

An ill wind: a gale, beachcombing and *Gastrochaenolites* Leymerie in peat, North Sea coast, the Netherlands

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Abstract

Clasts of Quaternary (presumably Pleistocene) peat were washed ashore on the North Sea coast of the Netherlands in late December 2013. Some preserved Recent borings identified as *Gastrochaenolites* isp. cf. *G. turbinatus* Kelly and Bromley. Most clasts were bored from one direction only (=upper surface), suggesting that they are ripped up fragments of a bed(s); one cobble with borings on both sides must have been resident on the sea floor as a rolling fragment. Borings are all incomplete, further suggesting that boring occurred when the clasts formed part of a thicker sedimentary succession. One specimen preserves two *in situ* shells of the boring bivalve *Petricola pholadiformis* Lamarck, the trace maker of *G.* isp. cf. *G. turbinatus* in this environment.

Key words: reworking, ichnology, preservation, boring bivalves, *Petricola pholadiformis*

Introduction

Exotic beach clasts may be accumulated by various processes, including extremes of weather, fluvial action and gravity (for example, contrast Donovan, 2010 with Donovan *et al.*, 2014). On Christmas Eve 2012, the author went beachcombing on the North Sea Coast of Noord Holland, the Netherlands. Amongst the specimens collected that day was a Quaternary pebble of peat preserving a Recent boring, *Gastrochaenolites* isp. cf. *G. lapidicus* Kelly and Bromley, 1984, with a distinctive bioglyph. Donovan (2013a) was able to identify the probable producer, certainly a boring bivalve and either *Barnea candida* (Linné) or *Petricola pholadiformis* Lamarck, based on local knowledge and inference.

On Christmas Eve 2013, the same coastline was hit by a major gale, preventing the author from making his annual excursion to the beach. But this collecting trip was only postponed until Boxing Day in anticipation of much debris having been carried ashore by the storm. Slabs of Quaternary peat were a common component of this flotsam, including many bearing multiple borings, although none bears a bioglyph. It is these latter specimens that form the subject of the present paper and form an extension to the deductions of Donovan (2013a).

Terminology of the *Gastrochaenolites* boring follows Kelly and Bromley (1984). My philosophy of open nomenclature follows Bengtson (1988). Specimens are deposited in the Naturalis Biodiversity Center, Leiden (RGM), the Netherlands.

Locality

(Abridged from Donovan, 2013a, p. 109.) The nine specimens described herein, RGM 791 619–791 627, came from the Zandvoort–Bloemendaal aan Zee–Parnassia Strand area, Noord Holland (Fig. 1; 1:25,000 topographic map Haarlem 25A). The strandline of this beach is commonly littered with myriad shells and valves of infaunal and epifaunal invertebrates (Donovan, 2007). Rare components of this death assemblage are boring bivalves, namely *Zirfaea crispata* (Linné), the oval piddock; *Barnea candida* (Linné), the white piddock; and *Petricola pholadiformis* Lamarck, the so-called American piddock (Beedham, 1972; Tebble, 1976). It is rare for fragments of submerged Quaternary peats and mudrocks derived from offshore to form part of this assemblage, except after a major storm, when rolled cobbles and pebbles are carried onshore. It is these clasts that form the subject of the present study.

Description

Nine slab-like cobbles of peat, RGM 791 619–791 627, were collected from amongst many more because each preserves one or more incomplete borings. The peat contains obvious plant debris. Clasts are flattened, presumably a relic of original bedding; they are irregular in outline, but are commonly more or less rounded to elliptical. Shell fragments embedded in the peat look fresh and may be Recent



Fig. 1. Outline map of the south coast of Noord-Holland, the Netherlands, with the coastline stippled and some important settlements marked (after Donovan, 2013a, fig. 1). The arrow pointing towards Zandvoort indicates the southernmost part of the coastline which yielded the specimens of boring bivalves and Pleistocene peat discussed herein. Key: NZK = Noordzee-kanaal. The inset map of The Netherlands shows political boundaries dashed and the coastline stippled. Compare the position of Haarlem (H) with the main map. Key: Bm, Belgium; Gy, Germany; A, Amsterdam; D, Den Haag (The Hague); M, Maastricht; R, Rotterdam; U, Utrecht.

inclusions. RGM 791 625 preserves an incomplete balanid barnacle attached close to the apertural end in the neck of a moderately broad boring (Fig. 2E).

Borings are circular in section and commonly perpendicular to sub-perpendicular to bedding, occurring singly or in clusters. Borings are typically conical and invariably incomplete. The sides of boreholes expose fine bedding structures on a mm scale, but no bioglyphs are developed (contrast with Donovan, 2013a). Borings that are non-penetrative have an unsculptured, hemispherical base to the chamber. Most borings are conical in one direction only, probably indicating that they were bored *in situ* in the peat bed, but RGM 791 623 (Fig. 2F) has been bored on both sides. RGM 791 626 is particularly woody, and its borings both interfere and show a broad range of orientations.

