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Mesolithic charcoal-rich pits: "pit hearths" or "ant nests" A short response to Huisman *et al.* (2020)

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1. Introduction

This short note is a response to the paper from Huisman *et al.* "Arguments in favor of an anthropogenic origin of Mesolithic pit hearths. A reply to Crombé & Langohr (2020)" published in 2020 in *Journal of Archaeological Science*. The Huisman *et al.* (2020) paper argues against the theory of a natural origin related to the burning of ant nests, as proposed by Crombé *et al.* (2015) in a paper entitled "Mesolithic hearth-pits: fact or fantasy? A reassessment based on the evidence of the sites of Doel and Verrebroek (Belgium)" and further developed in a reply paper entitled "On the origin of Mesolithic charcoal-rich pits: A comment on Huisman *et al.* (2020)" (Crombé & Langohr, 2020). In this short note we want to highlight some inconsistencies and shortcomings in the argumentation of Huisman *et al.* (2020), which undermine the theory of an anthropogenic origin of these features. Below we will follow the same structure as the latter paper.

2. Anthropogenic indicators?

2.1. (Supra)regional spatio-temporal patterns

Huisman *et al.* (2020) argue that the overall and regional spatio-temporal patterning of "pit hearths" is in favour of their anthropogenic origin. The fact that the vast majority of these features situate in northern Netherlands, north of the Rhine and Meuse (Fig. 1), and much less in the remaining parts of the NW European coversand area, is explained as "a reflection of geographical variability in culture-specific activities by humans". However, according to us it merely reflects profound differences in the post-depositional evolution of different areas within the extensive NW European Plain. The clustering of "pit hearths" north of the Rhine and Meuse coincides

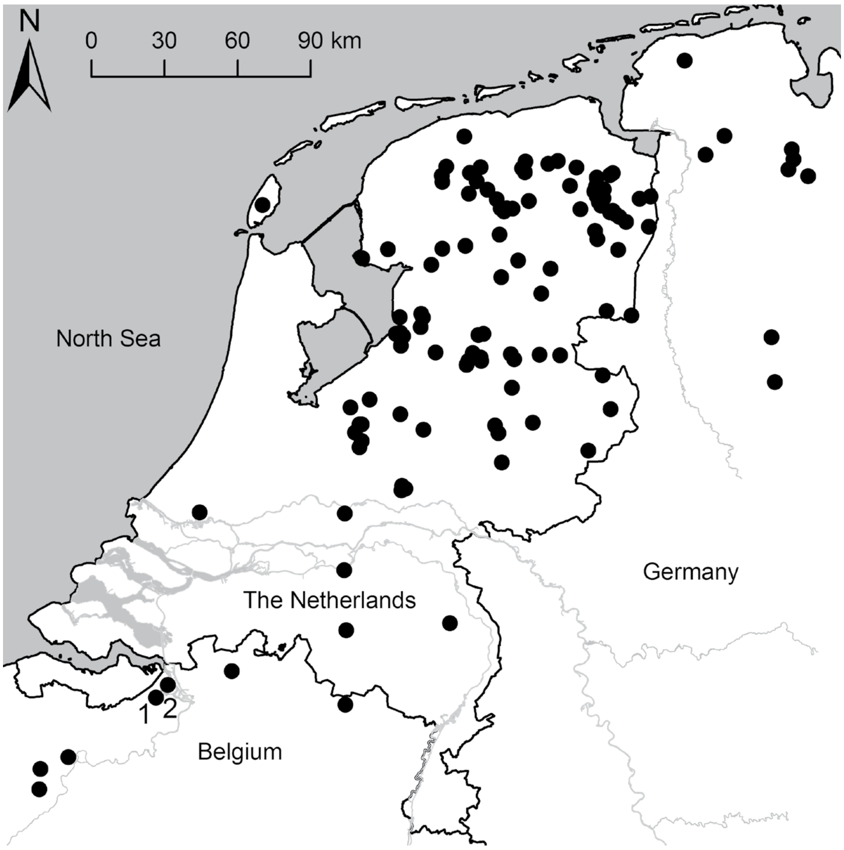

Fig. 1 – Distribution map of Mesolithic sites with "pit hearths" in the coversand area of the northwest European plain showing the location of the sites of Verrebroek (1) and Doel (2) (Crombé *et al.*, 2015).

spatially with the distribution of Holocene wetlands within the Netherlands. Indeed, from the Atlantic to Subboreal transition onwards northern Netherlands gradually got covered by peat sediments, resulting in a generally good preservation of the Mesolithic (coversand) landscape, sites and features. In contrast this sedimentary cover is largely lacking in the coversand area of southern Netherlands and northern Belgium inducing a much less favourable site preservation. In the latter regions the Pleistocene sediment is generally affected by erosion, bioturbation and ploughing, up to a depth of between 40 and 60 cm and locally even more. This implies that "pit hearths" which are usually not much deeper than half a meter, are no longer or just incidentally (just the deepest ones) preserved. Not coincidentally, the only two sites within northern Belgium which yielded dense concentrations of "pit hearths" - the sites of Verrebroek-Dok1 and Doel-Deuganckdok sector B - are situated in comparable wetland contexts as the sites in northern Netherlands. This proofs that these features only survive when sealed by later sediments. So, the general distribution pattern is significantly biased by site-taphonomy rather than reflecting human behavior[1].

