of Zeeland, is the site of a small indigenous settlement, dating from the early first to the early second century AD. This site consisted of a few farmsteads situated in the peat area near the coast. Its inhabitants practised mixed farming and fishing, and had some contacts with the Romans, based on archaeological finds[12]. Freshwater streams from the peat area, as well as brackish water in tidal creeks, provided possibilities for fishing, while the coastline with tidal flats and salt marshes was only a few kilometres away. Next to a tidal creek remains of a wooden fish trap were excavated.

2. Houten-Castellum
In contrast to the site name Houten-Castellum, the excavation revealed the remains of an indigenous farmstead dating to the Roman period. As the research of this site is still in progress, the provisional date for this occupation level is AD 70–150. One trap dating from this period was found in a silted up residual channel. Houten is situated in the central river area where a continuous process of river activity led to the relocation of rivers and tributaries, the build up and erosion of levees and alluvial ridges, and the formation and ensuing silting up of channels. The Houten area would have been a strictly freshwater region.

3. Leidsche Rijn area and Roman fort De Meern
This area, west of Utrecht's city centre, has been extensively developed during the last decade. This has led to much small and large scale archaeological research and finds, resulting in a thoroughly investigated microregion in the vicinity of the Roman fort of De Meern. Apart from the fort, watchtowers, roads, waterworks and quays that have been revealed, indigenous farms have been found which show clear ties to the Roman military. The researches have, over the years, resulted in the findings of no less than 9 fish traps. De Meern is located in the Dutch River Area. This area consisted of active rivers, that were flanked by higher levees and older alluvial ridges, formed by levees from former rivers and their residual channels. The fort of De Meern is thought to have been built near the split of the river Rhine and a diverging branch, the river Heldammer. All the excavated fish traps were found in silted up channels belonging to the so-called Heldammer channel belt (ref. nrs. 9, 10, 13, 18, 19, 20, 21, 22 and 23). The aquatic environment would have been strictly freshwater. For details on the dating of the respective sites within this area (**tab. 1**).

4. Uitgeest-2, terp 100
This indigenous settlement in the coastal area consisted of a low artificial mound (*terp*) on the salt marshes (Dutch: *kwelder*), near the Oer-IJ estuary where a northern branch of the river Rhine flowed into the North Sea. A simple dwelling (with a temporal use, perhaps herding sheep on the barrier plains in the summer) was probably constructed on the mound, and is dated to the late Iron Age or early Roman period. During excavations of the *terp* a fishtrap came to light[13] (ref. nr. 4).

5. Utrecht
Utrecht is located a few kilometres upstream from Leidsche Rijn/De Meern. Utrecht is situated in the Dutch River Area: active rivers, flanked by higher levees and older alluvial ridges that were formed by levees from former rivers and their residual channels. The fort of Utrecht was located in the centre of the present-day city, near the river Rhine. Near the fort, the river Vecht branched off towards the north. It was built during the forties AD and functioned well into the third century. The trap 'Achter Clarenburg' (ref. nr. 12) was

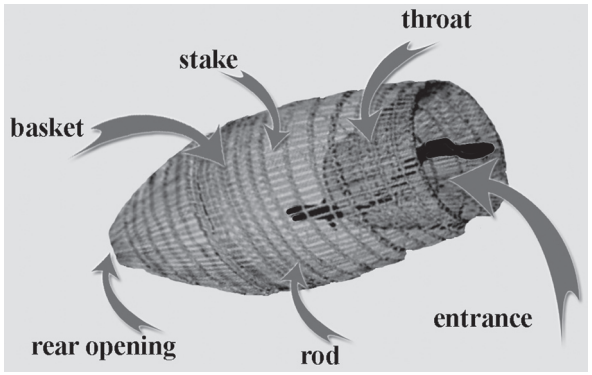

Fig. 2 Schematic drawing of a fish trap.

found in a silted part of the riverbed and has been radiocarbon dated to AD 70 ± 35[14].

6. Valkenburg (Zuid-Holland)
Valkenburg was situated in the coastal area in the western Netherlands, near the estuary where the river Rhine flowed into the North Sea. The aquatic environment here would have been slightly brackish as salty sea water mixed with fresh water in the estuary. In the area surrounding the estuary a marine clay deposit had been deposited on top of peat or older clay deposits. The Valkenburg area formed part of a freshwater tidal district[15]. Roman Valkenburg lay on the river Rhine's left bank, approximately 10 kilometres from the mouth of the river. Here, southern tributaries (elsewhere called Marktveld-gully and the Woerd-gully) joined the river Rhine. The fort was in use from the forties AD onwards well into the third century. During this period a *vicus*, Roman roads, a cemetery, quays and a watchtower also formed part of the area. The three traps (ref. nrs. 14, 15 and 16), probable date between AD 120–160, all come from the Marktveld-gully, as well as two fish-tanks that were also reported by van Rijn[16].

7. Velsen
The military base of Velsen-1 was built from ca. AD 14–16 and served as a fort and harbour for over 15 years. After this it was abandoned and a second fort built (Velsen-2) nearby. The fort of Velsen-1 was situated in the Oer-IJ estuary, where a northerly branch of the Rhine discharged into the North Sea and interrupted dune ridges and barrier plains. In the estuary fresh water mixed with salty sea water. Due to the tidal influence, the water in the harbour will have been somewhat brackish. The four traps (ref. nrs. 5, 6, 7, and 8) were found in the harbour.

8. Zwammerdam
The location of the Roman fort of *Nigrum Pullum* was situated on the Rhine's southern levees. The fort of Zwammerdam was built during the forties AD and continued to be in use until well into the third century. In this wet area, the levees formed a narrow corridor of accessible terrain through extensive wetlands with active peat development. Although there was tidal influence in the river Rhine, this did not extend beyond the Leiden area further to the west[17]. The aquatic environment, therefore, would have been strictly freshwater. Near the location of the fort of Zwammerdam, at least one fish trap was seen during civil engineering works but it could not be saved or researched[18].

The preservation of the traps mentioned was possible due to waterlogged conditions. The clay and sand layers resulting from the silting up of channels and rivers formed excellent circumstances to preserve the perishable wood. In cases where groundwater tables fluctuated, channels were (partly) reactivated or circumstances in the soil changed, traps were damaged, dried out and/or deteriorated because of exposure to oxygen. In most cases this has resulted in partial preservation of the trap (**tab. 2**).

3.2. Fish traps from the Roman period

Most of these fish traps have been published before as part of site reports, in most cases by wood specialists[19].

With one exception (Ellewoutsdijk, see below), all traps belong to the same type (**fig. 2**): a closely woven basket, cylindrical or bell-shaped, with a fixed internal tunnel or throat and an opening to remove the catch. The opening would have been closed with a plug made of wood, textile or grass. In one case (ref. nr. 5) mention is made of a small mat or flap closing over the opening. This flap was woven from willow bark and Spruijt[20] assumes that it sufficed to close the opening.

The trap from Ellewoutsdijk (ref. nr. 24) brings to mind prehistoric traps, with an open wickerwork structure. The remains of a wooden hoop were found in association with an iron fish hook and willow (*Salix*) rods or stakes. The hoop was made of split *Taxus* wood. The remaining part was about 2 metres long and about 0.028–0.032 m in width. At irregular intervals seven square holes were cut out in which small pins of *Taxus* wood were fixed. Another piece of *Taxus* wood with square holes in it was found nearby. The wil-

Fig. 3 Fish trap from Leidsche Rijn-Hoge Weide (LR 42), ref. nr. 10. Date: first half of first century AD.

low stakes, with a diameter of 0,01–0,025 m, were found inside the trap and could well have been part of the trap[21]. These could have formed open wickerwork in which the hoops were attached to keep the basket's rounded structure. Another possibility is that the hoops were connected to some sort of netting, made from plant fibre. Until now no such netting has been found on Dutch archaeological sites. Ellewoutsdijk remains the exception for the Roman period. All other fish traps are of the basket-like type which form the focus of this article.

