'Sparkling Aurantoside': the mystery of some sciophilous sponges in the Indo-West Pacific

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A monumental marine biodiversity survey of macrobenthos on the Great Barrier Reef (GBR), Australia (http://www.reef.crc.org.au/resprogram/programC/seabed/index.htm), has unearthed an enigmatic, yet ubiquitous, component of the sponge fauna. From 2003 to 2006, the seabed was documented and sampled across more than 1,400 sites along the length and breadth of the GBR, and at 72% of these sites, an unusual and distinctive new species of sponge was recovered. This species, which comprised more than 1/4 of the total invertebrate biomass collected, is made conspicuous by its characteristic eosinic yellow dye and sciophilous habit. Although it is the most common sponge in inter-reef habitats, the taxonomic affinities of this new species were obscure. Identification of this species creates more questions than it provides answers:

- Morphologically, it is most similar to pachastrellids; the presence of microrhabd-like sanidasters and the gross habit of encrusting and agglutinating benthic rubble are in broad agreement with *Dercitus* Gray and *Stoeba* Sollas. This new species is now described within *Dercitus*; although calthrops were found in a small proportion of the sample, warranting placement in *Dercitus*, the species lacks the consistent presence of tetraxons, making this classification slightly unsatisfying.
- Chemically, the sponge contains aurantosides. These complex sponge metabolites have been isolated previously only from species of the theonellid genera *Manihinea* Pulitzer-Finali, *Siliquariaspongia* Hoshino and *Theonella* Gray. The presence of aurantosides in the new species of *Dercitus* is strong evidence that it is a theonellid, not a pachastrellid, yet the absence of any rigid skeletal components contradicts such classification.
- Genetically, the new species is closest to theonellids. Analysis of DNA sequences (~1,200 bp of COI mtDNA and ~800 bp of 28S rDNA) supports a clear and very close relationship between this species and several other species of *Theonella*, and in turn, of this group to other theonellid genera such as *Discodermia* du Bocage. Again, the absence of desmas makes classification within Theonellidae awkward.

Existing nomenclature does not fully accommodate this species. Morphological data support pachastrellid affinities, but disagree with chemical and molecular datasets. We have since found additional genotypes, displaying subtle morphological distinctions, but which share the yellow colouration (signalling the likelihood of aurantosides) and sciophilous habit of the new species of *Dercitus*. These types almost certainly represent additional species, suggesting there may be a complex of these enigmatic sponges in Indo-West Pacific waters. Our phylogenetic estimates establish convincingly the position of Theonellidae within Astrophorida, as a sister to clades containing geodiids and pachastrellids; this is in broad agreement with previous DNA-based studies. Our findings open wider questions about the relationships and allocation of theonellids within demosponges, and about the boundaries and diagnosis of pachastrellids within astrophorids. Here, we hypothesise an evolutionary scenario to explain the mystery of these sciophilous sponges, which have pachastrellid morphology but theonellid chemistry and genetics. Like all good stories, it is a tale of conflict (of data), loss (of skeletal components) and (niche) exploitation, of families united and families ripped apart, but ultimately, it is a tale of redemption, via a new natural classification.