

A late Holocene forest fauna with *Spermodea lamellata*, *Merdigera obscura* and *Cochlodina laminata* in the dunes of Noordwijk, The Netherlands

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After excavations and sand drift, fossil shells of land- and freshwater-molluscs were found in the dunes between Noordwijk and Zandvoort in the western part of The Netherlands. Most remarkable was the presence of a forest fauna in an old soil with 36 land species, including *Spermodea lamellata*, *Merdigera obscura* and *Cochlodina laminata*. These species lived here about 1100 years ago, outside their modern range.

Key words: landsnails, *Spermodea lamellata*, *Merdigera obscura*, *Cochlodina laminata*, dunes, forest fauna, late Holocene, The Netherlands.

INTRODUCTION

Between the Dutch coastal villages of Noordwijk and Zandvoort there is an extensive area of dunes bordering the North Sea, called the "Amsterdamse Waterleidingduinen" (Amsterdam Watersupply Dunes = AWD). At the end of the 19th century a canal ("Van Limburg Stirumkanaal") was dug for the extraction of drinking-water. At the beginning of the 21st century this channel was infilled with sand that had been dug out more than a century earlier in order to restore the site to its previous condition. As the result of erosion, buried soils and older deposits ("Oude Duinen": Old Dunes) became visible within the dunes, representing much of the time since the mediaeval period. Geological and archaeological studies have been undertaken at several sites (Vader, 2007; Vossen, 2007). Eventually only a stretch of bare sand remained in the area, forming the so-called "Van Limburg Stirumvallei" (Figs 1, 2). Here, the wind had blown sand away to uncover



Fig. 1. Noordwijk, Van Limburg Stirumvallei. Northern part (ca. 10 km NE of Noordwijk), with remains of old soils. Asterisks are sampled places (Photo Google Maps, 2015).

light brown layers with shells. These indicate that at some sites puddles had been present supporting freshwater molluscs, mainly *Galba truncatula* (O.F. Müller, 1774) and *Stagnicola palustris* (O.F. Müller, 1774) s.l. Many shells of land snails were also seen on the surface. Most conspicuous were hundreds of shells of *Alinda biplicata* (Montagu, 1803), but these occurred in only a limited area (Fig. 3). This land snail lives nowadays in only one small part of a forest in the AWD. These observations triggered the research, the results of which are reported here.

Our data are comparable with those published by Bank (1976), who found on the eastern bank of a dune lake (Oosterplas, Kennemerduinen), 12½ km north-

