

Pakistan's Oceanographic Program North Arabian Sea Environment and Ecosystem Research (NASEER)

Technical Report: Zooplankton Biomass in the Surface (0-5m) Layer of the Arabian Sea in 1992-1994

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INTRODUCTION

The North Arabian Sea Environment and Ecosystem Research (NASEER) is Pakistan's JGOFS-related program in oceanography, funded by the United States' Office of Naval Research (ONR).

Three different vessels were chartered for the research program. The first two cruises, NASEER 1 (January 9 to 23, 1992) and NASEER 2 (August 11 to 25, 1992), were done aboard the S/V *Aghyar*. The third cruise, NASEER 3 (March 13 to 22, 1993), was conducted aboard S/V *Mangan* and the last two cruises, NASEER 4 (May 11 to 21, 1994) and NASEER 5 (December 18 to 28, 1994), were conducted aboard the naval survey vessel *Behr Paima*.

The area covered in the study lies between 20-25°N and 58-67°E, the northwestern part of the Arabian Sea (Fig. 1). The cruise track was 1500 nautical miles in length and there were 62 oceanographic stations on the track, out of which 18 were biological stations. Five of these biological stations (Stns. 8, 27, 33, 45, 57) were 24 h repeat stations, where a 6 h sampling routine was followed in order to study day and night differences in the biomass, behavior and taxonomic composition of zooplankton. The first biological station is near the 200 m isobath south of the Karachi coast, then the track goes over the Murray Ridge to the Oman coast (Stns. 41 and 45) and back to the west coast of Pakistan just off Pasni. The NASEER cruises 4 and 5 did not include Stations 41 and 45. This report describes the zooplankton biomass (standing stock) in terms of displacement volume measured during different monsoonal periods between January 1992 and December 1994.

Results including the zooplankton biomass and the distribution and abundance of major taxa are available in prior

publications (Amjad *et al.*, 1995; Kidwai *et al.*, 1997; Kidwai and Amjad, 2000). This data report covers the biomass data only.