Some borings retain the valves of articulated bivalve shells. Most are interpreted as boring bivalves (e.g. RGM 791 622) rather than nestlers or chance inclusions. Most of these *in situ* bivalves could not be removed for identification, but the shells are invariably long and slender. RGM 791 627 is the largest clast (about 165 x 125 x 40 mm), with two, large, *in situ* bivalves, one of which was removed (and replaced) after photography (Fig. 1A–D) and identified as *Petricola pholadiformis* Lamarck.

Discussion

This collection of reworked and bored clasts is notable for several reasons. The Quaternary peat is not exposed onshore and, without recourse to a boat, can only be sampled after clasts have been carried onshore by a storm. The clasts are invariably rounded, presumably due to a long residence time on the seafloor with associated tumbling by waves; some evidence of this is provided by RGM 791 623, the peat cobble bored from both sides, which must have been a rolling clast which was ‘flipped over’ more than once. Or possibly not, as peat is a particularly soft rock and one storm event may be all that is necessary to rip up and round such clasts. These peats are terrestrial in origin, but the borings are the spoor of marine bivalves. This disparity is an indicator of history. The peat was deposited at a time of lower sea level during the Quaternary (probably Pleistocene), but were subsequently drowned and more recently bored on the sea floor. The borings were mainly made in the *in situ* bedded peat, crossing two or more beds, which is why specimens preserve only incomplete sections of the neck or chamber in these fragments from single beds (*sensu* Kelly and Bromley, 1984, fig. 1). That these trace fossils are *Gastrochaenolites* is no surprise as it is a common boring in reworked clasts (see, for example, Donovan, 2011a, b, 2013a, b; Donovan and Pawson, 2013).

The sample is biased towards those with borings and selected by the author; others left on the beach showed few or no invasive structures. Although the peat clasts discussed herein are mainly perforated by borings, they nevertheless showed sufficient lithologic integrity to avoid complete disintegration. But all the borings are incomplete; Donovan and Isted (2014) noted that this is a common feature of both modern and ancient clavate borings in beach clasts. In the present study, *Gastrochaenolites* are preserved no longer than the thickness of beds in the peat; bedding determines the thickness of these flattened clasts.

Determination of *Gastrochaenolites* *isp.* is difficult from such incomplete specimens. Although size is a weak ichnotaxobase (Pickerill, 1994), these borings are commonly too big to be anything else but *Gastrochaenolites* (Fig. 2). As noted above, bored peat clasts commonly preserve just part of the borehole(s) in transverse section, part of the neck, chamber, base or a combination of these, which is not diagnostic to ichnospecies and is analogous to many bored Chalk clasts on the Norfolk coast of eastern England (Donovan, 2011a, fig. 1; 2011b, fig. 2C). Only by building up a composite description based on all specimens could a tentative determination be made which agrees well with the diagnosis of *G. turbinatus* by Kelly and Bromley (1984, p. 803); “Smooth *Gastrochaenolites*, acutely conical, having evenly tapered body and neck, the widest point close to the short rounded base; rounded cross-section throughout length.”

The most notable feature of these clasts is the rare preservation of *in situ*, articulated boring bivalves (Fig. 2A–D). One bivalve is almost exposed (Fig. 2D), and soon would have been lost if corrosion and abrasion had been allowed to continue. Both *in situ* shells occur in the same cobble and both have the same orientation, contradicting any speculation that they may be fortuitous inclusions positioned