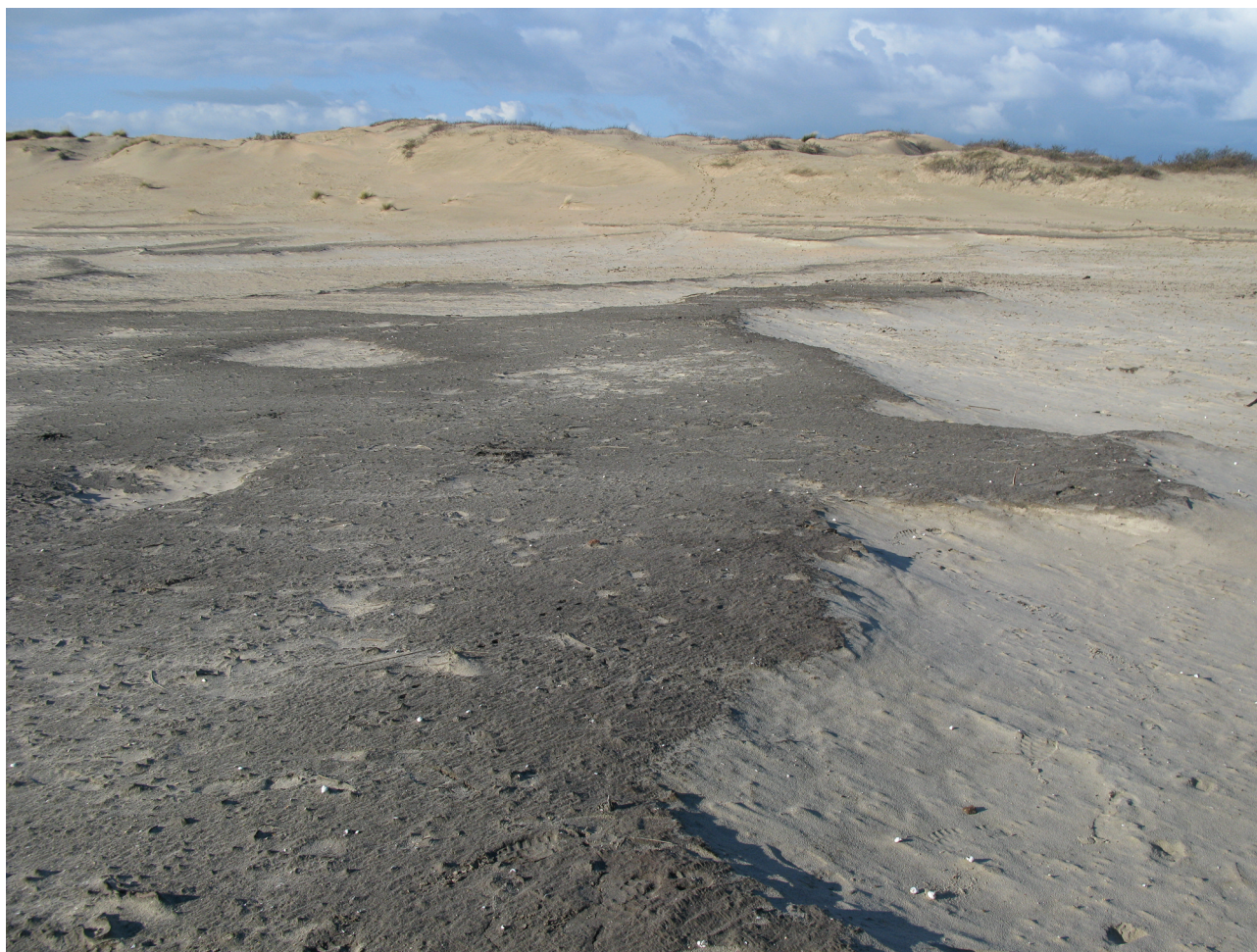


Fig. 2. Noordwijk, Van Limburg Stirumvallei. Northern part, with remains of old soils (Photo by Wim Kuijper).

east of our site, shells and deposits with a late Holocene fauna, containing species such as *Alinda biplicata* (syn. *Laciniaria biplicata*), *Merdigera obscura* (O.F. Müller, 1774) (syn. *Ena obscura*) and *Vertigo substriata* (Jeffreys, 1833).



Fig. 3. Noordwijk, Van Limburg Stirumvallei. Surface with *Alinda biplicata* (Photo by Wim Kuijper).

MATERIAL AND METHODS

As the result of the predominantly south-westerly winds, large quantities of sand and other material had been concentrated at the northern border of the area of bare sand. Especially shells were found on leeward locations behind vegetation. About 6.5 litres of these shells, mixed with sand, were sampled to get an idea of the species present at the site. This material was first analyzed.

While looking for the undisturbed deposits with shells, solid light brown sand deposits with shells were found. On the surface land- and freshwater-shells were seen; they are noted as 'on surface'. These layers, ranging from a few to 20 cm thick and situated at various depths, were sampled at 30 places, distributed over an area of 2500 m². In this way, a total volume of 83.5 litres was analysed. The lower layers were more humid than the upper ones. In the highest levels humus was virtually absent and the shells were very well preserved, but fragile. The soil samples were sieved in water using a 0.5 mm mesh. Due to sampling, transport and sieving, some of the shells were

broken. In table 1 the fragments are not noted, but converted to a minimum number, and samples with more or less the same 'fauna' were combined.

The research material will be stored at Naturalis Biodiversity Center, Leiden, The Netherlands.

RESULTS

In table 1 the species recorded in circa 6.5 litres of sand with 'blown together' shells are listed with an indication of their numbers. Two species found only as surface find ('on surface') were not recovered from the soil itself, viz. seven specimens of *Cochlodina laminata* (Montagu, 1803) and three of *Balea heydeni* Von Maltzan, 1881. Scattered over the surface were many shells of adult *Cepaea nemoralis* (Linnaeus, 1758). This snail lives nowadays in this dune area, but these shells have a 'fossil' appearance and were filled with brown sand of the soil.