2.2. Local and intra-site distribution patterns

We agree with Huisman *et al.*'s statement that generally there is an (apparent) intra-site spatial differentiation between clusters of "pit hearths" and flint scatters, as on most sites there is hardly any spatial overlap between both, although the impact of erosion and soil truncation cannot be denied here (see 3.3). However, we do not agree that this necessarily reflects a "deliberate spatial layout", i. e. an intrasite spatial separation between a special activity ("pit hearth" zone) and domestic zone (lithic scatters). It is perfectly imaginable that the Mesolithic occupants of a site did not really felt attracted to settle in between active ant hills and instead tried to avoid these areas as much as possible. Furthermore the intra-site spatio-temporal patterns cited by Huisman *et al.* (2020) as proof of human behaviour, such as the recurring spatial configurations of "pit hearths" (linear, triangular, rectangular and polygonal pit configurations), the spatial shift of these features over time (e. g. from west to east of the site) and the synchronicity between features within a same configuration, can all be perfectly explained by ant activity. As mentioned in our reply-paper (Crombé & Langohr, 2020), ant colonies do not have to be restricted to a single nest, they can comprise multiple spatially separate but socially connected nests, a phenomenon termed polydomy (e. g. Procter, 2016; Robinson, 2014). Often these socially connected nests occur spatially clustered, representing a shared territory, which closely match the spatial layout of "pit hearth" configurations (Fig. 2). Furthermore, recent research has demonstrated that ant colonies regularly shift their nests. In the National Trust's Longshaw Estate in the Peak District (UK) Burns *et al.* (2020) reported over a period of 8 years

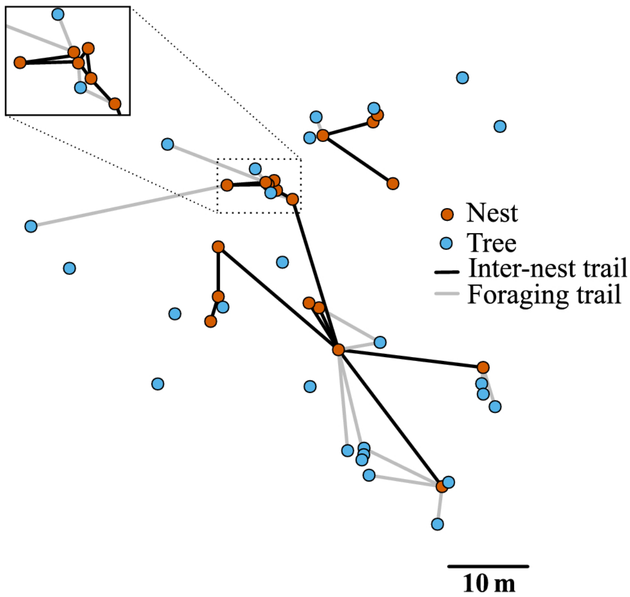

Fig. 2 – An example ant network map illustrating activities such as foraging trails and inter-nest trails between multiple spatially separate but socially connected nests. The spatial lay-out of these contemporaneous ant nests mirrors the spatial configurations observed in Mesolithic "pit hearths" (Burns *et al.*, 2020).

1 The almost complete absence of "pit hearths" in the wetlands of western Netherlands is entirely due to the too deep position of the Pleistocene substrate, which hinders (large-scale) excavations of Mesolithic sites.

more than 900 wood ant nests representing several polydomous colonies, each colony occupied by a mean of ten nests (range 4-20). They found that most polydomous ant nests (58.4 %) are abandoned in the first 2 years after being constructed and new ones were established a bit further. This high frequency of relocation of ant nests results in the formation of extensive ant nest complexes, very similar to clusters of "pit hearths".

