Patchiness in Gastropod Abundance and Diversity at Jakobsen’s Beach: A Depth Survey using SCUBA

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Objectives
To quantify variation in abundance and species richness of rocky substrate gastropods across depths and along N-S geographic gradient at Jakobsen’s beach, Kigoma. Ultimately this will provide data for a temporal comparison with last year’s Nyanza Project gastropod diversity team, an macroinvertebrate parallel with Heuser’s ostracod data, and a benthic grazer link with Knox’s physical map of aquatic substrates at Jakobsen’s beach.

To test the suggestion that there is a general biogeographic boundary that can be specified at Jakobsen’s beach #1. L. coronata is known to have the current end of its range here, and does not seem to occur on the rocky substrates between beaches 1 & 2, or to the north of Jakobsen’s beach. I sought to quantify diversity across taxa to test whether there are there effects for other gastropods as well?

Materials and Methods
Sampling sites were determined by the sediment sampling protocol established by Knox, with transect lines placed every 20m shoreline distance. I counted all gastropods in a 2m² quadrat (made from rope, sand bagged at the corners to allow definition of uneven surfaces) placed over large rock surfaces that were horizontal, to slightly inclined (i.e. no vertical surfaces were sampled). With the help of a dive buddy, I collected all visible snails in the quadrat at 1, 2, 5 and 10 m depths, identified them underwater to species, and returned them to their habitat. At the same locations, just at the base of the rocky surfaces, I collected sediment samples from approximately 0.25m² quadrats at the same sites. I sieved these samples in the laboratory, separated dead from live collected shells using rose bengal (a protein stain) as an indicator, then identified the number of individuals in each of the species using a binocular microscope. In this manner, I sampled both large and small gastropods quantitatively. Analyses are presented here on live material only.

Analysis
Preliminary analyses were graphical, showing abundance by species at each site and depth with histograms. Fisher’s alpha was used as a combined index of diversity and abundance, while similarities between sample transects and sites was done with cluster analysis (K-means (not shown) and heirarchical clustering of sites by depth). Generally I analyzed the data in two blocks: sites to the north of beach #1 and sites to the south of beach #1.

Results and discussion
Fig. 1 shows the gastropod species abundance, as sampled by SCUBA on rocky substrates, on the northern side of beach #1. Reymondia, L. nassa and L. grandis decrease with depth while Nov. gen. increased with depth. Fig.2 , shows the comparably sampled species abundance to the south of beach #1. Here both L. nassa and Nov. gen. increased with depth. The overall abundance in the southern side was higher compared to the northern side, perhaps because the rocky substrate in the southern part covers a much greater area compared with the northern part. The differing extents of the substrates are shown clearly in Knox’s substrate map from this year. Additionally, there are roads down to the beach near the northern section which might contribute to the increase sedimentation and thus reduce the abundance of gastropods in the northern side.
Figs. 3 & 4 show the results from the sieve sample analyses of smaller gastropods in sand sediment at the base of the rocks sampled in the dive data above. Both figures indicate that most of the species increased in abundance with depth in both the northern and southern sampling areas. I suggest that microgastropods were found mainly in deeper waters because it is below wave base and less disturbed when comparing with shallow waters. Figure 4 indicates that overall microgastropod abundance is greater in the deep waters of the northern sampling area than the southern area, perhaps because it receives more sediment input. Since the quantity of sediments was higher, the amount of detritus might be higher too compared to the predominantly rocky area of the southern area.

Fig. 5 shows Fisher’s alpha index for each sampling site. The general trend shows that the diversity is higher in the southern part, decreasing towards the north. Transects #6 and #7 had low diversity over all depths. This indicates the patchiness in gastropod distribution and abundance on the local scale of 10s-100s of meters, and cautions us against overinterpretation of spatially limited sampling.

Fig. 6a shows the results of the cluster analysis of faunal similarity of sites at 2m depth. At this depth there still is an overriding similarity among sites to the south that contrasts with sites to the north, of Jakobsen’s beach #1. Transects 1, 2, 4, and 5 of the north had very similar abundance and diversity, while transects 8, 9, and 10 clustered strongly with each other. However, cluster analyses of transects at other depths did not show this pattern, indicating that the north-south distinction may be a depth dependant pattern.

Conclusions:

Some species might be used as depth indicators, e.g. Nov. gen., and Anceya are common in deep waters while L.grandis is common in shallow waters. Patchiness was observed to be high between quadrats on rocky substrates at Jacobsens beach. Fisher’s alpha varies greatly between transects and depths, indicated highly localized patchiness. Based on cluster analyses, there is no indication of a biogeographic boundary between rocky areas north and south of Beach 1 except for the distribution of Lavigeria coronata. The sharpness of a biogeographic boundary at Jakobsen’s beach #1 was not supported across taxa, though the overall patchiness of results suggest that more replicate sampling is needed.
Species abundance South sites Jacobsen

Figure 1

Species abundance South sites Jacobsen

Figure 2
Species abundance North sites Jacobsen

Figure 3

Species abundance South sites Jacobsen

Figure 4
Figure 5