**Osedax mucifloris** (Polychaeta, Siboglinidae), a bone-eating marine worm new to Norway

Christoffer Schander, Hans Tore Rapp and Thomas G. Dahlgren

The bone-eating siboglinid polychaete **Osedax mucifloris** Glover, Källström, Smith & Dahlgren, 2005 is reported from Norwegian waters for the first time. Dense growth was found on bovine bones deposited at 118 meters depth off western Norway. Dwarf males were observed for the first time. The two specimens sequenced were identical to haplotypes previously found at a Swedish whale fall. The possibility of finding additional species of **Osedax** is discussed.

Keywords: Whale fall, Siboglinidae, Annelida, fjord, Scandinavia, deep sea, reducing habitats

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Christoffer Schander, University of Bergen, Department of Biology, P.O. Box 7800, 5020 Bergen, Norway, University of Bergen, Centre for Geobiology, Allégaten 36, 5020 Bergen, Norway and Uni Miljø, P.O. Box 7810, 5020 Bergen, Norway. (Current address: 101 Life Sciences Building, Department of Biological Sciences, Auburn University, Auburn Alabama 36849 USA).

Hans Tore Rapp, University of Bergen, Department of Biology, P.O. Box 7800, 5020 Bergen, Norway and University of Bergen, Centre for Geobiology, Allégaten 36, 5020 Bergen, Norway.

Thomas G. Dahlgren, Uni Miljø, P.O. Box 7810, 5020 Bergen, Norway and University of Gothenburg, Department of Zoology, Box 403, 405 30 Göteborg, Sweden.

Corresponding author: Christoffer Schander
E-mail: Christoffer.Schander@bio.uib.no

**INTRODUCTION**

Specialized marine fauna associated with chemosynthetic ecosystems have been intensely studied in recent years. These ecosystems include hydrothermal vents (e.g. Van Dover, 2000; Desbruyères et al. 2006; Schander et al. 2010 and references therein), hydrocarbon seeps (e.g. Levin 2005; Cordes et al. 2009; Van Gaever et al. 2009), wood falls (e.g. Pailleret et al. 2009; Bernardino et al. 2010) and whale falls (e.g. Smith & Baco 2003; Dahlgren et al. 2004; Wiklund et al. 2009). A range of novel species as well as unusual microbial and macrofaunal interactions have been discovered.

The genus **Osedax** was first described from two species found at a naturally-occurring whale-carcass (or 'whale-fall') off California (Rouse et al. 2004). Other species have since been described from Sweden (Glover et al. 2005) and Japan (Fujikura et al 2006). A fifth species was described by Rouse et al. (2008) and 12 additional "species" were listed, but not formally described by Vrijenhoek et al. (2009). One putative species of a bone eating siboglinid worm has also been named based on trace fossils from remains of a Lower Pliocene (5.3-3.6 Ma) baleen whale (Mysticeti) from Almériá, Spain under the name **Tränmites ionasi** (Muñiz et al. 2010). The evidence presented in this paper is however not conclusive that this trace is **Osedax**, or even any kind of bone-eating macrofauna. More likely traces of **Osedax** were reported by Kiel et al. (2010) from two early Oligocene whale-falls. Since it has been shown that **Osedax** grows on any large mammal bone (e.g. Jones et al. 2008, but see Glover et al. 2008), we placed a number of bovine bones in a fjord south of Bergen, Norway, to study possible colonization. Here we report on the results of this study.
Figure 1. Map of the locality (square) of the artificial whale falls in Bjørnafjord, Hordaland, Norway (Background map provided by Institute of Marine Research, Norway).

Figure 2. Dense growth of *Osedax mucofloris* on a bovine bone in a laboratory aquarium. White growth is *Beggiatovia*-like bacteria. Photo: David Osca Ferriol.

Figure 3. *Osedax mucofloris* from Bjørnafjord, Western Norway. A. Live, dissected female surrounded by eggs. Scale bar 1 mm. B. Detail of palps. Scale bar 250 µm. C. Dwarf male, alongside oviduct. Photo: Schander & Dahlgren.
MATERIAL AND METHODS

Twenty bovine bones (bought in a pet shop) were sunk in Bjørnafjord south of Bergen at 118 m depth at position 60°11.057598 N, 05°30.527768 E (Figure 1) in April 2009 during a cruise with R/V Haakon Mosby. The hydrography of the area is described in Hosia & Båmstedt (2007). The bones were 30-35 cm long and arranged on a 2x2 m PVC frame. Some of the bones were recovered in February 2010 using the ROV Aglantha. The recovered bones were inspected under a stereo microscope on board, and dense growth of Osedax could be observed. Some of the specimens were dissected out and placed in Eppendorph tubes with 96% ethanol for molecular analysis. The specimens were extracted and sequenced using the primers and protocol given in Glover et al. (2005). The obtained sequences were checked against available data in GenBank using BLAST. Two COI sequences have been deposited in GenBank (Accession numbers HM045512 & HM045513).

Two bones were taken to the laboratory and Osedax have been kept alive in an aquarium with running seawater for several months (Figure 2).

RESULTS AND DISCUSSION

Both morphology and DNA barcoding (e.g. Schander & Willassen 2005) identified the species as Osedax mucofloris Glover, Källström, Smith & Dahlgren, 2005 (Figures 2 & 3). BLAST searches resulted in 100% match with GenBank Accession numbers AY827568.1 (Osedax mucofloris haplotype G) and AY827563.1 (Osedax mucofloris haplotype B).

In the original description of Osedax mucofloris it is mentioned that the authors could not find any dwarf males in spite of examining 50 free-dissected specimens. Dwarf males were however present in our specimens, located along the oviduct (Figure 3c).

Norwegian waters harbor populations of a number of large-bodied whale species including blue whale (Balaenoptera musculus), fin whale (Balaenoptera physalus), sei whale (Balaenoptera borealis), minke whale (Balaenoptera acutorostrata), sperm whale (Physeter macrocephalus), pilot whale (Globicephala melas), and northern bottlenose whale (Hyperoodon ampulatus). Carcasses of all these species are the probable sources of natural habitats for Osedax mucofloris in Norway. The type locality of O. mucofloris is an experimentally implanted minke whale carcass at 125 m depth in a Swedish fjord (Glover et al. 2005). Additional Swedish populations have been found at a pilot whale carcass at 30 m depth (Dahlgren et al. 2006) and at four sperm whale vertebrae collected in a shrimp trawl from a depth of 60-90 meters (Dahlgren, unpublished).

This study shows that Osedax mucofloris is widespread in Scandinavian waters. In light of the many Osedax species found in the Pacific Ocean, it can be expected that a high diversity of bone eating worms will be discovered also in the Atlantic. The distribution patterns are likely dependent on depth (Braby et al. 2007), and we have therefore recently deployed new bone experiments at 600 meters. More extensive genetic comparisons between the Swedish and Norwegian material is currently carried out.

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