3.4. Research methods

Between ten and fifteen samples were taken from most traps to gather information on taxon, age, cutting season, use of complete or split rods, and whether rods were peeled or not. The position of rods and twigs was noted, and the weaving method described. Most traps were found flattened and deformed, and with oval rods. Sizes and diameters, therefore, are to be considered as reconstructions more than absolute values.

For the anatomical microscopic identification of wood remains, the wood was prepared by taking microscopically thin slices of the transversal, radial and tangential plane in relation to the longitudinal axis of a tree. A transmittent-light microscope with magnifications between 10–100 x and Schweingruber's identification keys[22] were used, sometimes together with reference slides from BIAX Consult to identify the wood taxa.

3.5. General construction techniques

The general construction of the basket-like traps is as follows: The weaver starts by making the throat. The throat is made by placing stakes (the passive elements) at a regular interval. In most cases with these traps an interval of approximately 0,02–0,04 m is common. The stakes are mostly used in pairs, occasionally in groups of three. Rods are then inserted and woven around the stakes. In most cases the technique used in these Roman fish traps is the so-called English randing, rods inserted one at a time[23]. In some cases French randing is used, where two or more rods are inserted and worked up simultaneously[24].

In three cases (ref. nrs. 18, 19 and 21) the weaving on the stakes started only after several centimeters. In these cases, the tips of the stakes were sharpened and protruded into the basket, preventing the fish from swimming out[25].

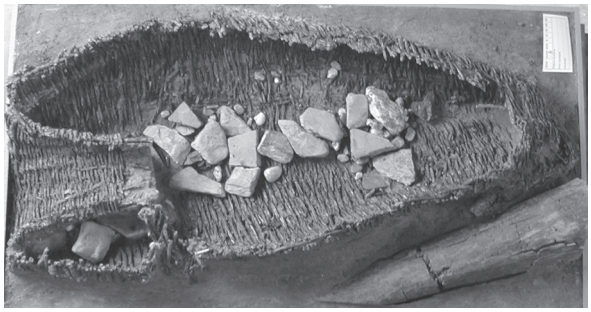

Fig. 4 Fishtrap from Leidsche Rijn Gemeentewerf, ref. nr. 18. Date: end of second or beginning of third century AD.

Although the throats are very tightly woven, Spruijt[26] indicates that in the case of Velsen 1986-1 (ref. nr. 5), the beginning of the throat is of an open nature. This would enable slightly bigger fish to push through the small opening and enter the basket. Spruijt also mentions that the weaving of this throat is different from that of the basket. The rods have been twisted every time before weaving into the next stake. The twisting both enforces the rods and makes them more flexible, thus enabling the rods to bend more easily without fear of breakage.

While weaving the throat, extra stakes are inserted to enlarge the diameter of the throat and trap. After several tens of centimetres, the stakes are bent backwards and the weaving of the basket begins. In one case at this point (ref. nr. 5) some form of reinforcement is woven into the basket, in the form of twined strands of willow bark.

During the weaving of the basket, more stakes are inserted, and a bell shape is formed. After reaching the maximum desired diameter of the basket's belly, the weaver gradually diminishes its size by weaving the stakes in between the rods of the basket. The outcome is a closely woven basket.

The basket ends in a small opening at the rear, where a rim is formed by fixing stakes and rods behind each other, and then the last remaining bit cut out. This rear opening is used to take the fish out, and can be plugged by moss, textile, wood, etc. In a few cases these plugs have been found; Spruijt indicates the use of a woven bark mat to close the opening (ref. nr. 5; some form of plug may also have been inserted on top of this). In one case (ref. nr. 6) moss was found.

In two cases, Velsen ref. nr. 7 and Valkenburg ref. nr. 7, the trap has an attached handle made of twisted rods [27]. The handle makes it easier to place the trap and haul it up again by the fisherman. The trap of Zwammerdam (ref. nr. 17) could only be observed in the field. No further information on this trap is available than that it was of the same closely woven type as other Roman fish traps[28].

3.6. Dimensions of the traps

Due to partial preservation of most traps, it has not always been possible to take all the traps' desired measurements. In some cases, it was possible to measure or reconstruct some of the original sizes. The general findings are discussed below; for details please see **tab. 2**.

Length of the traps: the majority of the traps (n=11) vary in length between ca. 0.80 m and 1.03 m. In at least two cases (ref. nrs. 4 and 10) the length of the traps is significantly smaller: respectively 0.50 and 0.55 m. The connected sites are Uitgeest-2, terp 100 and Leidsche Rijn-Hoge Weide. These are both local farmsteads that date from the early Roman period.

Width of trap: the width varies considerably, from 0.35 to 0.67 m, but it is not always clear from the site and specialists' reports if the width is the reconstructed (original) width, or measured while the traps were flattened due to the weight of the soil under which they lay buried for over 1.500 years.

There seems to be no real connection between the length of trap and its width. This apparent lack of significance for width and length may be attributed to the few data from those traps that were preserved well enough to enable (reconstructed) width and length measurements.

Length of throat: in cases where the throat was more or less completely preserved, lengths vary from ca. 0.26 m (n=1: Utrecht-Achter Clarenburg, ref. nr. 12) to a 0.45–0.49 m (n=4; ref. nrs. 14, 15, 16 and 18). In the case of Utrecht-Achter Clarenburg the total length of the trap is ca. 0.95 m, while the traps from Valkenburg-Marktveld (ref. nrs. 14, 15, 16) vary from 0.80 to 1.03 m, matching the length of the trap from Leidsche Rijn (ref. nr. 18; length 0.85–0.90 m). Utrecht-Clarenburg therefore seems to be an exception to the throats' lengths found in general.

Rear opening: the diameter of the rear opening when preserved (n=5) varies from 0.02–0.04 m with the exception of Utrecht-Achter Clarenburg (ref. nr. 12) where the rear opening measures ca. 0.075 m. If the rear opening is used to take the fish out, this could be an indication for the size (and to some point species) of fish targeted by the fisherman. There seems to be no direct connection between total length of the trap and the width of the rear opening.

3.7. Wood taxa, age and diameter and indications for wood management

All traps, except one, are made from willow (*Salix*) with occasional use of one or more rods of dogwood (*Cornus sanguinea*) in the case of Leidsche Rijn-Gemeentewerf (ref. nr. 20). One trap (ref. nr. 16), however, is completely made from *Cornus.* This trap was one of the three found in Valkenburg. *Cornus sanguinea* and *Cornus mas* cannot be distinguished anatomically. *Cornus sanguinea* is indigenous in the western part of the Netherlands, whereas the most northern limit of the natural habitat of *Cornus mas* is found in the southeastern part of the country. Seeds of *Cornus sanguinea* were found in the macroscopic soil samples taken from the Marktveld-gully[29].

The different species of *Salix* cannot be distinguished with the microscope but possible candidates are *Salix pupurea, Salix trianda, Salix fragilis, Salix viminalis* and *Salix alba*. These would be well suited to the environment and are in fact still in use in the Netherlands for fine basketry.

In all cases the stakes and rods were unpeeled, with the exception of the *Cornus* trap from Valkenburg (ref. nr. 16). This had shaven rods.

Rods in the traps were both split and unsplit, with a preference for unsplit. In one case (Uitgeest-2, ref. nr. 4) mention is made of simultane-

Fig. 5 Detail of the closed weaving (trap ref. nr. 19).

ous use of split and unsplit rods. In the *Cornus* trap from Valkenburg (ref. nr. 16), exclusive use is made of split rods.

