Journal of Experimental Marine Biology and Ecology xxx (2017) xxx–xxx

Contents lists available at ScienceDirect

Journal of Experimental Marine Biology and Ecology

journal homepage: www.elsevier.com/locate/jembe

# Extraction of metazoan meiofauna from muddy deep-sea samples: Operator and taxon effects on efficiency

Melissa Rohal [1], David Thistle *, Erin E. Easton [2]

*Department of Earth, Ocean and Atmospheric Sciences, Florida State University, Tallahassee, FL 32306-4520, United States*

ARTICLE INFO

*Article history:*
Received 17 August 2016
Received in revised form 6 December 2016
Accepted 13 January 2017
Available online xxxx

*Keywords:*
Benthos
Desmoscolecidae
Harpacticoida
Ludox®
Nematoda

ABSTRACT

Deep-sea metazoan meiofaunal specimens are usually extracted from muddy samples by centrifugation in a fluid in which meiofauna tend to float and sediment particles tend to sink. Although the procedure is in common use, its efficiency has seldom been examined. The study reported here showed that well-trained operators extracted metazoan meiofauna with efficiencies that were different enough to be a concern in quantitative studies. Therefore, samples should be assigned to operators in a stratified-random manner. In the course of these studies, both operators also extracted individuals of the common nematode family Desmoscolecidae significantly less efficiently than other nematode families, a bias that could interfere with studies that compared relative abundances of nematode families.



## 1. Introduction

Ideally, when an investigator takes a sediment sample for the study of an ecological question, no individuals are lost during collection and sample processing. The possibility of loss is of particular concern for sediment-dwelling, metazoan meiofauna (hereafter meiofauna), which are difficult to see with the naked eye. The most accurate method of counting meiofauna in a preserved sediment sample is to examine the entire sample, aliquot by aliquot, through a dissection microscope (Nichols, 1979), but this procedure consumes so much time that many investigators (e.g., Jenkins, 1964; Heip et al., 1974) have proposed methods to speed the process. Because the buoyancies of most sediment particles are less than those of most meiofaunal individuals (ostracods are an exception), most of the meiofauna will float in the upper portion of the supernatant in a fluid of appropriate density. Most of the sediment particles will sink and constitute the "sediment fraction" or "pellet." Some workers (e.g., Bowen et al., 1972; de Jonge and Bouwman, 1977) allowed gravity to do the separation. Others (e.g., Nichols, 1979; Schwinghamer, 1981) used centrifugation to speed the process. Workers have used several fluids of appropriate density, in particular, colloidal silicas with the brand names Ludox® (du Pont) and Levasil® (H. C. Starck, now available from Akzo Nobel Chemicals GmbH as Levasil CS40-316P). Methods that used Centrifugation in a Fluid of Appropriate Density are referred to here as CFAD methods. In samples from shallow water, these methods can extract most meiofaunal groups with efficiencies approaching 100% (see, e.g., Burgess, 2001; Du et al., 2009).

Although CFAD methods have been used to extract the meiofauna of muddy deep-sea sediments for more than a decade (see, e.g., Vanreusel et al., 2000; Tselepides and Lampadariou, 2004), the present authors know of only two published studies of extraction efficiency for such samples. Escobar-Briones et al. (2008) removed all the meiofauna from each sample by hand, counted the specimens of each group, returned the specimens to the appropriate sample, and extracted each sample once using a CFAD method based on Ludox-AM®. Their method extracted only 27% of the meiofauna from their continental-slope samples and only 20% from their abyssal-plain samples, extraction rates too low for quantitative ecological studies. Kitahashi et al. (2014) extracted each sample three times using a CFAD method based on Ludox HS40®. They quantified efficiency by searching the pellet by hand for unextracted specimens. Their extraction efficiency for harpacticoids was 100%; they did not report efficiencies for other taxa.

Because the extraction of meiofauna from a sample by hand takes an inordinate amount of time, investigators of the muddy deep sea will certainly continue to take advantage of the time saving afforded by CFAD methods. At the same time, more information is needed about the problems of the CFAD approach and their potential effects on quantitative

* Corresponding author.
*E-mail addresses:* mrohal@islander.tamucc.edu (M. Rohal), dthistle@fsu.edu (D. Thistle), erineeaston@gmail.com (E.E. Easton).
[1] Present address: Harte Research Institute, Texas A&M University-Corpus Christi, 6300 Ocean Drive, Unit 5869, Corpus Christi, TX 78412, USA.
[2] Present address: Departamento de Biología Marina, Universidad Católica del Norte, Núcleo Milenio de Ecología y Manejo Sustentable de Islas Oceánicas (EMSIO), Larrondo 1281, Coquimbo, Chile.

http://dx.doi.org/10.1016/j.jembe.2017.01.006
0022-0981/

**Table 1**
Station information. The positions and depths are the averages of those of the multiple-corer deployments from each station.

| Station | Position | Depth (m) |
|---|---|---|
| 1 | 44.0012°N 130.3946°W | 3242 |
| 2 | 42.5594°N 131.9228°W | 3591 |
| 3 | 39.9917°N 125.8781°W | 3676 |
| 4 | 40.0011°N 125.4447°W | 2694 |
| 5 | 36.7975°N 123.6998°W | 3676 |
| 6 | 36.6806°N 122.8213°W | 2720 |
| 7 | 32.8739°N 120.6151°W | 3852 |
| 8 | 32.7977°N 120.3709°W | 2704 |

ecological studies. The study reported here showed that two carefully trained operators extracted some groups with significantly different efficiencies. Given the likelihood that extraction efficiency is affected by sediment properties, we looked for effects of differences in sediment grain-size distributions and for effects of differences in the concentrations of chloroplastic pigment equivalents (hereafter CPE).