In the soil samples, 34 species of land snail were found, which together with the *Cochlodina laminata* and *Balea heydeni*, it makes a total of 36 species land snails recovered from the top of the Old Dunes. In the different wet and marshy environments at least 10 freshwater gastropods and two species of freshwater bivalves also occurred.

Sample 7 differs from the other ones because in this case the soil was peaty. It contained a fauna of a humid environment, with five aquatic species together with land snails of damp ground (table 1). Seeds of plants of an open, very humid environment were present in this sample. Also the place represented by sample 4 was once very humid. Here the species indicate a marsh vegetation with a fluctuating water-level [*Anisus leucostoma* (Millet, 1813), *Aplexa hypnorum* (Linnaeus, 1758)] in an open forest. Sample 8 suggested the existence of a shallow pool, well vegetated with stoneworts (*Chara* sp.). It is a combination of aquatic and terrestrial species that indicate a high humidity [*Carychium minimum* O.F. Müller, 1774, *Valonia pulchella* (O.F. Müller, 1774), *Vertigo antivertigo* (Draparnaud, 1801)].

Also recovered were large numbers of sclerotia of a soil fungus (*Cenococcum geophilum*) that commonly occurs in sandy soils, together with the calcite granules produced by earthworms (Lumbricidae), as well as cocoons of worms, small pieces of wood (roots?) and seeds. Hemp agrimony (*Eupatorium cannabinum* Linnaeus, 1753) was present and very common in many of the samples. Fruits of this species are known to survive in strongly oxidized sediments such as these (e.g. Preece & Bridgland, 1999: 1107). This plant prefers marsh, banks, dune valleys, and wet forest environments.

Six samples were devoid of shells; four of these

yielded peaty material. In the samples without shells, from a somewhat lower level, seeds were found of Three-nerved Sandwort [*Moehringia trinervia* (L.) Clairv., 1811)], Mint (*Mentha aquatica* Linnaeus, 1758/*Mentha arvensis* Linnaeus, 1753), Hemp Agrimony (*Eupatorium cannabinum*), Cinquefoil (*Potentilla* sp.) and Cypress-like Sedge (*Carex pseudocyperus* Linnaeus, 1753). These point to a moist environment.

Sample 1 yielded some small bones and two molars of the Wood Mouse [*Apodemus sylvaticus* (Linnaeus, 1758)] and sample 7 contained dozens of small bones and teeth (nearly a whole skeleton) of the Root Vole [*Microtus oeconomus* (Pallas, 1776)]. The Wood Mouse lives in open country, wet pastures, woods, edges of forests with scrub, dunes and heather fields. They are common in The Netherlands. The Root Vole is a good swimmer and inhabits wet places (marsh, reed, wet forests, damp dune valleys) and dry grasslands and in Europe today has a mainly North-East European distribution, although some relict populations persist in The Netherlands (Broekhuizen et al., 2016). Remains of larger vertebrate were also recovered including a molar of Red Deer (*Cervus elaphus* Linnaeus, 1758), found on the surface, and, most surprisingly, the bones of Brown Bear (*Ursus arctos* Linnaeus, 1758) in sample 1 (Kuijper et al., 2016 in press).

DISCUSSION

In the richest samples 24 to 29 terrestrial species occurred. The most surprising species here was *Spermodea lamellata* (Jeffreys, 1830), represented in large numbers. This species is absent from the modern Dutch fauna, but it did once occur in a forest (Mantingherbos) in the province of Drenthe, in the northern part of The Netherlands (Butot, 1964; Jansen, 2015). The only other Dutch occurrence is from a late Middle Pleistocene deposit at Maastricht-Belvédère (Meijer, 1985). This small (2 mm) snail lives today in Ireland, Scotland and northern and western parts of England, Denmark, along the south coast of the Baltic Sea and in some coastal areas in Norway and Sweden. It has a disjunct southern range from along the western coasts of Spain and Portugal (Welter-Schultes, 2012: 205; Cardavall & Orozco, 2016: 172). [While this paper was in press, Oueslati & Duvivier (2016) reported this species from Holocene deposits in northern France (département du Nord)]. The snails prefer undisturbed, damp to wet deciduous woodlands and live in the leaf litter and under fallen wood. They are also found in beech forests with a top layer that is poor in chalk.