Diameters of rods and stakes: when weaving a basket, it is usual that the stakes (the passive elements) are more robust than the rods that have to be flexible enough to be bent and inserted. In the case of these traps, however, little difference is found between the thicknesses of stakes and rods. This might explain the use of pairs of stakes in the weaving to enhance robustness in the trap's length. Diameters lie mostly between 0.03–0.08 m, with two exceptions: Leidsche Rijn-Gemeentewerf (ref. nr. 21), where thicker (0.09 m) stakes were sometimes used alone, and Leidsche Rijn Gemeente-werf (**fig. 5;** ref. nr. 19), where Van Rijn reports an overall use of thicker elements for the basket of the trap (up to 0.09 m) in contrast to a lighter throat. The same was observed by Lange for the trap from Leidsche Rijn Waterland, ref. nr. 13[30]. The differential use may stem from the fact that thicker elements would be less suitable for stakes in the throat as they were likely to break when bent backwards. A more robust basket would ensure that the living content would be unable to break through and worm its way out.

The age at cutting of the willow rods differs: one year's growth but also two- and three-year-old rods are used. In four cases the season of cutting was early spring, in one case late spring/early summer. Only in the case of Valkenburg (ref. nr. 14) were the rods cut in late autumn or winter. In case of the *Cornus* trap (ref. nr. 16) it was not possible to assess the age, due to splitting. In the trap from Leidsche Rijn Gemeentewerf, where *Cornus* was used incidentally (ref. nr. 20), the *Cornus* rods were two-years-old (**tab. 3**).

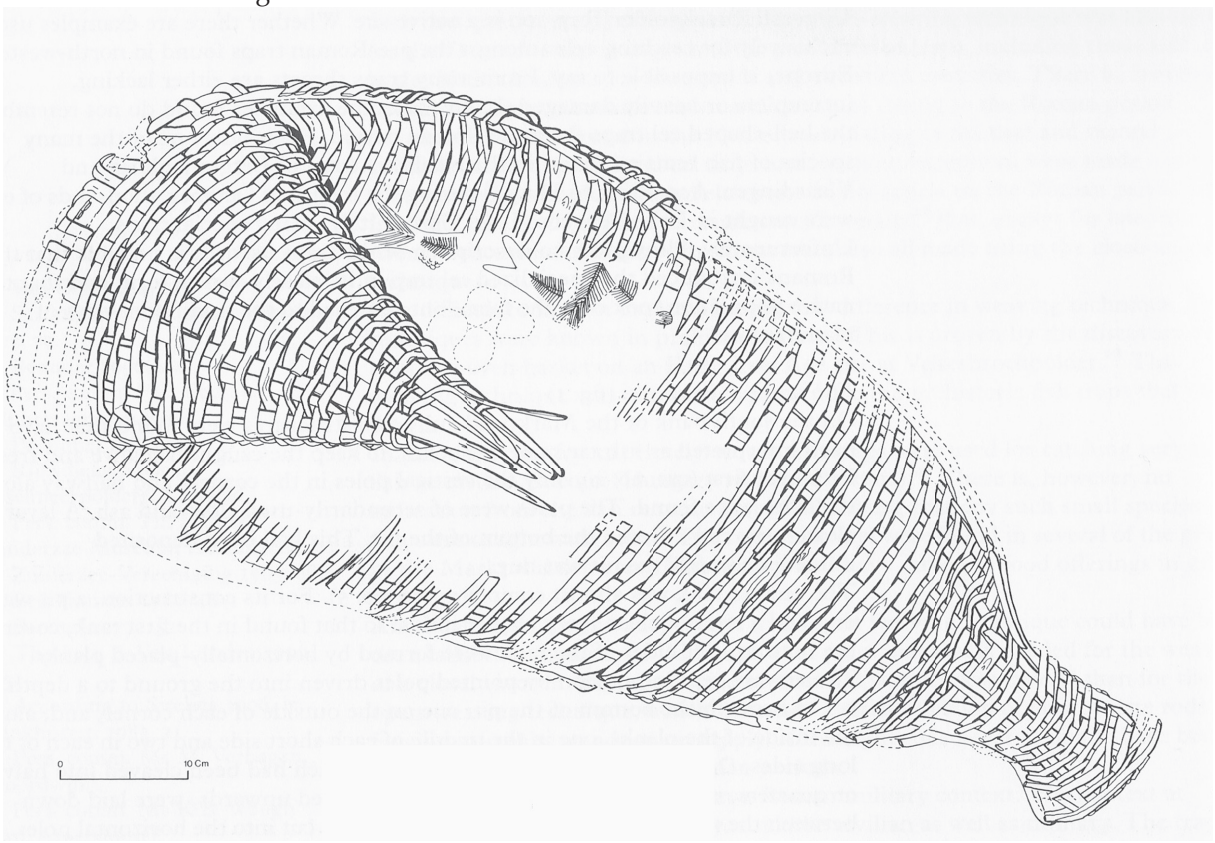

Fig. 6 Fish trap from Valkenburg (ref. nr. 15), showing the finds of fish remains inside the trap.

Fig. 7 Knot from *Salix*, found in Leidsche Rijn Parkzichtlaan-Zuid (LR62), trap ref. nr. 22; a similar one was found in Valkenburg.

3.8. Wood management?

It is tempting to conclude on the basis of the average diameter size, and the (almost sole) preference for *Salix*, that the wood used for these traps comes from managed woodlands. Out, Vermeeren & Hänninen[31] have recently shown that such a conclusion cannot be drawn lightly. It requires thorough studies and measurements of the wood finds. The researchers conclude in the case of the Neolithic fish traps from Emmeloord that diameter selection in hazel and willow may take place but that small diameter sizes need not exclusively come from managed trees, as these type of thin, long branches (one- to two-year-old rods) are also found on (damaged) natural trees. For most of the traps in this article, that were unearthed over a thirty year period, the registered measurements do not provide enough information to draw any conclusion on the point of managed woodland. Lange[32] studied wood from another Roman site in the Leidsche Rijn area (LR 45), dating to the second half of the second century AD. From the age and diameter of the rods, as well as from finds of roots and stems that show signs of repetitive cutting (harvesting), she concludes that active management of *Salix* took place in this area.

3.9. Fishing with wickerwork fish traps

Fishing with a trap is a passive form of fishing. It does not require the constant presence of the fisherman, in contrast to angling or the use of cast nets[33]. Traps can either be placed individually or form part of a system whereby fish on their way up- or downstream meet with fences that they cannot pass. With fences or screens on both sides of a stream, fish are forced into a narrow path that can end in some sort of trap[34]. In the case of the traps under discussion here, it is questionable if such a trap-system was in use. In one case the site report does mention the nearness of what may possibly have been a wooden screen or fish fence near the trap (Utrecht-Achter Clarenburg, ref. nr. 12)[35].

A freshly woven trap will float in water. This floating is prevented by putting heavy items into a trap so it will sink and stay in the desired spot. In 12 out of 19 traps (**tab. 2**) there were finds of natural stones, Roman tiles and bricks, a ceramic net-sinker and a cow's bone, all used to weigh the traps down and make sure the opening would be in the right position.

The traps are placed with the opening on or near the bottom of the river or stream. How the opening is placed exactly, depends on the behavior of the species targeted. A good fisherman will also make adjustments based on the water's temperature, tide, and other factors. The traps are usually tied with a rope to a stake or nearby tree. In some cases marks are attached to these ropes or stakes. Sailing ships, row boats and canoes appeared on these waters and these marks would have indicated both ownership and warned crews to stay clear of the traps.