2.3. Charred plant remains in the pits: composition

Huisman *et al*. (2020) argue that the presence of multiple wood species in numerous "pit hearths" dated < 8000 uncal BP, some including non-local "wet" species such as *Alnus* and *Salix*, combined with the fact that ants cannot move large wood fragments, definitely proofs the man-made origin of these features. Yet, the authors do not at all take into account that "pit hearths" are not always fully homogenous and in fact are potentially mixed contexts. This has been demonstrated many times by the (relatively frequent) occurrence of residual and/or intrusive remains in these features, mostly carbonized hazelnut shells and lithic artefacts. Cross-dating of hazelnut shells on various sites has clearly proven these to be either older or younger than the charcoal dates from the same features (Crombé *et al*., 2013b; Hamburg *et al*., 2012: tab. 5.1). They are interpreted as settlement waste from the Mesolithic surface which accidentally got trapped in "pit hearths". Although Huisman *et al*. (2020, 4) accept that most if not all lithic artefacts and hazelnut shells in "pit hearths" are residual or intrusive, they do not make the logic reflection that this can also apply to other items in these features, such as charcoal and incidental charred aquatic and wetland plant remains (e. g. macro- and parenchymal remains). It is perfectly imaginable that part of the charcoal and other plant remains from surface hearths, generally situated within lithic scatters, ended in "pit hearths" due to ant activity, just like lithic artefacts and charred hazelnut shells. This particularly holds for sites displaying some degree of spatial overlapping between "pit hearths" and lithic scatters[2]. This is the case at the extensive site of Dronten-N23, yielding over 772 such features and representing therefore one of the most important "pit hearth" sites of northern Netherlands. In fact, at this site the spatial distribution of the "pit hearths" (Hamburg *et al*., 2012: fig. 5.4) matches perfectly that of the (lithic) settlement waste (Hamburg *et al*., 2012: fig. 2.13), implying that here the risk of "contamination" with residual and/or intrusive material is extremely high. This is corroborated by the frequent occurrence of charred hazelnut shells in "pit hearths", the majority dated older or sometimes younger than the charcoal (Tab. 1). Interestingly, precisely at Dronten the frequency of "pit hearths" with a multiple charcoal composition is particularly high, as can be deduced from figure 1 in the Huisman *et al*. (2020) paper. So, there is no reason to assume that only hazelnut shells accidentally ended in "pit hearths". Several other Mesolithic sites, such as Verrebroek-Dok 1 (wrongly mentioned by Huisman *et al*. as example of spatial differentiation), Kampen-Reevediep and Hempens also display spatial overlaps, albeit on a more local level, hence charcoal admixture probably is much more common than hitherto assumed.

In order to verify the above assumption of mixed charcoal contexts, much more effort should be invested in cross-dating "pit hearths" on charcoal samples from different wood species using AMS dating on single-entity samples. The few attempts so far (Tab. 2) revealed

2 We agree with Huisman *et al*. (2020) that spatial overlap "is more likely to be a function of the extent of the habitable area; if it is relatively small, repeated use would ultimately lead to a palimpsest of different, non-synchronous activities involving pit hearths and flint." Since it has been demonstrated that many Mesolithic sites are in fact spatial or cumulative palimpsests resulting from repeated re-occupation (Crombé *et al*., 2006, 2013a) spatial overlapping between "pit hearths" and lithic scatters probably is more frequent than hitherto assumed, but is overlooked due to limited/partial excavation of lithic scatters and the truncation and/or careless excavation (Huisman *et al*., 2020, 4) of the top of the coversand, in which the bulk of the lithic scatters is situated.

Site	*Feature*	*Lab. reference*	*Dating material*	*BP date*	*Failed chi-squared test*
Almere "Hout Zwaanpad"	?	GrN-28888	?	8000 ± 50	
	?	UtC-12794	?	7930 ± 50	
Groningen "AZG"	18	GrN-29191	*Pinus*	8010 ± 80	
	18	GrN-29192	*Quercus*	7980 ± 90	
	8	GrN-29184	*Quercus*	8120 ± 60	
	8	GrN-29183	*Pinus*	8070 ± 60	
	15	GrN-29189	*Pinus*	8150 ± 60	
	15	GrN-29190	*Quercus*	8080 ± 60	
Grootegast-Niekerk	1	GrN-24745	*Quercus*	6220 ± 40	
	1	GrN-24436	*Quercus*	6140 ± 40	
Hempens "N31"	33	GrN-30634	*Quercus*	7380 ± 60	T=4.446 (5 % 3.8)
	33	GrN-28976	?	7545 ± 50	
	34	GrN-30635	*Quercus*	7880 ± 60	T=30.570 (5 % 3.8)
	34	GrN-30636	*Alnus*	7450 ± 50	
Mariënberg	171	GrN-22145	*Quercus*	7260 ± 40	T=22.840 (5 % 3.8)
	171	GrN-22156	*Pinus*	7500 ± 30	
	173	GrN-22146	*Quercus*	7270 ± 30	
	173	GrN-22157	*Pinus*	7285 ± 25	
	83	GrN-22135	*Quercus*	6510 ± 30	T=6.790 (5 % 3.8)
	83	GrN-22155	*Pinus*	6640 ± 40	
	40	GrN-29375	*Alnus*	6390 ± 35	
	40	GrN-29376	*Quercus*	6365 ± 35	
	59	GrN-29379	*Alnus*	6450 ± 60	T=10.323 (5 % 3.8)
	59	GrN-29380	*Quercus*	6210 ± 45	
Verrebroek "Dok 1"	66	UtC-9452	*Quercus*	8200 ± 70	
	66	UtC-9451	*Pinus* trunkwood	8190 ± 70	
Verrebroek "Dok 1"	91	UtC-9448	*Pinus* branch	8250 ± 70	
	91	UtC-9449	*Quercus* large fragment	8320 ± 60	
	91	UtC-9450	*Corylus* large fragment	8330 ± 70	
Zwolle	?	GrN-20953	?	6980 ± 60	
	?	GrN-29416	?	6920 ± 60	

