EXCEPTIONAL FOSSIL STARFISH BED, PRINCE ALBERT DISTRICT, WESTERN CAPE

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- **Introduction**

Fossil "starfish beds" are thin fossiliferous horizons of marine sediment which typically contain numerous, intact skeletons of stellate echinoderms (true starfish and / or serpent stars). The calcareous skeletons of such animals are composed of thousands of small elements which normally become dissociated after death. Starfish beds result from the catastrophic burial of living animals; their corpses are then protected by sediment from scavengers and currents. They provide rare opportunities to study complete specimens (often preserved in life position), as well as the associated fauna which is often dominated by echinoderms. They represent a "snap-shot" of the shelly invertebrate communities living on the ancient sea bed.

In mid 2003 an exceptionally well-preserved starfish bed was discovered by Mr Pieter Olivier on the farm Vrischgewaagd in the Weltevrede Valley, SW of Prince Albert. Since its discovery, the site has proved to be of considerable educational value and has been visited by several supervised ecotourism groups. During this period it has been monitored and photographed in detail by Dr Judy Maguire in collaboration with Mr Reinwald Diederkind, both of Prince Albert. By 2004, however, it was already apparent that the rock matrix containing the fossils was deteriorating rapidly and fragments of the delicate fossils were spalling off. Some loose pieces may have been taken, or inadvertently trampled upon, by visitors.

On consultation in August 2004, Dr Herbie Klinger and Mr Derek Ohland of Iziko Museums, Cape Town examined the fossil site and discussed various possible courses of remedial action. These included attempting to stabilise the fossil panel *in situ* with chemical hardeners or by covering it with a protective transparent plate, casting the fossil moulds with liquid rubber to make replicas, collection of fossil material, or letting natural weathering take its course. It was recognised that no solution was ideal; all options would involve damaging the fossils to some degree, but it would be a pity to allow the starfish fossils to weather away in the field. The decision was left with interested members of the Prince Albert community.

Following a public alert about the imminent loss of the Prince Albert starfish bed by Dr Judy Maguire, a further site visit was made over the period 16-18 December 2004 by Dr John Almond and Derek Ohland on behalf of Heritage Western Cape (Archaeology, Palaeontology & Meteorites Permit Committee).

- **Brief description of fossil site**

The fossil site (21° 51' 30" E, 33° 17' 05" S) is situated on the eastern margin of the farm Weltevrede 150 as indicated on the 1: 50 000 Map 3321 BD Kruisrivier. However, this area has now been incorporated into the adjacent farm Vrischgewaagd 152. The fossiliferous horizon lies close to the base of the Voorstehoek Formation (lower Bokkeveld Group) of Early Devonian age. A panel of approximately one square meter of highly fossiliferous mudrock, dipping steeply northwards, is exposed on the southern face of a small, E-W flowing stream gulley. The complete extent of the starfish bed is unclear; it clearly continues laterally into the bedrock.

Invertebrate fossils, preserved as natural moulds, are present at several closely-spaced horizons within the starfish bed as well as on its upper and lower surfaces. The fossil fauna is strongly dominated by various echinoderm classes - notably brittle stars (ophiuroids), starfish (asteroids) and carpoids - which in most cases are preserved intact. A number of other invertebrate groups are also represented, including trilobites, bivalves, inarticulate brachiopods, hyolithids, and tentaculitids. In the neighbourhood, but not directly associated with the starfish bed, further fossil groups such as gastropods, articulate brachiopods, crinoids and trace fossils occur, but no recognisable echinoderm remains apart from fragmentary crinoids.

Of these fossils, the well-preserved true starfish are of particular systematic importance. Hitherto, only a handful of starfish fossils, representing three species, have been recorded from the Bokkeveld Group (Jell & Theron 1999. *Memoirs of the Queensland Museum* **43**). The new Vrischgewaagd material, comprising several starfish individuals, is likely to represent an undescribed taxon; this can only be ascertained once the specimens are cast. The numerous ophiuroids probably include more than one species which may, or may not, be new. The carpoids belong to the well-known genus *Placocystella* and are of palaeobiological interest. Also unusual are the dense concentrations of delicate lingulid brachiopods and the preservation of opercula in association with the hyolithids.

The sedimentological setting, as well as the prevalence of intact echinoderm and hyolithid fossils, indicates catastrophic preservation by *obrution*; *i.e.* the sudden smothering by mud of a living shelly invertebrate community on the Devonian sea bed. Comparable echinoderm-rich obrution deposits have certainly been recorded elsewhere within the Bokkeveld Group, though not always recognised as such. In all previous cases, however, the fossils have been collected (or destroyed by road building) without an accompanying taphonomic or palaeoecological study of the whole assemblage *in situ*. Valuable palaeobiological information has consequently been lost.

• Conservation assessment and recent action

The entire fossil-bearing panel is riddled with fine cracks, many of which traverse the delicate fossil moulds themselves. The excellent photographic record of the panel since discovery shows that some of these cracks are now opening up rapidly. Fragments of fossiliferous mudrock have recently fallen away, especially from the projecting lower margin of the starfish bed.

A substantial lower portion of the starfish bed, bearing several important starfish, carpoid and other fossils, was found to be very loose and in imminent danger of catastrophic collapse. It was therefore decided in December to attempt the removal of this portion immediately. The component fragments were successfully released with minimal damage, embedded in plaster on a wooden board, and carefully packed for transport to Iziko: South African Museum, Cape Town. Living plant roots and disintegrating mudrock were found beneath the removed section and clearly threaten remaining portions of the panel.

The north-facing starfish bed is currently exposed to extreme diurnal and seasonal temperature fluctuations, percolating water, freeze-thaw processes, root action, flash floods, as well as falling scree. Under these circumstances, further and increasingly rapid deterioration of the starfish bed can be confidently expected. Indeed, this is the *norm* for invertebrate fossils preserved as natural moulds in Bokkeveld mudrocks. Unless collected soon after exposure, they soon decompose into crumbly fragments.

• Recommendations

Given the exceptional scientific value of the Vrischgewaagd starfish bed in taphonomic, systematic, palaeoecological and educational terms, as well as the certainty of its eventual destruction by weathering if left *in situ*, we recommend that:

1. as much as possible of the remaining exposed starfish bed be carefully collected at the earliest opportunity (adjacent, as yet unexposed, portions of the obrution horizon could remain as witness sections)

2. relevant taphonomic data be collected while the starfish bed is still in place, as well as during and after collection

3. fossil material from adjacent (*non*-obrution) exposures of the lower Voorstehoek Formation be collected for comparison

4. all fossil material be curated in the palaeontological collections of the Iziko: South African Museum, Cape Town

5. funds be sought to construct an educational fossil display, focusing on the Weltevrede starfish bed, for the Fransie Pienaar Museum, Prince Albert

These recommendations are made following consultation with Dr Judy Maguire, who has actively promoted palaeontological education locally, as well as with the landowner, Mr Herman Olivier of Vrischgewaagd, who maintains a constructive interest in the fossil material.

• Acknowledgements

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