In five cases the presence of nearby poles is mentioned in the site reports (Velsen-1, ref. nr. 7, Leidsche Rijn Gemeentewerf, ref. nrs. 18, 19 and 20. and Leidsche Rijn Parkzichtlaan-Zuid, ref. nr. 22), although a direct association to the traps cannot be made. It is possible that the traps could be set at the desired depth and angle by changing the position of such wooden poles[36]. Trap ref. nr. 22 also had an associated knot of willow bark (**fig. 7**), whereas the trap with the handle from Valkenburg-Marktveld (ref. nr. 14) had a thick rope fastened through the handle, thus implying that these traps were indeed tied to a nearby stake or tree.

The form of the trap lures the fish in, but at the same time prevents it from swimming out. This effect is obtained by attaching a rapidly narrowing throat to the trap; in the case of the traps discussed here, the throat forms an integral part of the woven structure. The fish will swim up the throat towards the trap's end, which is only centimetres wide. Most fish will swim through this opening and become trapped inside the basket. The basket is tightly woven, and fish cannot escape. The tips of the stakes that form the start of

the throat and protrude into the basket are sometimes flattened and sharpened. The fish that try to swim back through the small opening will wound themselves on these pointed stakes, and so be prevented from escaping. The catch is gathered in the rear part of the basket.

The fish in the traps will stay fresh for one or more days. A regular check of the traps is required, however, preferably daily or every other day. The trap is hauled up and the catch removed from an opening at the rear of the trap. The fisherman can decide to leave the trap in the same place or put it somewhere else. Once out of the water, a wickerwork trap will soon dry out, so it is better to leave it in the water, even when not in use. A wickerwork trap could be used for one or two seasons. After this it would have had to be replaced by a new one.

4. Which fish were targeted?

There are several points to consider when it comes to understanding which species of fish were targeted with these traps: form, width of entrance and rear opening, and habitat demands.

The form of the described wickerwork traps, a basket with a throat, is suitable for fish looking for a safe space to rest and targets species that like to hide between branches, reeds or in mud, and/or in the dark. This applies to many species, and gives little indication. The width of the openings, however, is more telling. With the exception of the trap from Utrecht-Achter Clarenburg (ref. nr. 12), the rear opening is only 0.02–0.04 m wide. The throat opening could be observed in only six traps, and then is 0.02–0.04 m wide; there is a slightly larger opening of 0.05 m in the case of Leidsche Rijn Hoge Weide (ref. nr. 10) and a much wider opening in the case of Utrecht-Achter Clarenburg (0.07–0.10 m).

A width of around 0.04 m will allow several species to pass, but flatfish are less likely to enter. Cyprinids, salmonids and clupeids, such as shad will be able to pass, up to a length of 0.20–0.25 m, based on the observed body depth of 19–25 % for most of these species[37]. One exception is bream (*Abramis brama*). Bream has a fairly steep and high back, so only small specimens of this species would have been able to pass through these openings. Eels are very slender and even very large specimens up to 1 m would be able to pass[38]. Another species that has no historical record of consumption in the Netherlands, but was (and sometimes still is) highly favoured in other European countries is the river lamprey (*Lampetra fluviatilis*). Until well into the nineteenth century this eel-like species migrated in large quantities in Dutch rivers, but was mainly used as bait for sea fishing (especially for cod and haddock)[39]. Lampreys have a cartilaginous skeleton that usually does not preserved; only its tiny teeth are sometimes found and so attest their presence. No lampreys have yet been identified in the archaeological record for the Netherlands.

The most important habitat demands in the case of fish are the occurrence of specific water plants, substrate, salinity, flow velocity, oxygen, water temperature, water acidity, depth, water quality and food availability. It is apparent that many of these criteria are unknown from the archaeological record. Specialists' research, such as archaeobotany, diatom and geophysical research can provide data on landscape and plants, aquatic environment, substratum and salinity. In the estuaries and zones with tidal influence, salinity will have been higher, but several freshwater species are tolerant for increased salinity, at least for a short time span[40]. Flow velocity is more difficult to establish. Most of the Dutch area falls within the so-called bream zone, with a gentle gradient, low flow velocity, average to high oxygen and a soft, silty substrate. Eastern and southern parts of the Netherlands also showed characteristics of the so-called barbel zone with a higher flow velocity and a substrate consisting of gravel and silt[41]. Therefore, the occurrence of most freshwater species expected for these zones, differs only gradually throughout the Dutch waters.

Apart from three traps (ref. nrs. 4, 9 and 13), all traps are supposed to have been more or less *in situ*. No doubt this was due to the material that was used to weigh them down. Only the traps from Utrecht (ref. nr. 12) and Zwammerdam (ref. nr. 17) were situated in the Rhine itself. Most other traps were found in channels with the exceptions of Velsen and the nearby site of Uitgeest, situated in the Oer-IJ estuary. Zwammerdam, Utrecht, the Leidsche Rijn area, and Houten would be strictly fresh water areas, whereas both Velsen and Uitgeest, and Valkenburg would be close enough to the sea for tidal influences and salt water dispersal, resulting in partly brackish conditions. The channels were usually not very wide and flow velocity was probably limited. In the case of Valkenburg (ZH) tidal flow may have been considerable, but data on this are lacking. Seasonally, river activity will have been higher, resulting in a different flow

velocity in the channels. For Ellewoutsdijk, it is unclear if the trap was *in situ*; its location next to a channel suggests it was not.

A final though lesser point to take into consideration is the space in the basket's rear section. This section houses the trapped fish. The length of most traps is ca. 0.80–0.90 m with the throat protruding for 0.40–0.50 m into the basket. This would leave the fish a space of around 0.40 m to dwell in, with a maximum diameter of around 0.45–0.55 m. This would not house very large specimens, with the exception of eels.

When considering the smaller sized trap openings, the basket's tight weave, and the rather small space in the basket's rear, it is clear that smaller, more slender fish were targeted. It has been argued before[42] that these traps have similarities to the much later Dutch eeltrap called '*aalkubbe*'. It should be kept in mind that apart from eel (*Anguilla anguilla*), these traps would also attract many other species.

The larger opening of the Utrecht-Achter Clarenburg trap may indicate that here larger fish were targeted. This may also explain the wooden screen found nearby, although other explanantions for such a screen are possible. Interestingly, it is also one of two traps (the other being Zwammerdam, ref. nr. 17) found in the Rhine itself, where migratory fish would have been more likely to pass than in the channels branching off the main waterway.

The channels and gullies would have been good places to position fish traps, as most would harbour a variety of edible species in quantity to allow for a regular portion of fish, although perhaps more for local consumption than as an industrial activity. During migration season (which differs per species), it would be possible to intensify fishing (with weirs, traps, nets, etc.) and harvest larger quantities. This would mean temporarily high activity, perhaps on a larger organisational scale as well, to catch, process and preserve the fish for future consumption.

4.1. Fish remains found inside the traps, and at the sites

The contents of the excavated traps have in most cases been researched by hand or sieved. Only in the cases of Velsen and Valkenburg have fish remains been found, although it is not definitely clear if these represent specimens that entered and remained trapped while the trap itself was no longer used or if their presence is the result of thanatocoenose. Another possibility is that the traps were left in the water while the waterways were silting up, so later refuse slowly gathered around, and partially inside, the already decaying baskets. In the case of Valkenburg, however, the fish remains were obtained by sieving the contents of the fairly complete traps. As can be seen in **fig. 6**, the head and tails of white bream[43] were found inside the trap (ref. nr. 15). The original interpretation of these fish remains is that they represent bait in order to attract eels[44].

In Valkenburg, the fish bones were retrieved by sieving the complete contents of these traps over 1 and 2 mm mesh. The re-study of the fishbones[45] has confirmed the former identification of *Blicca bjoerkna* for the contents of trap ref. nr. 15, as well as remains from bream (*Abramis brama*) and cyprinids (Cyprinidae) of which no further identification to species is possible. The length of these fish was, if possible, reconstructed at 0.10–0.15 m in the case of the white bream, and at 0.10–0.20 m for the bream and most other cyprinids.