Another unexpected species was *Merdigera obscura*, which was represented only by fragments. This snail is also unknown from this part of The Nether-

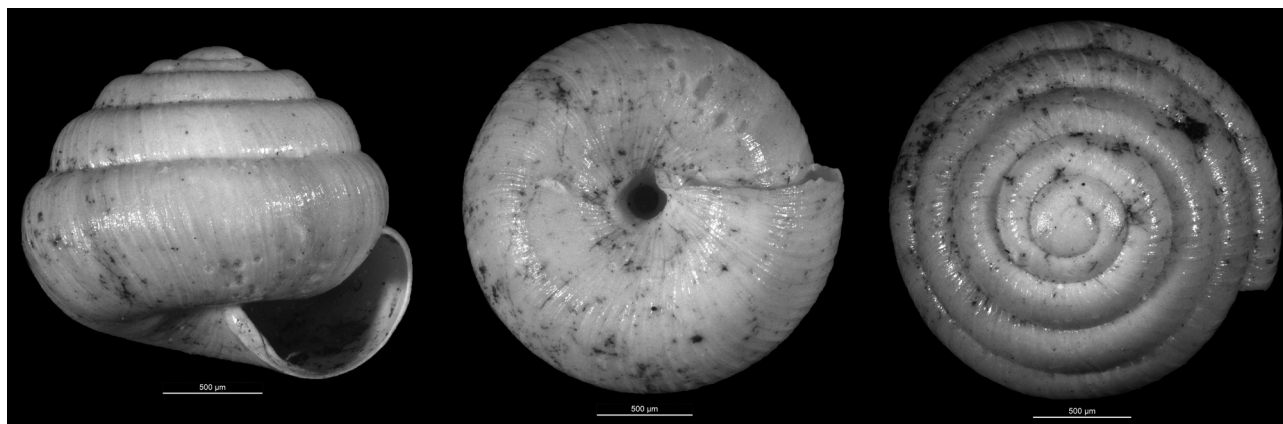


Fig. 4. Noordwijk, Van Limburg Stirumvallei. *Spermodea lamellata*, frontal, basal and apical view (Photo by Petra Sonius, Naturalis).

lands, where it only occurs in the southern part of the province of Limburg. In that area there are also some fossil records of it (Felder, 1998; Kuijper, 2015; Ubaghs, 1884). Outside Limburg it is known from late Holocene deposits in the Kennemerduinen (Bank, 1976).

Cochlodina laminata is also very rare in The Netherlands. This species occurs mainly in southern Limburg and has been introduced on the island of Texel. In earlier times it lived in the western part of The Netherlands, in deciduous woods on the banks along rivers, viz. about 4500 years ago at Hekelingen (south of Rotterdam) and about 1200 year ago at Leiderdorp, east of Leiden (Kuijper, 1990; unpublished personal observations).

Alinda biplicata, *Acanthinula aculeata* (O.F. Müller, 1774), *Vertigo substriata* and *Balea heydeni* are all rare in Holocene deposits in the Netherlands.

On the "Oude Duinen" (Older Dunes) forests were present in the Holocene. Palynological data from peat samples indicate that between 175 BC and 900 AD

there was an increase of forests (birch, oak, alder, willow). By the end of the 8th - 9th centuries AD the increase of beech was conspicuous (Jelgersma et al., 1970; Vossen, 2007) and the entire dune area between Velsen and Noordwijk had become densely wooded. At the same time, the water table rose and much open water developed.

Excavations and archaeological research in this dune area, has shown that there were large oaks and beeches (wood, fruits). A part of this forest was situated in the border area of Rijnland and Kennemerland and for that reason remained unaffected. Around 1300 AD the area was a 'wilderness' and was partly known as "Haarlemmerhout" (van Til & Mourik, 1999: 16).

After circa 1000 AD, the surface of the Older Dunes began to be eroded by the wind as they were buried by the "Jonge Duinen" (Younger Dunes). Ancient deciduous forest is unlikely to have existed at the site after this time. It is assumed that the *Spermodea lamellata* came from a former soil at the top of the Older Dunes. This would have been colonised by ancient forest for many centuries. At our site the remains of birches (*Betula* sp.) and alder (*Alnus* sp.) (Fig. 5) were recovered.

