



## Traces of cassid snails predation upon the echinoids from the Middle Miocene of Poland: Comments on Ceranka and Złotnik (2003)

STEPHEN K. DONOVAN and RON K. PICKERILL

**Small round holes in the tests of fossil echinoids present problems of interpretation, the most obvious questions being who did it and why? Both have been the cause of considerable conjecture by ichnologists and echinoderm palaeontologists. “Drill holes” described from the Miocene of Poland in the echinoid *Echinocyamus linearis* Capeder are classified within the ichnospecies *Oichnus simplex* Bromley. Contrary to the original analysis, the possibility remains that some of these holes were the result of eulimid parasitism rather than predation by juvenile cassids. If other, larger echinoids in the fauna suffered predation by adult cassids, then the available samples are probably too small for it to be recognised.**

### Introduction

The recent paper by Ceranka and Złotnik (2003) on gastropod predation of the clypeasteroid echinoid *Echinocyamus linearis* Capeder is a welcome addition to the burgeoning data set regarding ancient drilling predation (other recent references include Kelley et al. 2003; Hua et al. 2003; Leighton and Aronowsky 2003). Nevertheless, with respect to its content and conclusions, we feel that additional commentary is warranted. Some significant aspects of the palaeontology and ichnology of this occurrence were either ignored or ‘taken as read’ in the analysis of Ceranka and Złotnik. In so doing, we believe the authors failed to provide a truly comprehensive view of an exciting occurrence. We offer the following commentary which adds to the original analysis.

### Ichnology

Somewhat surprisingly, Ceranka and Złotnik (2003) referred to their material in the vernacular merely as “drill holes” rather than attempting, or possibly not even considering, any nomenclatural considerations to the observed bioerosional structures. We regard this approach as enigmatic, and, instead, consider that these “drill holes” can be named with relative ease rather than retaining them in rather vague and open nomenclature, as the authors apparently preferred. We emphasize this because in any scientific endeavour, names, be they biotaxonomic or ichnotaxonomic, should be adopted as conventional symbols or ciphers that serve as a means of reference, thereby avoiding the

need for continuous and repetitive use of cumbersome and generalised descriptive phrases. The descriptor “drill holes” is potentially confusing and uninformative, and we feel that it could be quickly overlooked, eventually forgotten and certainly not entertained in any form of ichnotaxonomic surveys. Reiterating Pickerill (1994, p. 15), “...the labelling of ichnotaxa provides a necessary vocabulary for writing and conversing about trace fossils.” Trace fossils require names so that they are amenable to stabilization, synonymy and survival, and that they establish conformity in usage (cf. Bromley 1981). Such an ichnotaxonomic approach has been taken in at least one other recent paper on bored echinoids (Santos et al. 2003). An informative contribution to this effect, with respect to ichnogenera and their nomenclature in association with hard substrates, was recently published by Taylor and Wilson (2003), particularly table 2 therein.

The “drill holes” documented by Ceranka and Złotnik (2003) are cylindrical, perpendicular to the tests of *Echinocyamus linearis*, completely penetrative, smooth and generally circular to sub-circular in outline. A small percentage display more irregular shapes, interpreted by the authors as a result of location at ambulacral pores and/or adjacent to plates that were small and easily dislodged, a conclusion with which we concur, and undoubtedly a result of taphonomic processes occurring during or subsequent to initial penetration. Irrespective, based on their more typical morphology, the “drill holes” are, ichnotaxonomically, confidently assigned to the ichnogenus *Oichnus* as originally discussed and defined by Bromley (1981). Furthermore, based on both the description and figures provided by the authors, of its currently recognized seven ichnospecies (reviewed in Donovan and Jagt, 2002), *Oichnus* within *E. linearis* can clearly be referred to *O. simplex* Bromley, 1981.

### Gastropod predation

The authors make a strong case for the borings being made by a gastropod predator, most probably a cassid based on multiple lines of evidence. They point out that the only extant gastropod groups that make borings into echinoid tests are cassids and eulimids (Kowalewski and Nebelsick 2003: 281–284). Eulimids were discounted for a number of reasons: none of the borings are healed or are associated with attachment scars; no mem-

bers of this group are known from this deposit (unlike the cassids); and frequency of multiple borings is lower than is typical of extant eulimids (11 % against 20 %). However, although rare fossil cassids are known from these deposits (Ceranka and Złotnik 2003), they are all adults, yet the analysis predicts that the borers, if made by this group, must have been juveniles. Thus, the purported culprit does not have a fossil record in this deposit per se. It is surely conservative to recognise that arguments against the non-preservation of juvenile cassids apply equally well to small eulimids, so perhaps either or both of these groups were involved in drilling. If eulimids were a rarer component of the fauna than juvenile cassids, then the small number of multiple drillholes is explicable by dilution by the preponderant single cassid borings. In this scenario, it is only the absence of attachment scars and healed perforations that remain as evidence against common eulimid involvement in drilling. However, Kowalewski and Nebelsick (2003: 284) considered that eulimids only “occasionally” left distinct attachment scars and these authors could not provide “reliable diagnostic guidelines for differentiating unambiguously drill holes made by eulimids from those made by cassids”. We conclude that the borings in *Echinocyamus linearis* tests may have been produced by juvenile cassids; equally, they may have been the product of drilling by both juvenile cassids and eulimids, neither of which has left a record of body fossils in this deposit. The bold assertion that borings must be the product of cassids may be only partly correct.