The other trap from this part of the channel (ref. nr. 14) contained two more or less complete individuals from the family Clupeidae, identified as shad (*Alosa* sp.), and some bones from the three-spined stickleback (*Gasterosteus aculeatus*). The shad had a length of ca. 0.18–0.20 m. The three-spined sticklebacks were 0.03–0.05 m long, and would normally have been able to escape from the trap. Their presence can be explained as part of a predator's stomach contents, or as a result from deposition after the trap went out of use.

At the Valkenburg site thousands of fish bones have been excavated from the Marktveld-gully and from settlement contexts. After the excavations, only part of these finds have been identified[46]. A study of these fish remains is currently being undertaken[47]. At least 39 species have been identified so far, many of which could have been at home in the direct aquatic environment. But there are also marine species, including large gadids (Gadidae), that may indicate coastal fishing with lines or nets. Eel bones form only a very small portion of the total number of fish bones, despite intensive and fine mess sieving.

In the case of Velsen, fish remains were identified belonging to cyprinids like bream (*Abramis brama*) and white bream (*Blicca bjoerkna*), although no numbers or elements have been published, and the setting makes it possible that these remains do not form part of the trap's content but are rather the result of later depositing processes. Part of the fish remains excavated from the silted-up harbour

were studied[48] and these show fresh water species such as cyprinids, eel, catfish (*Siluris glanis*), pike (*Esox lucius*), perch (*Perca fluviatilis*) and ruffe (*Gymnocephalus cernuus*), and anadrome species as sturgeon (*Acipenser sp.*) and salmonids and clupeids. The presence of some marine species (such as sharks and mullets) may, again, indicate sea fishing. The fish traps from Velsen could have been used to target (small) cyprinids, eels, perches, ruffes, clupeids, salmonids and mullets.[49]

Although the fish traps from the Leidsche Rijn area themselves did not contain any fish remains, the excavations at the indigenous farmstead of Leidse Rijn Hoge Weide (LR 42)[50] yielded fish traps (ref. nrs. 9 and 10) and fish bones (**fig. 3**). These reveal consumption of pike, perch, catfish and several cyprinids, all of which could have been caught in local waters. Sieving on these locations was done with a 4 mm mesh size, so no conclusions can be drawn on size-distribution, or the absence of small species.

Information on fish consumption by the military in this area comes from the study of food remains found at the site of Leidse Rijn Zandweg (LR 31)[51]. A Roman military watchtower functioned here during the second half of the first century. Among the identified species are cyprinids such as bream, white bream, and roach (*Rutilus rutilus*), as well as eel and pike. The majority of the fish were small to middle-sized, with bream up to a maximum of 0.35 m; several small pike up to 0.20 m; and eels within a range of 0.29–0.52 m in length. Also, remains from much larger pike specimens were present at the site, which may have been caught by line fishing.

Only two fish bones were retrieved from the Ellewoutsdijk site: flatfish and bream. These bones did not allow for size reconstruction.

5. Earlier traps from Iron Age sites in the Netherlands

Until recently no traps that could be dated to the Iron Age were known from the Netherlands. But re-assesment of earlier information and recent excavations have had implications for earlier theories on these fish traps.

The first one is the previously discussed trap of Uitgeest-2, terp 100, earlier assumed as dating from the early Roman period[52]. Re-evaluation of the original excavation information now shows that the wickerwork trap was found under the *terp*, but is assumed to have been *ex situ* from its original location, and to have ended up in the silted-up area under the *terp* by accident[53]. Therefore, it is suggested that the date of this trap should be earlier, at least to the Iron Age.

In the excavation of Utrecht-Amerikalaan, a 0.51 x 0.64 m large part of a wickerwork trap (ref. nr. 3) was found in a silted-up gully. Radiocarbon dating provides a date of 420-200 calBC, consistent with the geomorphological information. This trap was constructed from *Salix* rods, unsplit and unpeeled, with a diameter of ca. 0.03 m. Because the trap was too fragile to preserve, the research of the trap was conducted immediately after lifting, on site together with a professional basket weaver. The original length of the trap is assumed to have been ca. 0.90 m, and the width ca. 0.30 m. The edge of the trap's mouth, or entrance, had been strengthened by inserting a willow rod of ca. 0.01 m thickness while weaving. The throat had a (reconstructed) length of ca. 0.25 m. The technique used was English randing, resulting in a closely woven basket. Stakes had been used in pairs and threes[54].

Three traps have been found in silted up residual channels in the excavation at Houten-Castellum. Two traps (ref. nrs. 1 and 2) came from sediment layers dating to the Middle Iron Age, in connection with a rural settlement. One came from the Late Iron Age/Roman period (ref. nr. 11) in connection with an indigenous farmstead. All three used a technique akin to that of the fish traps under discussion, namely closed weaving[55].

6. Traps from the Roman period in Europe

Traps have been excavated and reported from other European sites, dating from the Iron Age and Roman period. In Germany, a score of fish traps was excavated from a silted up lake near Oberdorla. The lake formed part of an indigenous cult site where worship continued from prehistory into the Middle Ages. In total 39 traps date to the Roman period. These differ in form and weaving technique. Traps in the form of a trumpet, but also the basket-like traps similar to those from the Netherlands, are present. Both closed and open structured weaving are present[56]. The basket type is around 0.80–0.90 m long, and ca. 0.40 m wide, while the throat has a length of 0.30–0.40 m and a width at the end of ca. 0.20 m. Barthel describes two forms of rear opening: a simple hole that was closed by shoving a ring over it, and another where the opening was closed with a woven cover. This woven cover was attached to the opening's rim by rods and acted as a lid. This detail is

reminiscent of the Velsen trap (ref. nr. 5).

In 2010 a large wickerwork fish trap was excavated in an ancient channel of the Emscher River near Dortmund (Germany). This had a length of over 2.30 m and is believed to date to the 4th century AD[57]. This trap has an open structure and is more akin to the larger prehistoric traps, or perhaps the Ellewoutsdijk trap, than the basket-like traps.

Another find comes from France, Chalon-sur-Saône[58], where a fish trap was found in a fossil meander, dating to the third century AD. The nearly complete remains were 1.30–1.34 m long, and ca. 0.53 m in width. The throat's length is 0.44 m; at the end the throat's opening is 0.175 m wide. The rear's opening is 0.12–0.13 m wide. The materials used were willow, dogwood and clematis. Monthel reports that this trap resembles the one from Melz-sur-Seine (Seine-et-Marne) dating from the Iron Age, La Tène II period. This trap measures 1.02 metres in length, has a diameter of 0.27 m and a rear diameter of around 0.08 m[59]. Both traps look more like the prehistoric ones from the Netherlands.

All these traps were found in fossilized or silted up channels, a situation similar to that of the Dutch traps. It may, therefore, be very likely that the exceptionally high number of excavated fish traps from the Netherlands is not only due to a natural landscape with many rivers and good preservation conditions. The intensive re-use and restructuring of the Dutch landscape during the last decades may also be responsible. This re-use and restructuring has resulted in a higher number of excavations. In similar ancient natural landscapes, fish traps are found elsewhere in Europe as well.

7. Discussion

From the data from the Netherlands, at least two types of fish traps, dating to the Roman period, can be distinguished.

Type 1: Hoops with attached wickerwork and open woven structure (ref. nr. 24). It is not clear whether the throat was attached or loose and if the trap was placed individually or in a larger structure of weirs and traps.

Type 2: Basket-like type with attached throat and closed structure. Type 2 may be subdivided on the basis of length, and diameter of throat and rear opening.

- Subtype 2a: length ca. 0.50–0.65 m; throat and rear opening 0.02–0.04 m, throat length at least 0.25 m (n=5: ref. nrs. 3, 4, 5, 6, 10).