Tab. 1 – List of charcoal dates from "pit hearths" which have been dated on two or more samples. Although generally dates within one feature are consistent, in at least five cases statistical differences can be observed which indicate integrity problems. For references to sites, see Crombé *et al.*, 2013b. Analysis performed with the IntCal13 curve (Reimer *et al.*, 2013) and the OxCal online version 4.3.

that charcoal dates from a same feature are not always perfectly contemporaneous, indicating that some mixing among the charcoal needs to be seriously considered[3].

3. Lack of anthropogenic indicators

3.1. Lack of rubified soil material

We follow Huisman *et al.* (2020) in their statement that soil reddening is dependent on various factors, such as moisture content and properties of the soil iron oxide

3 Interestingly, two of the five cases of incompatible charcoal dates include samples of *Alnus*, supporting our hypothesis that this non-local wood species probably derives from perturbed surface hearths and are intrusive within the "pit hearths". However, it is clear that further cross-dating is needed to clarify this issue further.

minerals, which may be different from site to site. However, this cannot fully explain the complete absence of soil rubification in the many thousands of excavated "pit hearths", especially those of type A. Earlier (Crombé *et al.*, 2013b) we already pointed out the surprising intra-site difference between "pit hearths" and surface hearths at the wetland sites of Almere and Urk; the former lacking any trace of heat weathering, while the latter displayed clear traces of in situ burning. This marked intra-site difference cannot be explained by different soil properties but rather indicates that no fires with ample oxygen supply were lit within the "pit hearths".

Furthermore, we do not agree with the statement that reddening of the soil in most cases does not occur below open fires with temperature < 900°C (Huisman *et al.*, 2020). Laboratory studies with open fires (Terefe *et al.*, 2005) indicate that, due to changes among iron oxides, redness can already increase in the range of 300 to 500°C. These are the temperatures estimated for the Mesolithic "pit hearths" (Huisman *et al.*, 2020), hence reddening should have occurred if fires were lit in these pits. The most evident argument for low temperatures comes from the abundance of charcoal and particularly of charred organic-rich earth in the "pit hearths". The statement that the presence of charcoal does not necessarily imply high-temperature fires in these pits as it could be prepared in another location makes no sense as the dominant characteristic of these structures is the presence of charred organic-rich earth. It is difficult to imagine that this substance was prepared elsewhere.

Feature code	*Dating material*	*BP date*	*standard deviation*
389	*Corylus* nut shell	8530	50
389	*Pinus* cone fragment	8215	40
X^2-Test fails: df=1 T=24.396 (5 % 3.8)			
387	*Corylus* nut shell	8225	45
387	*Pinus* cone fragment	8030	40
X^2-Test fails: df=1 T=10.517 (5 % 3.8)			
1233	*Corylus* nut shell	7955	40
1233	*Pinus* cone fragment	7965	40
R_Combine		*7960*	*29*
784	Corylus nut shell	8520	45
784	*Pinus* trunk wood	8280	40
X^2-Test fails: df=1 T=15.940 (5 % 3.8)			
683	*Corylus* nut shell	7615	45
683	*Salix* trunk wood	7670	40
R_Combine		*7646*	*30*
831	*Corylus* nut shell	7845	45
831	*Alnus* trunk wood	7780	40
R_Combine		*7809*	*30*
281	*Corylus* nut shell	8080	40
281	*Pinus* twig wood	8200	40
X^2-Test fails: df=1 T=4.500 (5 % 3.8)			
475	*Corylus* nut shell	8285	45
475	*Pinus* cone fragment	8125	40
X^2-Test fails: df=1 T=7.077 (5 % 3.8)			
1062	*Corylus* nut shell	7770	40
1028	*Pinus* twig wood	8260	40
X^2-Test fails: df=1 T=74.915 (5 % 3.8)			
Augering 501	*Corylus* nut shell	7690	50
1304	*Corylus* nut shell	7800	45
1304	*Pinus* twig wood	8210	40
X^2-Test fails: df=2 T=80.730 (5 % 6.0)			
1036	*Corylus* nut shell	8290	45
1036	*Pinus* twig wood	8340	40
R_Combine		*8318*	*30*
1137	*Corylus* nut shell	8670	45
1137	*Pinus* cone fragment	8200	40
X^2-Test fails: df=1 T=61.271 (5 % 3.8)			
2184	*Corylus* nut shell	8675	45
2184	*Salix* undet.	6975	40
X^2-Test fails: df=1 T=802.243 (5 % 3.8)			
2166	*Corylus* nut shell	8735	40
2166	*Alnus* trunk wood	7040	40
X^2-Test fails: df=1 T=881.461 (5 % 3.8)			