### Echinoid taphonomy

We agree with Ceranka and Złotnik (2003) that the absence of *Oichnus simplex* borings produced by adult cassids in larger echinoid tests from these deposits is difficult to explain, at least at first glance. Part of the explanation may be due to predation by cassids occurring without drilling, as they suggest. However, examination of the known echinoid fauna from this succession (Mączyńska 1977, 1987) suggests that there is a strong taphonomic bias in the preservation of complete tests. Ceranka and Złotnik (2003) recognised one bored test of *E. linearis* out of 12 specimens from the Korytnica Clays (8.3%) and 277 out of 7,290 in the *Heterostegina* sands (3.8%). Bored *E. linearis* tests are thus rare as a percentage of total known specimens (totals 7,302 tests, 278 bored, 3.8% bored). Fortuitous finds apart, to recognise analogous borings in tests of another echinoid species would require a sample of, say, 25–50 tests, assuming predation pressure was of a comparable order of magnitude on larger taxa. Only *Echinocyamus* spp. tests are so common and, for other echinoid taxa, 10–15 complete tests seems to be a large sample (Mączyńska 1977, 1987). Even large species of clypeasteroid, that otherwise have a good fossil record, such as *Clypeaster* sp. and a scutellid, are only known from fragments (Mączyńska 1987: 148–149, table). Clypeasteroids have the most robust tests among the echinoids (Smith 1984; Donovan 1991), and differences in preservation and fossil abundance between other echinoid taxa and *Echinocyamus* spp. doubtless reflects multiple influencing factors (e.g., Nebelsick 1995), probably includ-

ing original abundance and weakening of tests by drill holes. Thus, in these deposits, some large echinoids may preserve evidence of drilling predation by adult cassids, but the available sample is probably inadequate for it to be recognised. It is also probably true that predation by cassids was selective, so only certain species would have been likely to have been drilled.

### Acknowledgements

Grant support was provided by National Geographic Society grant # 7278-02 (to S.K.D.) and the National Sciences and Engineering Research Council of Canada (to R.K.P.). This is a contribution to The Natural History Museum, London, project number 301, “Palaeoecology of hard substrates.”

### References

- Bromley, R.G. 1981. Concepts in ichnotaxonomy illustrated by small round holes in shells. *Acta Geologica Hispanica* 16: 55–64.
- Ceranka, T. and Złotnik, M. 2003. Traces of cassid snails predation upon echinoids from the Middle Miocene of Poland. *Acta Palaeontologica Polonica* 48: 491–496.
- Donovan, S.K. 1991. The taphonomy of echinoderms: calcareous multi-element skeletons in the marine environment. In: S.K. Donovan (ed.), *The Processes of Fossilization*, 241–269. Belhaven Press, London.
- Donovan, S.K. and Jagt, J.W.M. 2002. *Oichnus* Bromley borings in the irregular echinoid *Hemipneustes* Agassiz from the type Maastrichtian (Upper Cretaceous, The Netherlands and Belgium). *Ichnos* 9: 67–74.
- Hua, H., Pratt, B.R., and Zhang, L.-Y. 2003. Borings in *Cloudina* shells: complex predator-prey dynamics in the terminal Neoproterozoic. *Palaios* 18: 454–459.
- Kelley, P.H., Kowalewski, M., and Hansen, T.A. (eds.) 2003. *Predator-Prey Interactions in the Fossil Record: Topics in Geobiology* 20. xvi + 464 pp. Kluwer Academic/Plenum, New York.
- Kowalewski, M. and Nebelsick, J.H. 2003. Predation on Recent and fossil echinoids. In: P.H. Kelley, M. Kowalewski, and T.A. Hansen (eds.), *Predator-Prey Interactions in the Fossil Record: Topics in Geobiology* 20, 279–302. Kluwer Academic/Plenum, New York.
- Leighton, L.R. and Aronowsky, A. (eds.) 2003. Drilling predation in the fossil records. *Palaeogeography, Palaeoclimatology, Palaeoecology* 201: 183–234.
- Mączyńska, S. 1977. Echinoids from the Korytnica Basin (Middle Miocene; Holy Cross Mountains, Poland). *Acta Geologica Polonica* 27: 193–200.
- Mączyńska, S. 1987. A supplementary account on the echinoids from the Korytnica Basin (Middle Miocene; Holy Cross Mountains, central Poland). *Acta Geologica Polonica* 37: 145–152.
- Nebelsick, J.H. 1995. Comparative taphonomy of Clypeasteroids. *Eclogae Geologicae Helvetiae* 88: 685–693.
- Pickerrill, R.K. 1994. Nomenclature and taxonomy of invertebrate trace fossils. In: S.K. Donovan (ed.), *The Palaeobiology of Trace Fossils*, 3–42. Wiley, Chichester.
- Santos, A., Mayoral, E., Muñoz, F., Bajo, I., and Adriaenssens, O. 2003. Bioerosión en erizos irregulares (Clypeasteroidea) del Mioceno Superior en el sector suroccidental de la cuenca del Guadalquivir (Provincia de Sevilla). *Revista Española de Paleontología* 18: 131–141.
- Smith, A.B. 1984. *Echinoid Palaeobiology*. xii + 191 pp. George Allen and Unwin, London.
- Taylor, P.D. and Wilson, M.A. 2003. Palaeoecology and evolution of marine hard substrate communities. *Earth-Science Reviews* 62: 1–103.

Stephen K. Donovan [Donovan@naturalis.nnm.nl], Department of Palaeontology, Nationaal Natuurhistorisch Museum, Postbus 9517, 2300 RA Leiden, The Netherlands;

Ron K. Pickerrill [rpickeri@unb.ca], Department of Geology, University of New Brunswick, Fredericton, New Brunswick, Canada E3B 5A3.