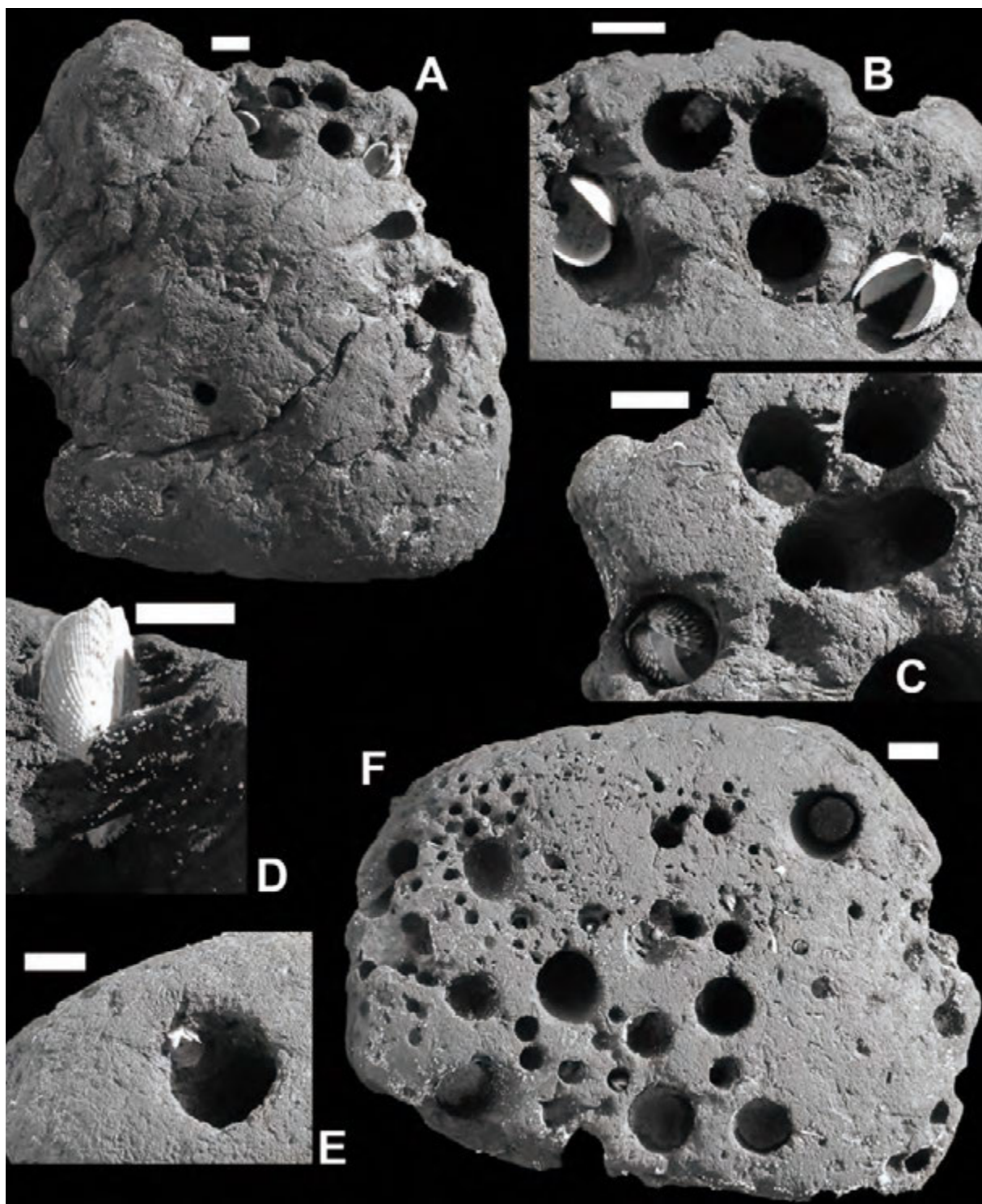


Fig. 2. Reworked Pleistocene peat clasts with Recent *Gastrochaenolites* isp. cf. *G. turbinatus* Kelly and Bromley from the strandline north-northeast of Zandvoort, Noord Holland, the Netherlands. (A–D) RGM 791 627, large cobble preserving two in situ boring bivalves, *Petricola pholadiformis* Lamarck. (A) Upper surface of flat clast, borings towards top right. (B) Same surface, detail of borings and bivalves. (C) Reverse surface of same area of clast; only one of the borings retaining a bivalve is penetrative (lower left). (D) Lateral view of bivalve in (C) in life position; this was later removed for identification and replaced. The other bivalve cannot be removed without damage, but appears conspecific. (E) RGM 791 625, balanid barnacle infesting *Gastrochaenolites* boring. (F) RGM 791 623, surface of clast to show multiple boreholes of different diameters. Specimens uncoated. Scale bars represent 10 mm.

by physical process. They are identified as *Petricola pholadiformis* Lamarck, a boring veneracean that is convergent in form to a pholad. Shells and valves of boring bivalves are rare on the beach at Zandvoort

compared with the many hundreds of burrowers, but the commonest is *P. pholadiformis* (Donovan, 2013a, table 1). This was confirmed when the peat clasts were collected; *P. pholadiformis* (three articulated shells,

six right valves) outnumbered the only other borer encountered, *Zirfaea crispata* (Linné) (two partial left valves).

RGM 791 623, the clast bored on both sides, was presumably repeatedly infested as a rolling clast. Small borings in a cluster on one side of this cobble (Fig. 2F) suggest that this was the last spat-fall and the producers were only early juveniles.

Note: In late January 2014, after this paper was submitted for review, further beachcombing revealed peat clasts with broader *Gastrochaenolites* borings, in which “The main chamber bears a sculpture of prominent, parallel circular bioglyphs that are separated by numerous fine, short and oblique striations” (Donovan, 2011a, p. 187). These are *Gastrochaenolites ornatus* Kelly and Bromley, 1984, and are the spoor of *Zirfaea crispata* (Linné). These specimens will be deposited in the RGM.

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