Synopsis of the Family *Xeniidae* (Cnidaria: Octocorallia): Status and Trends

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Introduction

The family Xeniidae (Ehrenberg 1828) is often an abundant component of shallow-water octocoral communities throughout the Indian Ocean, Red Sea and Central West Pacific Ocean. Xeniids are rapid colonizers of artificial surfaces (Schuhmacher 1974; Benayahu and Loya 1987) and natural hard substrates (Fabricius and Alderslade 2001; Wood and Dipper 2009). Colonies are zooxanthellate. Most exhibit multiple longitudinal rows of pinnules on each side of the polyp tentacles (Fig. 2), a morphological feature used to differentiate species. There has been relatively little work published on the taxonomy of xeniids, which is likely due to limited variation in characters among xeniid species and the uniformity of the sclerites. In the present study, we provide a historical context for the development of Xeniidae taxonomy and outline the progress made with modern tools now used to describe specimens to the species level.

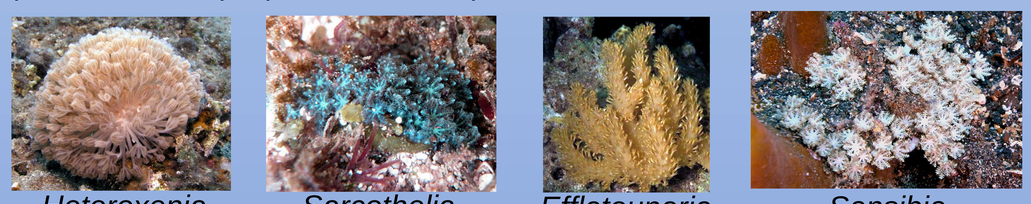
Figure 1: Xenia elongata (Dana, 1846); a) photo of holotype in dry condition, scale 1 cm, b) Colony drawing after Dana, 1846, c) photomicrograph of sclerites under light microscope.

Historical Remarks

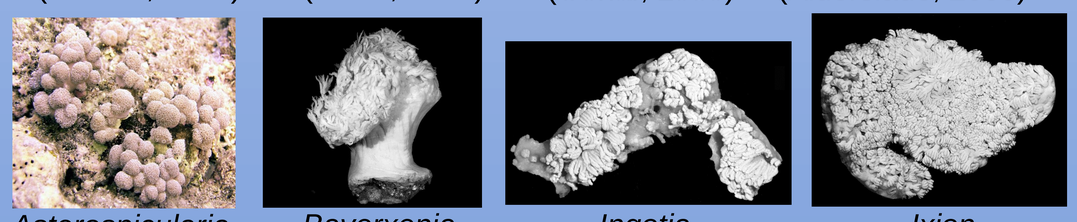
The first Xeniidae colonies were collected over 200 years ago as part of Napoleon's invasion of Egypt during the years 1798-1799 when specimens of *Anthelia glauca* and of *Xenia umbellata* were brought back to Europe. Both specimens were given brief descriptions by Lamarck (1816). His work was published a year later by Savigny (1817). Ehrenberg (1828) established the family Xeniidae making note that the octocoral polyps were soft, fleshy and fully extended (Fig. 1a, b). Wright and Studer (1889) provided the first systematic description for the family Xeniidae based on material collected on the Challenger Expedition.

Chronological List of Xeniid Genera

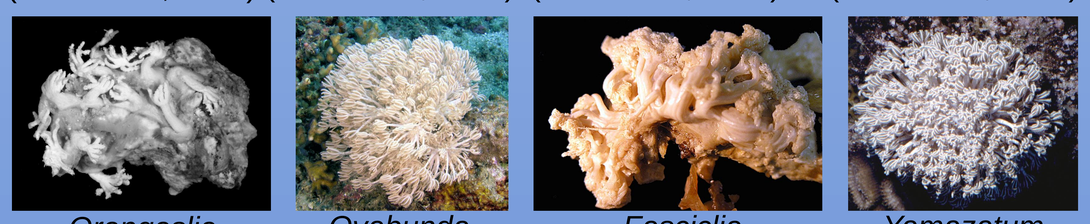
Anthelia (Lamarck, **1816**) *Xenia* (Lamarck, **1816**) *Sympodium* (Ehrenberg, **1834**) *Cespitularia* (Milne-Edwards,**1857**)



Heteroxenia (Kölliker, **1874**) *Sarcothelia* (Verrill, **1928**) *Efflatounaria* (Gohar, **1939**) *Sansibia* (Alderslade, **2000**)



Asterospicularia (Alderslade, **2001**) *Bayerxenia* (Alderslade, **2001**) *Ingotia* (Alderslade, **2001**) *Ixion* (Alderslade, **2001**)



Orangaslia (Alderslade, **2001**) *Ovabunda* (Alderslade, **2001**) *Fasciclia* (Janes, **2008**) *Yamazatum* (Benayahu, **2010**)

Acknowledgements

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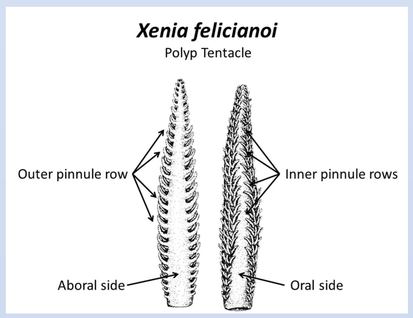

Figure 2: Diagram of a *Xenia felicianoi* tentacle exhibiting four rows of pinnules on each side.