- Subtype 2b: length ca. 0.80–1 m; throat and rear opening 0.02–0.04 m throat length 0.45–0.49m (n= 9: ref. nrs. 7, 13, 14, 15, 16, 18, 19, 20, 21[60]).

- Subtype 2c: length ca. 0,80–1 m; throat and rear opening 0.07–0.10 m, throat length 0.26 m (n= 1: ref. nr. 12).

One explanation for the different trap dimensions may be that different subtypes were used for targeting different sizes and species of fish. For the Netherlands there seems to be no relation between location and subtypes 2a–b; 2c, although only represented by one specimen, may be tentatively linked to main waterways, and targeting larger, migratory species. Time may be a factor, as for now, subtype 2a seems to be restricted to the earlier period, middle Iron Age to the first half of the first century AD, although co-occurring with type 2b at Velsen (ref. nr. 7).

Until recently no fish traps dating to the Iron Age were known from the Netherlands. This, in combination with the markedly different form and weaving technique of the Roman traps compared to those from the Bronze Age or earlier, led to the speculation that type 2, a closely woven basket, was a new introduction. Due to the presence in sites with either a direct Roman military character (forts, watchtowers) or indigenous farms with early and close links to the Romans, it was suggested that these traps may even have been a Roman military introduction[61]. The geographical placement of Ellewoutsdijk, in the periphery of Roman attention and influence, with its different, more prehistoric-like type of trap, added to this idea. The information from the sites of Uitgeest-2, Utrecht-Amerikalaan and Houten, all dating to the Iron Age, questions the validity of this earlier conclusion. The closed woven trap was already in use when the first Romans arrived in the Netherlands, and therefore is the product of an indigenous technology. This is consistent with the observations from the indigenous Germanic site of Oberdorla where the same technique was used, in a period before intensive Roman contact.

English randing and French randing have been used as techniques, but if this was due to the weaver's preference and training, or if there is some functional or other explanation for this, needs further investigation. Within the available dataset, no relation can be found between the type of randing and the nature or date of the settlement.

In terms of wood choice, *Salix* is the most commonly used wood, with occasional use of other taxa such as dogwood and taxus. Out suggests[62]

that the availability of *Cornus*, or lack of other material, was reason for its use on several prehistoric sites; the same may be true for the Roman period as well as for the *Taxus* used in type 1. Wood management and coppicing seems probable by the recurrent diameter and growth years of the rods, and attested to by the other wood finds. If *Salix* was indeed managed during the Roman period, as suggested by Lange[63], it would make sense that this material was widely used. However, apart from suitability and availability, other functional, technological or personal aspects (such as the weaver's preference), may have led to a different choice of material, which may also explain the use of clematis in the traps from France.

The cutting season can be identified, in all but one case (ref. nr. 14), as (early) spring. This would be reasonable. If waters were still frozen it may have been easier to cut and transport the rods. Early spring also makes sense from a wood management point of view, as this would be before the start of the sap flow. Another possibility might be late autumn when the growth process slows down and cutting would not mean a risk for the tree. For the fisherman, to work and set traps in spring, would be sensible as well. Not only would waters no longer be frozen, but fish would be much more active due to rising water temperatures.

By the time of the Roman arrival, basketry clearly was a well-established tradition. This is shown not only by a constant choice of and preference for well-suited materials, but also in the technical knowledge and performance shown in the individual traps. These were made by skilled workers with a long tradition of weaving. At least 150 rods were probably needed in order to make one trap. As fish traps were not the only wickerwork that was being made, the question arises as to whether every farm or community owned and managed their own coppices. If so, an interesting point is in how far the Roman occupation of the area influenced ownership, maintenance and exploitation of these woodlands.

When traps no longer functioned, due to decay, damage or wear, they were probably left where they were. The only useful items for the Dutch area may have been the stones inside, but with the Roman army, and a continuous shipment of goods by boats, stones were never in short supply. As we have seen in the case of Velsen, even heavy bones were used and re-used as weights.

Several fish species could be caught with traps: cyprinids, salmonids, eels, perches, clupeids and several others, all available from the local waters. They would have a restricted size up to ca. 0.25 m due to the width of the trap's entrance; much larger eels would also fit due to their elongated body shape. The trap from Utrecht (ref. nr.12), as well as the one from Ellewoutsdijk (ref. nr. 24), may have targeted larger specimens and/or other larger species.

Although the focus in this article is on fishing with traps, it is clear from archaeological finds that several types of fishing methods were used throughout the Roman period, such as angling and the use of cast nets[64]. The main Dutch rivers served as an inland and seawards migration route for many fish species on their way to their spawning grounds, such as sturgeon, salmonids, clupeids, eels and lampreys. On these occasions the use of weirs, in combination with nets or traps would guarantee a high catch. This fishing method was already in use in prehistory, both in the Dutch delta as elsewhere in Europe[65]. The wooden screen near the Utrecht trap (ref. nr. 12) may be an indication that it was practised in the Utrecht area as well. However, once the Romans took hold of the Dutch riverine area, and the Rhine river became an important transport corridor, it is questionable whether this fishing method was allowed by the authorities. Not only could the weirs hamper ships *en route*, but the placing and maintenance of the weirs, and retrieving the catch, would mean constant ongoing activities of boats and fishermen. In an area that had only recently been brought under control, where the Rhine meant not only provisions, but also a corridor of control to the other side of the *limes* and its recurrent threat of piracy and invasion, the Roman authorities may not have wanted to take any safety risks.

This leads to the question: did the Roman presence cause a perhaps temporary abandonment of this fishing method and denial of fishing rights on the Rhine and other main waterways by the local population? If so, this may have led to intensified fishing elsewhere, for instance in local channels, targeting different species or smaller specimens, thus leading to an increased use of type 2 wickerwork fish traps.

8. Conclusion

This article discusses 24 wickerwork traps from the Netherlands, dating from the middle Iron Age to well into the middle Roman period – a time span of around 700 years. By bringing together and reassessing all available research information on

this subject, new insights have been gained. For the weaving of the traps, *Salix* is the most commonly used wood, with occasional use of other taxa such as dogwood and *Taxus*. By the time of the Roman arrival, basketry clearly was a well-established tradition, and there are indications that local communities managed *Salix* woodlands to provide for suitable material. The cutting season would preferably be spring, when little damage was inflicted on the trees. The traps were made and set after the ice melted, as fish would get more active due to rising water temperatures and thus be easier to catch.

At least two different types of trap were coexistent: type 1 with wooden hoops and attached open wickerwork, and type 2: a closely woven, basket-like type. The last type forms the majority of the traps, and was earlier thought to be a Roman, possibly military, introduction, and perhaps specifically targeting eel. However, evidence from sites dating to the Iron Age, shows that the closed woven trap was already in use before the Roman occupation. This type-2 trap may be subdivided on the basis of length, and diameter of throat and rear opening. A possible explanation for the different dimensions may be that the traps were used to target different and/or sizes of fish. Time may also be a factor, and it will be interesting to see if the future research on the Houten traps confirms this observation. And although the Roman military were not responsible for the introduction of a new type of fish trap, their presence may well have led to an increased use of these traps, as a result of exercising control over the main waterways.

Footnotes

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van Enckevort 2004.

2 Polak/Kooistra 2013.

3 Bechert/Willems 1995.

4 van Heeren, in prep.

5 Waasdorp 2012.

6 van Dierendonck/Vos 2013.