A comparison with previous work across the AWD (van Blokzijl en Pruijssers, 1989; Jelgersma et al., 1970 and Vossen, 2007) indicates that our interpretation is broadly correct. Radiocarbon dating of one of the bones of the bear yielded a date of 1140 ± 30 BP (GrA-66477), with a probability distribution of 880-970 AD calendar years (Kuijper et al., 2016 in press).

Two species (*Cochlodina laminata* and *Balea heydeni*) had not been recovered from the soil itself but this is



Fig. 5. Noordwijk, Van Limburg Stirumvallei. Stub of a birch (Photo by Wim Kuijper).

Table 1 (next page). Noordwijk, Van Limburg Stirumvallei.

Overview of the "blown together" shells, shells on surface of the site and the fauna's from the old soils. Legend: x = some, xx = dozens, xxx = hundreds.

Material from Sample	blown together	on surface	in situ 1	in situ 2	in situ 3	in situ 4	in situ 5	in situ 6	in situ 7	in situ 8
Soil	sand	sand	sand	sand	sand	sand, humic	sand	sand	sand, peaty	sand+chalk
Colour	-	l.brown	l.brown	l.brown	l.brown	brown	brown-grey	brown	d.brown	white-grey
Volume (liters)	6.5	6	18	28.5	12	5.5	2.5	7	8	2
Freshwater species										
<i>Bithynia tentaculata</i> (operculum)	-	-	-	1	-	-	-	-	-	-
<i>Valvata cristata</i>	2	-	-	-	-	1	-	1	-	-
<i>Galba truncatula</i>	xxx	xx	6	5	-	10	1	6	xx	xxx
<i>Stagnicola palustris</i> s.l.	xx	xx	-	1	-	6	-	-	15	x
<i>Radix balthica</i>	x	-	-	-	-	-	-	-	1	3
<i>Aplexa hypnorum</i>	x	1	-	-	-	6	-	-	-	-
<i>Planorbarius corneus</i>	1	-	-	-	-	-	-	-	-	-
<i>Anisus leucostoma</i>	12	2	-	3	-	7	1	-	-	-
<i>Planorbis planorbis</i>	1	1	-	-	1	2	-	-	-	-
<i>Gyraulus albus</i>	3	-	-	-	-	-	-	-	-	-
<i>Gyraulus crista</i>	-	-	-	-	-	1	-	-	-	-
<i>Bathymophalus contortus</i>	6	-	4	3	1	1	-	-	-	-
<i>Segmentina nitida</i>	3	-	-	-	-	11	-	-	-	-
<i>Pisidium obtusale</i>	-	-	-	-	-	xx	-	-	-	-
<i>Pisidium</i> sp.	2	-	-	-	-	2	-	1	1	-
<i>Sphaerium corneum</i>	-	-	-	-	-	-	-	-	1	-
Terrestrial species										
<i>Carychium minimum</i>	xxx	x	x	xxx	xx	xx	xx	xxx	xx	xx
<i>Carychium tridentatum</i>	xxx	xx	xxx	170	xx	xxx	xx	xxx	-	-
<i>Succinella oblonga</i>	xxx	xx	1	6	-	-	-	3	xx	xxx
<i>Oxyloma elegans</i>	xx	x	10	11	4	8	1	1	xx	-
<i>Cochlicopa lubrica</i>	xx	xx	xx	xx	x	xx	8	xx	cf 3	xx
<i>Cochlicopa lubricella</i>	xxx	xx	xx	250	xx	xx	8	xx	3	xx
<i>Vallonia costata</i>	xxx	xx	xxx	xx	xx	6	-	-	-	-
<i>Vallonia pulchella</i>	xx	-	-	-	-	-	-	-	xx	xx
<i>Vallonia excentrica/V.pulchella</i>	xx	-	-	-	-	-	-	-	-	-
<i>Acanthinula aculeata</i>	xx	xx	xx	253	xx	21	33	xx	-	-
<i>Spermodea lamellata</i>	xx	7	xxx	102	xx	3	1	-	-	-
<i>Pupilla muscorum</i>	xxx	x	7	107	x	-	2	-	-	2
<i>Columella edentula</i>	xx	x	xx	3	-	-	-	11	-	-
<i>Vertigo antivertigo</i>	xx	x	1	13	1	1	1	6	xx	xx
