

Background

The distribution and abundance of benthic infaunal organisms (e.g., marine worms and bivalves) are greatly influenced by the physical characteristics of the sediment and grain size is one of the most important. Infauna are patchily distributed even in sediments of similar grain size and small-scale (cm-m) differences in microtopography may create this pattern.

Ripples influence flow so that variable amounts of particulate organic



Fig. 1: Map showing the location of LEO-15 and a sand ripple.

material or fine organic flocs (food) are deposited in ripple troughs creating patches of food. Ripples are found in sandy sediments at the LEO-15 research site, on the continental shelf off New Jersey (Traykovski et al. 1999) where the Rutgers University Marine Field Station is located (Fig. 1). In a community study at LEO-15 the deposit-feeding worm *Polygordius* sp. was more abundant in ripple troughs than in ripple crests.

Objective

To determine if patchiness in fine organic flocs is responsible for distribution of the marine worm, *Polygordius* sp. in ripple troughs of sandy, subtidal sediments.

Questions

In order to meet the project objectives we addressed three questions using field observations and flume experiments:

Field work:

1. Can the higher abundance of *Polygordius* sp. in ripple troughs compared to crests be related to sediment grain size or fine organic flocs (food), measured as chl a and phaeophytin?

Flume Experiments:

2. Can *Polygordius* sp. select a more favorable habitat [fresh sediment (FS, + food)] over a less favorable one [washed sediment (FSW, - food)] through subsurface movement?

3. Is the movement of *Polygordius* sp. directed or random and if directed at what distance can it detect fine organic flocs?

Methods & Results

Field Work

To compare the abundance of *Polygordius* sp. in the trough of a sand ripple versus a crest, three crest-trough pairs of cores (6 total: 7 cm diameter, 10 cm deep, 38.5 cm²) were collected by SCUBA divers at LEO-15, May 25, 2006. Each sample was preserved in 4% formalin, processed over a 300 µm sieve, and transferred to 75% ethanol with Rose Bengal. *Polygordius* sp. samples were sorted and enumerated using a dissecting microscope. Prior to preservation, a small amount of sediment was removed from the top layer (~1 cm deep) of each core and frozen for later fluorometric determination of chl a and phaeophytin. Following removal of *Polygordius* sp. grain size was determined [using stacked sieves (> 2mm, 1 mm, 500 µm, 250 µm, 63 µm, < 63 µm)].



Fig. 2: Bar graph showing the mean density with s.d. (n=6) of *Polygordius* sp. in ripple troughs versus crests.

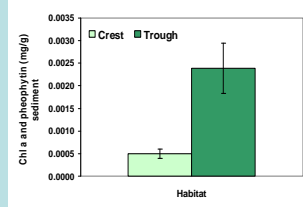


Fig. 3: Bar graph showing mean chl a and phaeophytin with s.d (n=6) for ripple troughs versus crests at LEO-15.

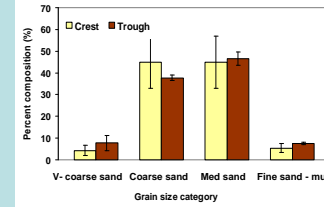


Fig. 4: Bar graph showing percent composition with s.d. (n=6) for four sediment grain size categories for ripple troughs versus crests at LEO-15.



Organism of Interest

Polygordius sp. is a small deposit-feeding worm (Fig. 9) representing a new species, the first of its kind to be described from North America. *Polygordius* sp. is frequently the most abundant member of macrofaunal communities on the continental shelf, and in bays and harbors from Massachusetts to southern New Jersey (Ramey and Fiege 2006). Little is known about its ecology and behavior.

Significance

Understanding the relationship between infaunal organisms and the sediments in which they live is important in order to predict ecological responses to long-term habitat changes in coastal environments (Thrush et al. 2003). Infauna such as marine worms are an important food source for various fish and crustaceans of economic importance. Moreover, infaunal species bioturbate the sediments and affect the fluxes of nutrients and other sediment properties. The widespread distribution, abundance, and high mobility of *Polygordius* sp. are likely to affect sediment geochemistry over wide areas of the continental shelf.

Conclusions

- At LEO-15, *Polygordius* sp. is more abundant in ripple troughs than in crests.
- Over a 48 hr period, *Polygordius* sp. has the ability to select a more favorable habitat, one containing fine organic flocs, over a less favorable habitat, one without fine organic flocs.
- Preliminary results suggest that *Polygordius* sp. has directed movement and can detect fine organic flocs up to a 4-cm distance given a 4-hr time period. However, more experiments need to be conducted under flow conditions and over shorter time periods to determine if this is a consistent result.