Tab. 2 – List of "pit hearths" from Dronten-N23 which were cross-dated on individual charred hazelnut shells and charcoal fragments. Chi-squared tests (X^2-tests) indicate that most hazelnut shells are incompatible with the charcoal from the same feature, demonstrating their mixed character.

3.2. Decay patterns in wood

According to Huisman *et al.* (2020) decayed wood, which occurs frequently in "pit hearths" would be more suitable for tar production, but as long as no tar remains have been found in these features this functional interpretation remains highly hypothetical (Crombé & Langohr, 2020). Furthermore, fresh wood, like birch bark, is generally mentioned as excellent products for tar production.

3.3. Variable ^{14}C dates

Huisman *et al.* (2020) question the validity of the observation of a decrease in "pit hearth" dates from the Atlantic onwards, interpreted by Crombé (2016) and Crombé & Langohr (2020) as reflecting a decrease in wildfires due to the installation of a mixed deciduous forest. Huisman *et al.* (2020; fig. 2) refer to a graph[4], showing the frequency of 345 uncalibrated radiocarbon dates in 200-year bins. However, it is unclear how this figure was constructed. In his 2005/2006 paper, M. Niekus already mentions at least 324 charcoal dates from "pit hearths" from northern Netherlands. Meanwhile a substantial number of new dates have been obtained from other sites such as Hempens (27 dates), the Hanzelijn (62 dates), Dronten-N23 (96 dates) and Kampen-Reevediep (46 dates), which makes a total of over 550 dates. So how come that these were not all included in the analysis? Why were the ca. 200 remaining dates not included in the figure? As long as this is not clarified, we need to address figure 2 within the Huisman *et al.* (2020) paper with much caution as it is potentially biased.

Even if we admit that the trend in radiocarbon dates in the published figure is correct, despite being based on just a selection of dates, we believe that our earlier observations remain solid. Two of the three peaks we identified earlier (Crombé, 2016) - a large one between ca. 8400 and 7600 uncal BP and a smaller one between ca. 7000 and 6800 uncal BP (Fig. 3) - are still clearly visible in figure 2 of Huisman *et al.* (2020). In fact, the latter peak, representing ca. 15 % of all dates, has become much more pronounced; it contrasts sharply with the mean frequency of dates just before and after this peak (between ca. 7500 and 6000 uncal BP, i. e. the Late Mesolithic/Atlantic) which hardly attains ca. 5 % of all dates. We consider this as a confirmation of our earlier interpretation of this small, Late Mesolithic peak as reflecting the impact of the 8.2 cal BP cooling event. This short but abrupt climatic event would have led to drier conditions, which might have increased the risk of forest wildfires.

Furthermore, Huisman *et al.* (2020) argue that the sudden and marked decline of "pit hearths" after ca. 6000 uncal BP does not match with the ant theory, as there is no reason to assume that ant activity decreased after this date, in particular in the drylands. According to us, however, the almost complete "disappearance" of "pit hearths" is biased by the post-depositional factors mentioned in 2.1. In northern Netherlands ant activity probably decreased as a result of increasing wetter soil conditions which led to the formation of extensive peat deposits on top of the coversand dunes. Outside the wetlands, conditions were most likely still favourable for ants, but here soil erosion and ploughing has erased nearly all evidence (i. e. "pit hearths"). Only on specific well-preserved dry locations, such as the coastal dune at the Neolithic site of Schipluiden

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4 The radiocarbon ages in figure 2 of Huisman *et al.* (2020) are expressed in cal. yr. BP; however, this most likely is wrong and should be changed into uncal yr. BP, based on the fact that the authors state that no dates are available after ca. 6000 uncal BP. Similarly, the chronological indication in figure 1 is wrong and should be changed into cal. yr. BC as the youngest dates from Dronten are in the range of ca. 6450 uncal BP (Hamburg *et al.*, 2012: tab. 15.1).