<i>Vertigo pusilla</i>	xx	x	xx	122	xx	6	3	28	1	-
<i>Vertigo substriata</i>	xx	x	xx	58	x	14	-	41	-	-
<i>Vertigo pygmaea</i>	xx	x	x	97	x	16	2	20	4	xx
<i>Vertigo angustior</i>	x	-	-	-	-	-	-	-	-	3
<i>Merdigera obscura</i>	-	-	-	1	-	-	-	-	-	-
<i>Cochlodina laminata</i>	-	7	-	-	-	-	-	-	-	-
<i>Clausilia bidentata</i>	xx	xx	35	103	xx	xx	6	xx	1	-
<i>Balea heydeni</i>	3	-	-	-	-	-	-	-	-	-
<i>Alinda biplicata</i>	xxx fr.	xxx	17	31	1	7	1	12	1	-
<i>Punctum pygmaeum</i>	xx	xx	xx	186	xx	13	9	xx	4	xx
<i>Discus rotundatus</i>	xx	x	1	1	-	xx	1	xx	-	-
<i>Vitrea crystallina</i>	xx	x	xx	47	xx	4	5	13	-	-
<i>Euconulus fulvus</i>	xx	x	xx	48	xx	xx	6	29	1	-
<i>Aegopinella nitidula</i>	xxx	xx	xx	xxx	xx	xx	32	xx	-	-
<i>Oxychilus</i> sp.	1	-	-	-	-	-	1	-	-	-
<i>Nesovitreia hammonis</i>	x	-	5	23	3	8	4	3	-	-
<i>Zonitoides nitidus</i>	-	1	-	-	-	-	-	1	-	-
<i>Vitrina pellucida</i>	xx	2	6	2	-	-	-	1	-	-
<i>Limacidae</i> (small)	-	1	1	8	1	2	2	2	xx	x
<i>Limacidae</i> (large)	-	1	1	-	-	-	-	-	-	-
<i>Trochulus hispidus</i>	xxx	xx	xx	xxx	xx	xx	29	xx	-	-
<i>Helicella itala</i>	x	x	-	-	-	-	-	-	-	-
<i>Candidula intersecta</i>	1	-	-	-	-	-	-	-	-	-
<i>Arianta arbustorum</i>	2	xx	3	8	2	2	-	6	-	-
<i>Cepaea nemoralis</i>	xx	xxx	8	16	2	6	2	6	2	3
Other remains										
Lumbricidae (worms, granules)	xx	xx	xxx	xxx	xxx	xxx	xxx	xxx	xxxx	xx
Cocoon (brown, round)	x	-	xx	xx	x	x	x	xxx	xxx	-
Bones (small - large)	x	xx	xx	xx	x	xx	1	-	xx	-
<i>Cenococcum geophilum</i> (fungus)	xxx	xx	xxx	xxx	xxxx	xxxx	xxx	xxxx	-	-
Seeds + stoneworts (<i>Chara</i> sp.)	xx	xx	xxx	xxx	x	xxx	xx	xxx	xxx	xx

most likely to have been their source. The presence of *Vertigo antivertigo* points to wet conditions at that locality. Some freshwater snails must have lived in shallow puddles. The molluscan fauna consisted predominantly of terrestrial species, characteristic of a rather moist to wet old deciduous forest, the floor of which was covered with leaf litter and fallen wood. Sample 7 contains remains of wetland species and aquatic plants such as *Ranunculus cf. circinatus* Sibthorp, 1794 and *Chara* sp. They indicate a wet, more open environment. It is assumed that the sampled soil developed in an old forest at the transition of a low (marshy) to a higher (moist) level. Plants and animals (mammals) both support the interpretation derived from the molluscan analysis.

The fauna with at least 36 terrestrial species, including five *Vertigo* species, *Merdigera obscura*, *Acanthinula aculeata*, *Spermodea lamellata*, *Cochlodina laminata*, *Balea heydeni* and *Alinda biplicata*, shows just how rich the environment in the Dutch dunes was only about a millennium ago. None of these species persists in the now very open, dune area.