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References

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Flume Experiment 1

Live *Polygordius* sp. and sediment were collected at LEO-15 using cores (Fig. 1) and Van-veen grabs. Worms were kept at 20°C and sediment for the experiments was frozen for later use. The experiment contained two treatments including fresh sediment (FS, + food) and fresh sediment washed (FSW, - food) which was FS that had been washed over a 106 µm sieve to remove particulate organic material or fine organic flocs. In the Racetrack flume (Fig. 5), 3

Fig. 5: Racetrack flume (IMCS)

replicate trays (10 cm x 10 cm, 1 cm deep) were filled with the FS and FSW in an alternating pattern and separated using a thin plastic divider (Fig. 6A). A control tray was also set up with all cells containing FSW. Prior to the experiment, worms were starved for ~24 hrs and then 5 worms were placed in the middle of each cell and allowed to burrow for 30 mins. Next the plastic divider was removed and the flow was started (5 cm-sec⁻¹) and run for 48 hrs (see Fig. 6 B,C for visual results). This experiment was conducted four times and in each case, grain size, chl a and phaeophytin were determined along with flow profiles over each of the cells (using a laser) to insure similarity between experiments.

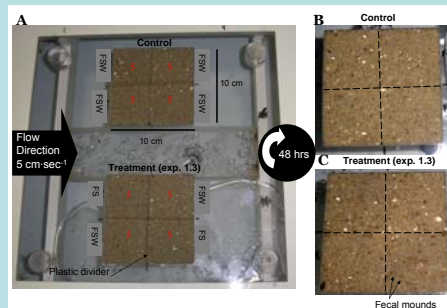


Fig. 6: A. Experimental set up B. results after 48 hrs for control C. results of treatment showing fecal mounds concentrated in the FS produced during feeding by *Polygordius* sp.

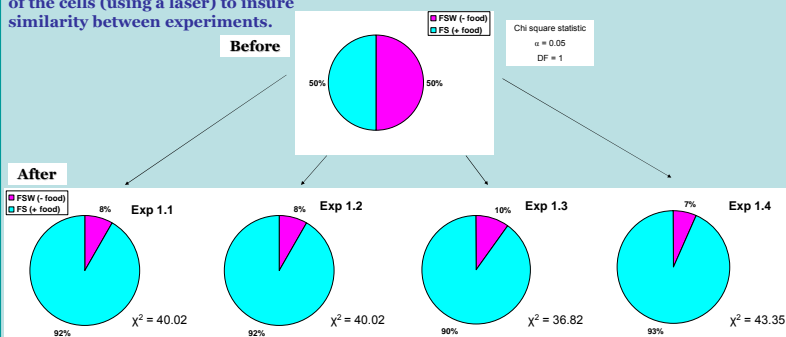


Fig. 7: Pie charts showing the percentage of *Polygordius* present in FS compared to FSW before the experiment began and after 48 hrs. Chi square values (χ²) were calculated using α=0.05; df=1. For all experiments the preference by *Polygordius* sp. for sediments containing fine organic flocs were statistically significant χ² > 3.841.

Flume Experiment 2

A still water experiment to test if the movement by *Polygordius* sp. was directed or random, and at what distance this worm can detect fine organic flocs (food), was set up using an experimental area containing 12 elongated cells (Fig. 8). To the left or the right of the center of the cells, patches of FS (+ food) were

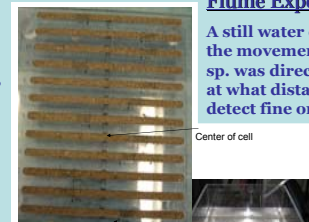


Fig. 8: Flume tray with elongate cells and still water box

placed at 2, 3, 4, and 5 cm distances. For each distance there were three replicates. One worm was placed in the center of each of the cells and left for 4 hrs. At the end of this time, plastic dividers were placed in the middle of each of the cells. The sediment from either side of the divider was removed separately to determine which side the worm had moved to (the side with the food patch or the side without the food patch).

Table 1: Results from still water experiment showing the number of worms found in the food patch or not for the 4 patch distances (3 replicates each) after 4 hrs.

Distance	# worms in food patch	# worms not in food patch
2 cm	2	1
3 cm	3	0
4 cm	3	0
5 cm	1	2
Total	9	3

Percent of total worms found in food patch = 75 %
 Percent of total worms not found in food patch = 25 %