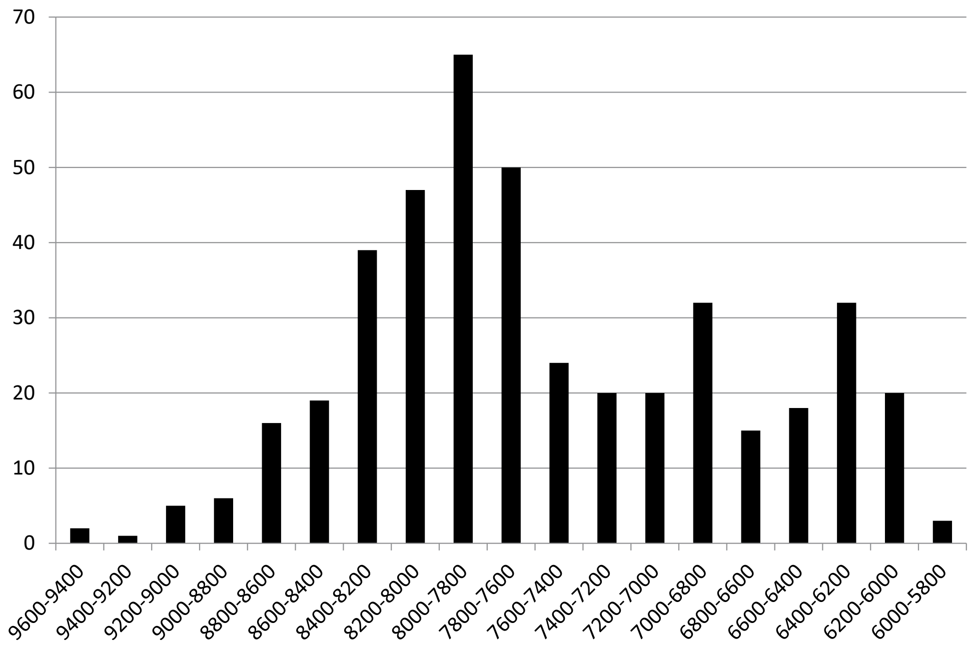

Fig. 3 – Distribution of 434 radiocarbon dates on charcoal from "pit hearths" (Crombé, 2016).

(Louwe Kooijmans & Jongste, 2005/2006) "pit hearths" (56 in total) very similar to the Mesolithic ones have been reported. So not only the spatial but also the chronological distribution of "pit hearths" seems to be severely biased by taphonomic factors, something which needs to be seriously taken into consideration.

4. What about ants?

Huisman *et al.* (2020) state that the ant hypothesis is based on "*assumed* properties of these nests, which are then argued to be similar to those of pit hearths" and therefore "do not present actual observations on the subsurface morphology of burned ant nests." Furthermore, they label the cross-section of abandoned and burnt ant nests, as published by Crombé *et al.* (2015: fig. 12) and Crombé & Langohr (2020; Fig. 1) as "oversimplifications". However, the cross-section through a nest of red forest ants they produced (Huisman *et al.*, 2020; Fig. 3) is more than simplified and does not match the numerous transects through such ant nests available on the web by scientists and naturalists specialised in ants[5]. According to this cross section the ant nest is restricted to a small area under the organo-mineral dome and is situated above a "residual" zone in a B soil horizon. In fact, the ant nest includes the dome and the deeper soil horizons, all units that are densely occupied by open galleries and chambers of the nest that will collapse during the fire and afterwards when the ants abandon the nest, as illustrated in figure 1 in Crombé & Langohr (2020). The reference to a photograph of a burned ant nest by Boer (s. d.) shows very well the "crater-like" structure also described in Boer

5 Cross sections of ant nests can be found on the following websites (checked in September 2020):
http://tpefourmie2013.e-monsite.com/medias/images/dessin-fourmiliere.jpg
https://www.waldwissen.net/wald/tiere/insekten_wirbellose/wsl_ameisen_faktenblatt/wsl_ameisen_faktenblatt_bild5
https://studylibde.com/doc/1076564/der-nesthaufen-der-waldameisen
http://www.nlmieren.nl/IMAGES/brand_duinbrand_comp.pdf

and Kelder (2016). However, it has to be mentioned that this picture corresponds to a nest much smaller than the nest reconstruction in the Huisman *et al.* 2020 paper.