7 Driessen/Besselsen 2014.

8 Kooistra et al. 2013.

9 Groot et al. 2009; Groot/Kooistra 2009.

10 Brinkhuizen 1983; Brinkhuizen 1989; Brinkhuizen 2001; de Vries 2004; van Amerongen, in press.; Roessingh/Lohof 2011.

11 See Brinkhuizen 1983; Louwe Kooijmans/ Hänninen/ Vermeeren 2001; Bulten/van der Heijden/Hamburg 2002.

12 Sier 2001; Sier 2003.

13 van Gijn 1984.

14 van Regteren Altena/Sarfatij 1973.

15 Kooistra et al. 2013.

16 van Rijn 1993, 153–157.

17 Kooistra et al. 2013.

18 Beunder 1990.

19 Lange 2005; Lange 2012b; van Rijn 1993; van Rijn 2001; van Rijn 2013.

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26 Spruijt, unpublished.

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30 Lange 2000, reported by van Rijn 2013.

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32 Lange 2005.

33 Dütting/Hoss 2014.

34 See Gabriel et al. 2005 for various examples worldwide.

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38 see footnote 37 morphometrics *Anguilla anguilla*: body depth ca. 6 % [Access: 15.11.2016].

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61 van Rijn 2013.

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64 Dütting 2016; Dütting/Hoss 2014.

65 Cleyet-Merle 1991.

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Fig. 1 Map after Vos/de Vries 2013 [Access: 21.04.2015].

Fig. 2 M. Tahir.

Fig. 3–5 Photo: H. Lägers, afdeling Erfgoed, Municipality of Utrecht.

Fig. 6 Copyright drawing Rijksdienst voor het Cultureel Erfgoed.

Fig. 7 Photo courtesy of S. Lange.

Tab. 1–3 Author.

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Table 1: reference number used in the article, site/information, date, references

ref.nr.	Site	Site type	Date	Nr traps	Reference 1	Reference 2	Reference 3
1, 2	Houten-Castellum	rural site	early Middle Iron Age to early Late Iron Age	2	van Renswoude/van Kampen *in prep.*		
3	Utrecht-Amerikalaan	silted up channel, in area with Iron Age occupation	trap dated 420-200 cal BC (Middle Iron Age or early Late Iron Age)	1	Lange 2012b		
4	Uitgeest-2 (Uitgeesterbroek), terp 100	rural farm, in zone with Roman military contact; Late Iron Age/Roman period	1st C AD but trap found under *terp*. More propbable date: Iron Age	1	van Gijn 1984	Spruijt 1990	van Rijn 1993
5, 6, 7, 8	Velsen-I	Roman fortress and harbour works	*c.* 15-30 AD	4	Spruijt 1990	van Rijn 1993	Bosman1997
9, 10	Leidsche Rijn: Hoge Weide (LR 42)	rural farm with early Roman military connections	First half 1st C AD	2	van Rijn 2013		
11	Houten-Castellum	rural farm with Roman military connections	70-150 AD	1	van Renswoude/van Kampen *in prep.*		
12	Utrecht-Achter Clarenburg	in silted up riverbed of river Rhine, 400m west of Roman fort of Utrecht-Domplein and 250 m west of associated military vicus	70 AD ± 35 (14C: 1880 ± 35 BP)	1	van Iterson Scholten 1971	van Regteren Altena/Sarfatij 1973	van Rijn 2013
13	Leidsche Rijn: Waterland (VTN-98)	silted up channel, near Roman road and military watchtower	*c.* 100 AD	1	van Rijn 2013	Lange 2000	
14, 15, 16	Valkenburg-Marktveld	in silted up side channel of river Rhine. Area with castellum, vicus, watchtower, Roman road and cemetery	traps dating ca AD 120-160	3	van Rijn 1993		
17	Zwammerdam	in silted up bed of river Rhine near Roman fort of Zwammerdam	Roman	1	Beunder 1990	van Rijn 2013	
18,19,20,21	Leidsche Rijn: Gemeentewerf	near Roman military watchtower; in silted up layers of a channel of the Heldammer channel belt	end 2nd - start 3d C AD	4	van Rijn 2013		
22,23	Leidsche Rijn Parkzichtlaan - Zuid (LR62)	in a fossil river bed near the Roman fort of De Meern	before end of 1st C AD (phase 2 of excavation)	2	Lange 2012a		
24	Ellewoutsdijk	next to a tidal creek, close to an indigenous settlement	early 1st - early 2nd C AD	1	Sier 2001	van Rijn 2001	Sier 2003

Table 2: Traps' dimensions, special details and filling.

ref.nr.	site-related ref.nr.	Site	length of trap	max Ø of trap	length of throat	Ø of throat	Ø of end of throat	Ø of rear opening	Special details on trap	Filling
19	163	Leidsche Rijn Gemeentewerf	100 cm preserved; original length around 103 cm.	max 35 cm	over 28 cm; but weaving starts at around 22 cm; leaving stakes protruding 7 cm into the basket.	min 11 cm narrowing towards end of throat.		missing		none
20	477	Leidsche Rijn Gemeentewerf	ca 80 cm	max 42 cm				missing	maybe in association with pole of Alnus lying nearby.	stones, bricks and bone
21	800	Leidsche Rijn Gemeentewerf (Wachttoren DO)	93 cm preserved; reconstructed length ca 98 cm	max 54 cm	over 31 cm; pointed end of stakes protruding into basket	43 cm at entrance		missing		tiles and tephrite
22	404	LR62-Parkzichtlaan - Zuid	no info	no info	no info	no info		missing	in association with a knot made of a willow barch, probably to attach the trap. Nearby poles of Alnus, Ulmus and Salix were found; unclear if there is a connection.	weights', no further specification
23	848	LR62-Parkzichtlaan - Zuid	89 cm max	max 67 cm (flattened)	no info	no info		no info	no info	no info
24		Ellewoutsdijk	unknown	unknown	not relevant	not relevant	not relevant	not relevant	wooden hoop made of split *Taxus* wood. Remaining part was about 2 m long and about 2.8 – 3.2 cm in width. At irregular intervals seven square holes were cut out in which small penns of *Taxus* wood were fixed. Another piece of *Taxus* wood with square holes in it was found nearby.	iron fish hook and willow (Salix) rods or stakes

Table 2: Traps' dimensions, special details and filling.