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REFERENCES

- BANK, R., 1976. Jong-Holocene mollusken uit het Nationale Park "De Kennemerduinen". – *De Kreukel* 12 (5-6): 45-56.
- BROEKHUIZEN, S., SPOELSTRA, K., THISSEN, J.B.M., CANTERS, K.J. & BUYS, J.C. (redactie), 2016. Atlas van de Nederlandse zoogdieren. *Natuur van Nederland* 12: 1-432. Naturalis Biodiversity Center & EIS Kenniscentrum Insecten en andere ongewervelden. Leiden.
- BUTOR, L.J.M., 1964. Is *Acanthinula (Spermodea) lamellata* in Nederland uitgestorven? – *Correspondentieblad van de Nederlandse Malacologische Vereniging* 109: 1143.
- CARDAVALL, J. & OROZCO, A., 2016. Caracoles y babosas de la Península Ibérica y Baleares: 1-817. – Barcelona (Omega).
- JANSEN, E.A., 2015. Veldgids slakken en mossels – land en zoetwater: 1-272. KNNV Uitgeverij, Zeist.
- JELGERSMA, S., JONG, J. DE, ZAGWIJN, W.H. & REGTEREN ALTENA, J.F. VAN, 1970. The coastal dunes of the western Netherlands; geology, vegetational history and archeology. – *Mededelingen Rijks Geologische Dienst, Nieuwe Serie* 21: 93-167.
- FELDER, P.J., 1998. Invertebrates (gastropods), in Felder, Rade-makers & de Grooth (eds), *Excavations of prehistoric flint mines at Rijkholt-St. Geertruid (Limburg, The Netherlands)*. – *Archäologische Berichte* 12: 51-54.
- KUIJPER, W.J., 1990. De mollusken van de holocene fluviale afzettingen bij Hekelingen (Spijkenisse, Zuid-Holland). – *Basteria* 54: 3-16.
- KUIJPER, W.J., 2014. De landslakken van de Heunsberg te Valkenburg aan de Geul in de Middeleeuwen. – *Natuurhistorisch Maandblad* 103: 299-103.
- KUIJPER, W.J., VERHEIJEN, I.K.A., RAMCHARAN, A., PLICHT, H. VAN DER & KOLFSCHOTEN, T. VAN, 2016 in press. One of the last wild brown bears (*Ursus arctos*) in the Netherlands (Noordwijk). – *Lutra* 59 (1/2).
- MEIJER, T., 1985. The pre-Weichselian non-marine molluscan fauna from Maastricht-Belvédère (southern Limburg, The Netherlands). – *Mededelingen Rijks Geologische Dienst* 39-1: 75-103.
- QUESLATI, T. & DUVIVIER, H., 2016. Découverte de *Spermodea lamellata* (Jeffreys, 1830) durant l'Holocène (600-500av. J-C.) dans un cortège malacologique forestier du Nord de la France. – *Journal MalaCo* 12: 3-4.
- PREECE, R.C. & BRIDGLAND, D.R., 1999. Holywell Coombe, Folkestone: A 13,000 year history of an English chalkland valley. – *Quaternary Science Reviews* 18: 1075-1125.
- TIL, M. VAN & MOURIK, J., 1999. Hieroglyfen van het zand. *Vegetatie en landschap van de Amsterdamse Waterleidingduinen*: 1-272. Gemeentewaterleidingen Amsterdam.
- UBAGHS, C., 1884. L'âge et l'homme préhistorique et ses ustensiles de la station lacustre près Maestricht: 1-92, 4 pl. Ruremonde.
- VADER, H., 2007. De oudste bewoners van de Amsterdamse Waterleidingduinen. – *Tussen Duin & Dijk* 7 (4): 8-11.
- VOSSEN, I., 2007. Archeologische Rapporten Oranjewoud 2007/86. Archeologische begeleiding Vernattingsproject De Zilk, Amsterdamse Waterleidingduinen. Oranjewoud B.V., Heerenveen. 35 pp, 5 appendices.
- WELTER-SCHULTES, F.W., 2012. European non-marine molluscs, a guide for species identification. Göttingen: 1-679. Planet Poster Editions, Göttingen.