Finally, we disagree with the statement of Huisman *et al.* (2020) that it is uncommon that wildfires turn tree trunks, roots and other voluminous wood remains into charcoal, which would imply that the charcoal found in Mesolithic "pit hearths" cannot be related to forest fires. However, this is a serious underestimation of the effects of wildfires. The intensity of wildfires is dependent on the fire regimes, which have been classified into 8 different types (Heinselman, 1981; Moore, 2000) ranging from light surface fires to severe surface and crown fires. An average surface fire on the forest floor might have flames reaching 1 meter in height and can reach temperatures of 800°C or more. Fuel may include dead litter on the forest floor and standing living and dead fuel such as woody shrubs or juvenile trees. It is not that far-fetched to image wildfires, even surface fires, affecting the stumps of dead trees on which ants generally construct their nests, producing large charcoal lumps which ultimately ended in the buried nest during its collapse.

5. Conclusions

Despite our comments on the Huisman *et al.* (2020) arguments against the ant nest theory, we would like to join the authors in their hope that this and earlier papers on the genesis and meaning of Mesolithic "pit hearths" will stimulate further interdisciplinary research on this topic. According to us future research should mainly focus on:

1. extensive cross-dating of hearth-pits using multiple charcoal samples, each composed of one particular wood species, preferably single entity samples;
2. an absolute need to observe and study in detail the deeper soil horizons above, besides and particularly under the black structure on which nearly all attention went until now;
3. field-work focussing on the impact of burning of ant nests;
4. soil studies on ant nests with an organic dome similar to those conducted on mineral mound-building ants (e. g. Green *et al.*, 1998).

References

BOER P., s.d. [2009] *Kwetsbaarheid van mieren voor brand*. Online: http://www.nlmieren.nl/IMAGES/brand_duinbrand_comp.pdf ["Vulnerability of ants to fire" in Dutch.]

BOER P. & KELDER L., 2016. Effecten van brand, kaalkap en verstuiving op Rode bosmieren. *De Levende Natuur*, 117(2): 61-64. ["Effects of fire, clear-cutting and wind erosion on red forest ants", in Dutch.]

BURNS D. D. R., FRANKS D. W., PARR C., ELLIS S. & ROBINSON E. J. H., 2020. A longitudinal study of nest occupancy, trail networks and foraging in a polydomous wood ant population. *Insectes Sociaux*, 67(2020), 419-427. Online: https://doi.org/10.1007/s00040-020-00777-2

CROMBÉ P., 2016. Forest fire dynamics during the early and middle Holocene along the southern North Sea basin as shown by charcoal evidence from burnt ant nests. *Vegetation History and Archaeobotany*, 25: 311-321.

CROMBÉ P. & LANGOHR R., 2020. On the origin of Mesolithic charcoal-rich pits: A comment on Huisman *et al. Journal of Archaeological Science*, 119: 105058. Online: http://dx.doi.org/10.1016/j.jas.2019.105058

CROMBÉ P., LANGOHR R. & LOUWAGIE G., 2015. Mesolithic hearth-pits: fact or fantasy? A reassessment based on the evidence from the sites of Doel and Verrebroek (Belgium). *Journal of Archaeological Science*, 61: 158-171.

CROMBÉ P., PERDAEN Y. & SERGANT S., 2006. Extensive artefact concentrations: single occupations or palimpsests? The evidence from the Early Mesolithic site of Verrebroek "Dok" (Belgium). In: Kind C. J. (ed.), *"After the Ice Age" Proceedings of the International Conference, Rottenburg 9-12 September 2003*, Materialhefte zur Archäologie, 78, Konrad Theiss Verlag, Stuttgart: 237-243.

CROMBÉ P., SERGANT J. & DE REU J., 2013a. La contribution des dates radiocarbone pour démêler les palimpsestes mésolithiques : exemples provenant de la région des sables de couverture en Belgique du Nord-Ouest. In: Valentin B., Souffi B., Ducrocq T., Fagnart J.-P., Séara Fr. & Verjux C. (dir.), *Palethnographie du Mésolithique. Recherches sur les habitats de plein air entre Loire et Neckar. Actes de la table ronde internationale de Paris, 26 et 27 novembre 2010*, Séances de la Société préhistorique française, 2-1, Société préhistorique française, Paris: 235-249.

CROMBÉ P., ROBINSON E., BOUDIN M. & VAN STRYDONCK M., 2013b. Radiocarbon dating of Mesolithic open-air sites in the coversand area of the Northwest European Plain: problems and prospects. *Archaeometry*, 55 (3): 545-562.

GREEN W. P., PETTRY D. E. & SWITZER R. E., 1998. Formicarious pedons, the initial effect of mound-building ants on soils. *Soil Survey Horizons*, 39 (2): 31-60.