ref.nr.	site-related ref.nr.	Site	length of trap	max Ø of trap	length of throat	Ø of throat	Ø of end of throat	Ø of rear opening	Special details on trap	Filling
1		Houten-Castellum	under study	under study	under study	under study		under study		under study
2		Houten-Castellum	under study	under study	under study	under study		under study		under study
3		Utrecht-Amerikalaan	reconstructed circa 90 cm	reconstructed width circa 30 cm	reconstructed circa 25 cm	not present		not present	thick rod of Ø1 cm used for entrance/rim mouth; at 3m distance from trap were 6 pointed poles, maybe some kind of platform from which to operate trap, or to which it could have been tied.	no info
4		Uitgeest-2, terp 100	50 cm (probably while flattened)	35 cm	unpublished	unpublished		unpublished		
5	1986-1	Velsen-I	65 cm	44 cm				3-4 cm	twined bark used to reinforce basket at point where width was diminished. Flap of woven bark at rear opening, used to close it.	17 stones, in total weighing 3.4 kg; oxidated iron (unspecified object)
6	1988-1	Velsen-I								metatarsus *Bos taurus* with traces of gnawing, so not fresh and not used as bait; also 19 stones weighing 4,7 kg
7	1988-2	Velsen-I	90 cm	45 cm					moss closing off rear opening. Trap possibly in connection with long stake to attach it to.	stones and parts of hand quern
8	unknown	Velsen-I	unknown	unknown	unknown	unknown		unknown	unknown	unknown
9	nr 388	Leidsche Rijn: Hoge Weide (LR 42)	remaining length 48 cm	max width 25 cm	unknown	unknown		unknown	no	unknown
10	nr 387	Leidsche Rijn: Hoge Weide (LR 42)	length of basket 51 cm; reconstructed length (plus 4 cm for upper rim) is 55cm.	unknown	over 25 cm	28.5 cm;	5 cm	missing		stones and Roman bricks inside basket.
11		Houten-Castellum	under study	under study	under study	under study		under study		
12		Utrecht-Achter Clarenburg	ca 95 cm		ca 26 cm	ca 28 cm at entrance	circa 7-10 cm	ca 7.5 cm	in same part of river remains of a wooden screen was excavated; fish fence?	stones and a triangular ceramic netsinker with a central hole
13	22	Leidsche Rijn: Waterland (VTN-98)	12 cm preserved; reconstrcuted lenght ca 80 cm	reconstructed width ca 40-50 cm		ca 17 cm			wooden pins stakes (diameter 3 cm) have been inserted; probably later phenomena as they would have weakened the basket's weaving	
14	041.0951 (cat.no. 1)	Valkenburg-Marktveld	max 80 cm (flattened)	unknown	45 cm (flattened)	25 cm (reconstructed);		ca 4 cm	handle made of twisted rods was fixed to outer casting; long thick rope was fastened through this handle	natural rock
15	041.1059 (cat.no. 2)	Valkenburg-Marktveld	max 103 cm (flattened)		ca 49 cm (flattened)	ca 25 cm (reconstructed)		2-3 cm		pieces of natural rock, fragment of Roman roof tile
16	074.0376 (cat.no. 3)	Valkenburg-Marktveld	max 80 cm (flattened)		49 cm (flattened)	ca 28 cm (reconstructed)		3-4 cm		pieces of natural rock and brick
17		Zwammerdam	unknown	unknown		unknown				
18	162	Leidsche Rijn:Gemeentewerf (Stroomweg Veldhuizen/ Wachttoren DO, VLEN-00; werkput 13)	between 85-90 cm	max 64 cm	ca 47 cm, including protruding pointed stakes (pointing inward) that are 7 cm long	ca 42 cm		missing	next to trap was large Alnus post (diameter ca 13 cm) that may have been used to fix this trap, as well as trap ref.nr 19 (site ref.nr 163)	in basket were fragments of stones and bricks.

Table 3b: Taxa, weaving and details on stakes and rods.

ref.nr.	Site-related ref.nr.	Site	Taxa	Age	Cutting season	Treatment	Stakes and rods	Type of randing	Diameters of stakes and rods	Observations
15	041.1059 (cat.no. 2)	Valkenburg-Marktveld	Salix	longitudinally-split rods of three years'growth used for max diameter of basket. One year's growth for rear throat opening		split and unsplit, unpeeled	stakes used in pairs	English randing		
16	074.0376 (cat.no. 3)	Valkenburg-Marktveld	Cornus	split and shaven rods of several years' growth				English randing	stakes used in pairs	
17		Zwammerdam	Salix	unknown	unknown	unknown	unknown	unknown	unknown	
18	162	Leidsche Rijn: Gemeentewerf (Stroomweg Veldhuizen/ Wachttoren DO, VLEN-00; werkput 13)	Salix	third year of growth	early spring	unpeeled	Basket : diameter stakes between 0.7-0.9 cm; diameters rods from 0.3-0.9 cm (most between 0.8 and 0.9 mm) Throat: between stakes 0.6-0.7 cm; rods 0.3-0.4 cm	English randing		throat started with 7 to 9 stakes but expanded rapidly.
19	163	Leidsche Rijn Gemeentewerf	Salix	second year of growth	spring	unpeeled	stakes used in pairs; at widest point 5 cm distance.	French randing	Stakes basket diameters b0.7-0.9 cm; rods from 0.3-0.7 cm. In basket 24 rods to 10 cm.	Stakes were usually thicker than material used for rods, and material for basket thicker than that used for throat.
20	477	Leidsche Rijn Gemeentewerf	Salix and Cornus sanguinea	Salix not possible to determine; Cornus-rods cut in second year of growth.		Salix: unsplit, unpeeled. Cornus split in two or three.	stakes used in pairs, some alone. Stakes about 7.5-8 cm apart.	French randing	no diameter given; 17 rods on 10 cm.	
21	800	Leidsche Rijn Gemeentewerf (Wachttoren DO)	Salix	second year of growth	end of spring or start of summer	unsplit, unpeeld	stakes used alone or in pairs; French randing. Stakes at 3 cm distance.	French randing	diameters rods between 0.4-0.9 cm	
22	404	LR62-Parkzichtlaan - Zuid	Salix	one year's growth		unsplit, unpeeld	stakes used in pairs. Distance between stakes 2-3 cm.	English randing	diameter rods 0.5 cm; as well as split branches: thickness 0.2 cm and width 2 cm.	
23	848	LR62-Parkzichtlaan - Zuid	Salix			unsplit, unpeeled	stakes used in pairs	English randing	no info	
24		Ellewoutsdijk	Taxus and Salix						diameter *Salix* stakes of 1-2.5 cm	

Table 3a: Taxa, weaving and details on stakes and rods.

ref. nr.	Site-related ref.nr.	Site	Taxa	Age	Cutting season	Treatment	Stakes and rods	Type of randing	Diameters of stakes and rods	Observations
1		Houten-Castellum	under study	under study	under study	under study	under study	under study	under study	
2		Houten-Castellum	under study	under study	under study	under study	under study	under study	under study	
3		Utrecht-Amerikalaan	Salix	one year's growth		unsplit, unpeeled	stakes used in pairs and in threes alternately	English randing	0.3 cm	1 cm thick rod used for edge of mouth of trap
4		Uitgeest-2, terp 100	unclear, possibly Salix			split and unsplit	no info	unknown	thicker rods than from Velsen-I, ref.nr. 5.	
5	1986-1	Velsen-I	Salix			probably unsplit and unpeeled	short average = 90 cm; long average = 120 cm; longest rod = 150 cm	unknown	average 0.4-0.6 cm	made with thin, sometimes forked branches, leading to finer weave
6	1988-1	Velsen-I	Salix					unknown		
7	1988-2	Velsen-I	Salix					unknown	average 0.35 mm, max Ø 0.5-0.6 cm	
8	unknown	Velsen-I	unknown	unknown	unknown	unknown	unknown	unknown	unknown	
9	nr 388	Leidsche Rijn: Hoge Weide (LR 42)	Salix		early spring of second year of growth	unsplit, unpeeled	stakes used in pairs.	English randing	stakes 0.3-0.5 cm; rods 0.3-0.4 cm. 23-26 rods on 10 cm in basket English randing.	
10	nr 387	Leidsche Rijn: Hoge Weide (LR 42)	Salix		early spring of second year of growth	unsplit, unpeeled	stakes used in pairs. Distance between stakes ca 3 cm.	English randing	Diameter stakes 0.3-0.6 cm; diameter rods of basket 0.3 cm; rods in throat 0.2 cm.	Trap's material slightly more robust than others' but rods of throat thinner than those used for basket. *C.* 16 rods to 10 cm.
11		Houten-Castellum	under study	under study	under study	under study	under study	under study	under study	
12		Utrecht-Achter Clarenburg	Salix				stakes used in bundels of 2 and 3; Distance between stakes varying from 1.8-3 cm in basket and from 2.5-3.6 cm at throat-entrance.	French randing	Ø stakes 3.9 cm (unclear if not misspelt; probably 3.9 mm is meant)	
13	22	Leidsche Rijn: Waterland (VTN-98)	Salix	one year's growth	unknown		stakes used in bundles of 3. Distance between stakes ca 7 cm.	English randing	Rods 0.4-0.8 cm	
14	041.0951 (cat.no. 1)	Valkenburg-Marktveld	Salix	one year's growth	cut in late autumn or winter	unsplit, unpeeled	stakes used in pairs	English randing		