## 2. Materials and methods

### 2.1. Core collection

We planned to sample each of four latitudes once at ~2700 m and once at ~3700 m, but bad weather prevented us from doing so at stations 1 and 2 (see Table 1 and Fig. 1). Samples were collected with a MC 800 Multi Core (Ocean Instruments, San Diego) that had eight tubes of 10-cm inner diameter. Three of the deployments from each station were chosen at random. From each, one of the high-quality cores was selected at random for the analysis of meiofauna. One of the remaining high-quality cores was selected at random from each deployment for determination of the grain-size distribution of the sediment and the concentration of CPE (Table 2).

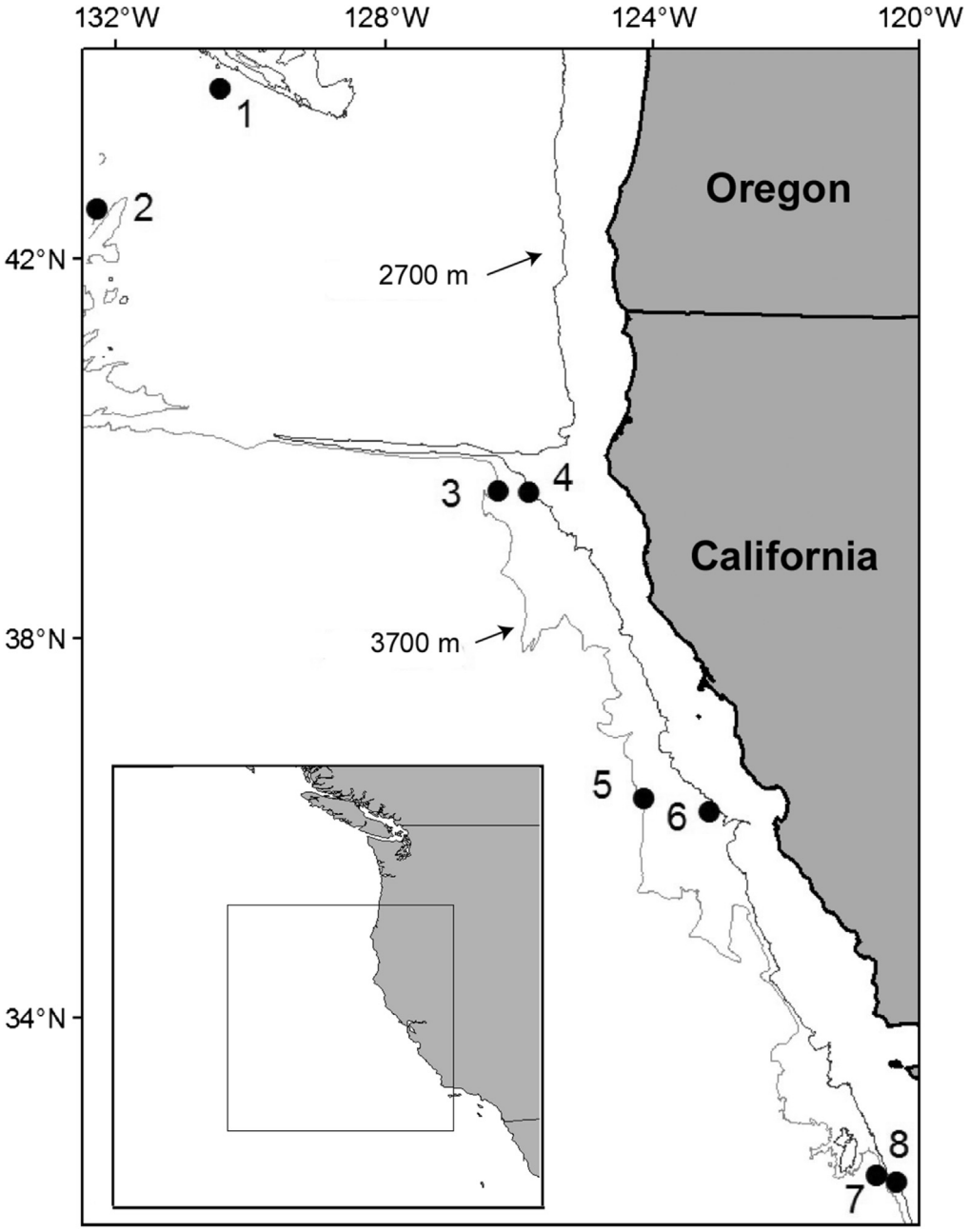


**Fig. 1.** Chart showing the locations of the stations and the 2700-m and 3700-m isobaths. The insert shows the position of the chart relative to the west coast of the United States.

Please cite this article as: Rohal, M., et al., Extraction of metazoan meiofauna from muddy deep-sea samples: Operator and taxon effects on efficiency, J. Exp. Mar. Biol. Ecol. (2017), http://dx.doi.org/10.1016/j.jembe.2017.01.006