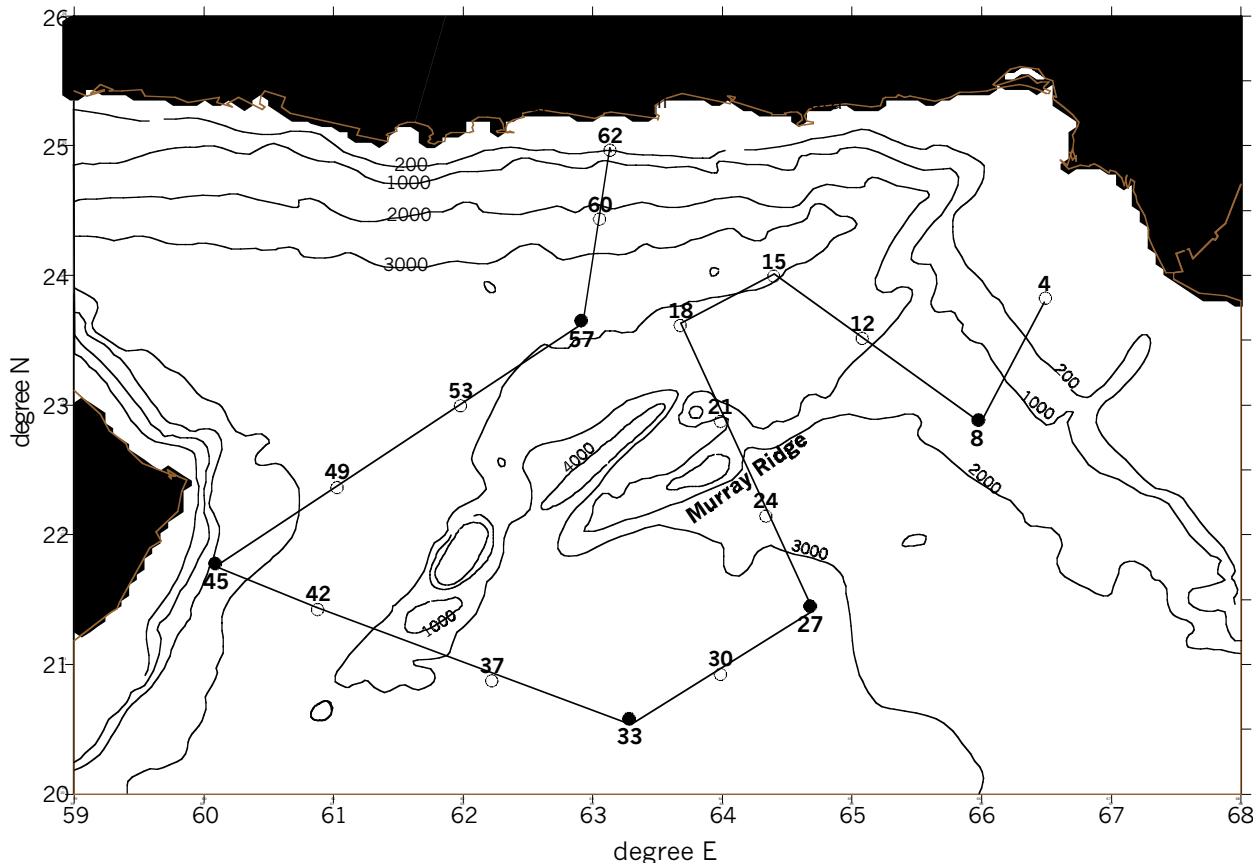


Figure 1. North Arabian Sea Environment and Ecosystem Research (NASEER) cruise track (all circles biological stations; closed circles 24 h repeat stations)

MATERIALS AND METHODS

1) Field sampling

The zooplankton sampling was carried out using 60 cm Bongo nets on all five cruises. Nets of mesh aperture 335 μm were used for NASEER 1, NASEER 2 and NASEER 3, while 150 μm mesh nets were used for NASEER 4 and NASEER 5. A digital flowmeter (HYDROBIOS, 0.3 m rev $^{-1}$) was mounted at the mouth of the net to measure water flow entering the nets. The nets were towed in a circular path, at the speed of 2 to 3 knots for 10 minutes, to obtain surface samples (0 to 5 m). The samples were washed in seawater and stored in 10% neutral formalin in plastic jars. Qualitative and quantitative analyses were carried out ashore at the National Institute of Oceanography (NIO) laboratory, Karachi, Pakistan.

2) Laboratory analysis

Biomass (standing stock) of zooplankton was determined by the settled-volume method (Steedman, 1976). Biomass was expressed as milliliters per cubic meter x 100 (Amjad et al., 1995; Kidwai and Amjad, 2000).

Approximately (1/4) quarter splits of all the samples from the cruises were sent to Dr. Sharon Smith's laboratory at the Rosenstiel School of Marine and Atmospheric School (RSMAS), Miami, Florida. The settled volumes of the preserved samples of the first two cruises were completed before the splits; the settled volumes of NASEER 3, NASEER 4 and NASEER 5 were done on the 3/4 of the sample remaining at NIO, with appropriate correction.

To be consistent with the Arabian Sea zooplankton net data previously submitted to the U.S. JGOFS database and reported as displacement volume (see for example <http://usjgofs.whoi.edu/jg/dir/jgofs/arabian/ttn-050/>), our data had to be converted from settled volume to displacement volume. To accomplish this, the samples residing at RSMAS were used to determine the correlation coefficient between the settled volume (SV) and the displacement volume (DV) of our samples. Random samples and samples with the highest and lowest settled volumes were analyzed (at least seven from each cruise), and SV and DV were measured using graduated cylinders of volume 10, 100, 250 and 500 ml depending on the sample volume. The samples were allowed to stand for 48 hours after which the settled volume was measured. Then displacement volumes were obtained by pouring the fluid contained in the SV graduated cylinder through meshes of 100 and 153 μm . The volume of fluid passing through these meshes was measured. The difference between the volume of water with the zooplankton and that without is the DV (Lane and Smith, 1997) reported here.

The SV and DV reported from the subset of samples from all the cruises which were remeasured at RSMAS (39 samples), were pooled, log transformed and regressed, resulting in the empirical equation:

$$\log DV = -0.212 + 0.839 * \log SV$$
$$(r^2 = 0.768, n = 39)$$

In order to cross-check how these SV estimates compared with the SV previously measured at NIO, the SV of the corresponding stations were used to calculate the DV. The resulting mean ratio of SV:DV was 1:3.57 (± 0.44), which is within the range given in earlier publications (George and White, 1985;

Sheard, 1947) and that given by Harris *et al.*, 2000 (quoting Postel, 1990, and Wiebe, 1988).

The regression was applied to the settled volumes previously measured, and the displacement volumes were calculated. The displacement volume was then divided by the volume of water filtered to calculate the biomass in cc m⁻³.

The data in this report are in chronological order beginning with NASEER 1. The format of presentation is similar to that in Lane and Smith (1997) for their Bongo net collections. Necessary explanations for each cruise precede each table.

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