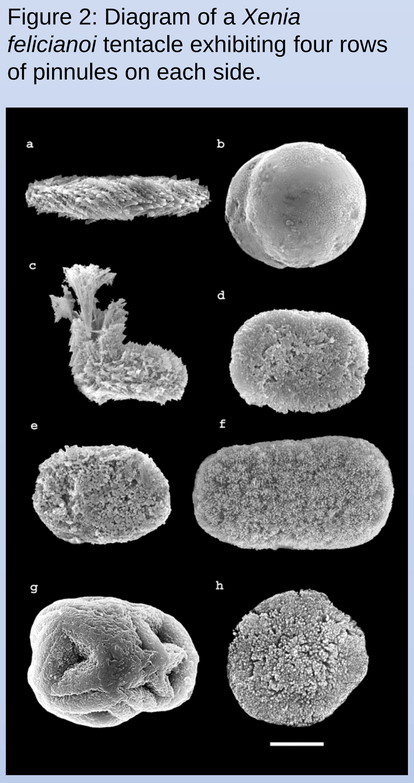

Figure 3: SEM sclerite images from xeniids; a) *Anthelia ternatana*, b) *Cespitularia simplex*, c) *Fasciclia ofwegeni*, d) *Heteroxenia elizabethae*, e) *Ovabunda aldersladi*, f) *Sympodium caeruleum*, g) *Yamazatum iubatum*, h) *Xenia puerto-galerae, scale = 0.01 mm*

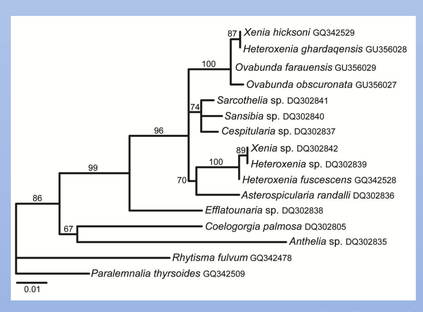

Figure 5: Maximum likelihood phylogeny of Xeniidae based on a 726 nt fragment of the octocoral-specific mitochondrial gene mt MutS. *Coelogorgia*, *Paralemnalia* and *Rhytisma* are included as non-Xeniidae outgroup taxa. All sequences from GenBank (accession numbers follow species names). Numbers above branches are bootstrap values.

Modern Investigation

Scanning Electron Microscopy

With the limited resolution of light microscopy, xeniid sclerites were considered to have a uniform platelet or biscuit-like shape (Fig. 2c) that only varied in size (Kükenthal 1902; Roxas 1933; Verseveldt and Cohen 1971). Utilizing SEM technology Alderslade (2001) noted that that at present the findings "indicate that the basic building blocks of the (xeniid) sclerites in all genera are calcite rods, and their differences in assembly can be used as generic level characters", something that had been previously overlooked by investigators.

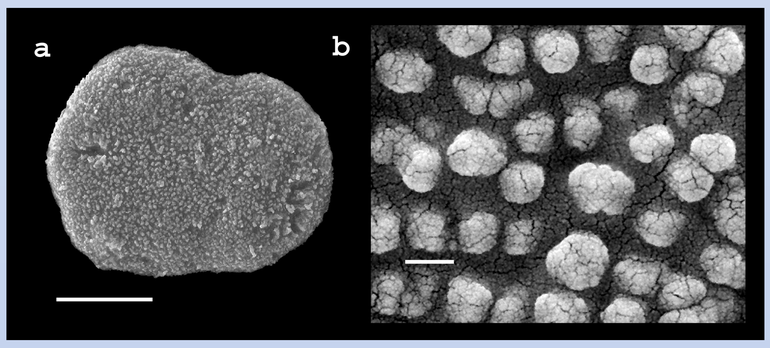

Figure 4: *Heteroxenia mindorensis* Roxas, 1933; a) SEM of an autozooid polyp sclerite, scale bar = 0.005 mm, b) ESEM high-resolution image of the sclerite surface, scale bar = 200 nm.

The environmental SEM (ESEM) has made high-resolution examination of sclerite microstructures easier (Fig. 4). Utilizing these new microscopic technologies for taxonomic identification has proved valuable in recent years. However, the need to re-examine previously described xeniid specimens where sclerite ultra-structures are unknown is vital, otherwise many new species may be synonyms of previously described species.

Molecular Tools

To date, only two phylogenetic studies of octocorals have included Xeniidae, and neither has included more than two representatives of any one genus (McFadden et al. 2006b; McFadden et al. 2011). Combined, the results of these two studies suggest taxonomic confusion among the morphologically similar genera *Ovabunda*, *Xenia*, and *Heteroxenia*, with members of the latter two genera co-occurring in more than one distinct clade (Fig. 5).

Challenges exist in the use of molecular analysis for xeniids. Not all species are reliably distinguished using the currently available genetic markers (McFadden et al. 2011). The advantage of molecular phylogeny will be its use in combination with traditional taxonomy. This can improve accuracy by identifying which morphological characters separate genera and assist in distinguishing specimens to the species level.

Focused Sampling

The process of selective sampling provides an opportunity to conduct detailed surveys at the family or genus level. Selective sampling surveys have already shown to yield a rich octocoral diversity of taxonomic significance (Reinicke 1997; Grasshoff and Bargibant 2001; Ofwegen 2008a, 2008b; Janes 2008).

Outlook

Xeniid taxonomy is only beginning to see the advantages of contemporary taxonomic science (Zlatarski 2008). Improvements in xeniid systematics have benefited from SEM and ESEM technologies, molecular analysis and selective sampling. However advances such as DNA barcoding have yet to be realized (McFadden et al. 2011).

References

A compete list of references is available in the Proceedings of the 12th International Coral Reef Symposium, Cairns, Australia, 9-13 July 2012