HAMBURG T., MÜLLER A. & QUADFLIEG B. (ed.), 2012. *Mesolithisch Swifterbant: mesolithisch gebruik van een duin ten zuiden van Swifterbant (8300-5000 v. Chr.): een archeologische opgraving in het tracé van de N23/N307, provincie Flevoland.* Archol report, 174, & ADC report, 3250, Archol & ADC-Archeoprojecten, Leiden & Amersfoort.

HEINSELMAN M. L., 1981. Fire regimes and ecosystem properties. In: Mooney H. A., Bonnicksen T. M., Christensen N. L., Lotan J. E. & Reiners W. A. (ed.), *Proceedings of the Conference: Fire Regimes and Ecosystem Properties, December 11-15, 1978, Honolulu, Hawaii*, US Department of Agriculture, Forest Service, General Technical Report WO-26, Washington D.C.: 7-57.

HUISMAN D. J., NIEKUS M. J. L. T., PEETERS J. H. M., GEERTS R. C. A. & MÜLLER A., 2020. Arguments in favour of an anthropogenic origin of Mesolithic pit hearths. A reply to Crombé and Langohr (2020). *Journal of Archaeological Science*, 119: 105144.

LOUWE KOOIJMANS L. P. & JONGSTE P. F. B. (ed.), 2005/2006. *Schipluiden: A Neolithic settlement on the Dutch North Sea coast, c. 3500 cal. BC.* Analecta Praehistorica Leidensia, 37-38.

MOORE J., 2000. Forest fire and human interaction in the early Holocene woodlands of Britain. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 164: 125-137.

NIEKUS M. J. L. T., 2005/2006. A geographically referenced 14C database for the Mesolithic and the early phase of the Swifterbant culture in the northern Netherlands. *Palaeohistoria*, 47/48: 41-99.

PROCTER D., 2016. *The effects of forest cover change and polydomous colony organisation on the wood ant Formica lugubris*. PhD thesis, University of York, Biology, York (GB).

REIMER P. J., BARD E., BAYLISS A., BECK J. W., BLACKWELL P. G., BRONK RAMSEY C., GROOTES P. M., GUILDERSON T. P., HAFLIDASON H., HAJDAS I., HATT C., HEATON T. J., HOFFMANN D. L., HOGG A. G., HUGHEN K. A., KAISER K. F., KROMER B., MANNING S. W., NIU M., REIMER R. W., RICHARDS D. A., SCOTT E. M., SOUTHON J. R., STAFF R. A., TURNEY C. S. M. & VAN DER PLICHT J., 2013. IntCal13 and Marine13 radiocarbon age calibration curves 0-50,000 Years cal BP. *Radiocarbon*, 55 (4): 1869-1887.

ROBINSON E. J. H., 2014. Polydomy: the organisation and adaptive function of complex nest systems in ants. *Current Opinion in Insect Science*, 5: 37-43.

TEREFE WONDAFRASH T., MARISCAL-SANCHO I., GOMEZ MIGUEL V. & ESPEJO SERRANO R., 2005. Relationship Between Soil Color and Temperature in the Surface Horizon of Mediterranean Soils: A Laboratory Study. *Soil Science*, 170 (7): 495-503.

Abstract

This short note is a response to the paper from Huisman et al. (2020) "Arguments in favour of an anthropogenic origin of Mesolithic pit hearths. A reply to Crombé and Langohr (2020)", which argues against a natural, ant-related origin of these features. Within this short note some inconsistencies and shortcomings in Huisman et al.'s argumentation are discussed, providing further support for the theory of organic dome-constructing ant nests affected by wildfires regularly occurring during the Early Holocene. The paper ends with some suggestions for further research into the origin of these charcoal-rich features, characteristic of the coversand area of NW Europe.

Keywords: Mesolithic, "pit hearths", ant nests, forest fires.

Samenvatting

Dit kort artikel is een reactie op het artikel van Huisman et al. (2020) "Arguments in favour of an anthropogenic origin of Mesolithic pit hearths. A reply to Crombé & Langohr (2020)", waarin geargumenteerd wordt tegen een natuurlijke oorsprong van deze structuren. In deze korte bijdrage wordt gewezen op een aantal fouten en inconsequenties in de argumentatie van Huisman et al. Vooral de gebrekkige tafonomische analyse die doorgaans op dit type structuren wordt toegepast wordt hierin aangekaart. Al te vaak worden "haardkuilen" geïnterpreteerd als "gesloten" en "homogeen" terwijl er tal van indicaties zijn die aantonen dat er vaak sprake is van gemengde contexten. Dit laatste kan het best verklaard worden door een natuurlijke oorsprong van "haardkuilen", meer bepaald als organische mierennesten die na bosbranden ineengestort zijn.

Trefwoorden: Mesolithicum, "haardkuilen", mierennesten, bosbranden.

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