

Using Thecamoebian Populations to Evaluate Historical Water Quality in Todds Lake in Murfreesboro, Tennessee

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Abstract

Water quality is and will continue to be an important environmental concern. Todds Lake is a small freshwater, artificial reservoir in Murfreesboro, Tennessee that was created in the 1930s by damming a wetland. Murfreesboro has experienced tremendous growth and rapid urbanization in the past decade with the population of the city increasing 50.5% from 2000 to 2010. Todds Lake is located in the Stones River Watershed and is fed by Black Fox Spring, which travels through several subdivisions receiving runoff from lawns and driveways before ending in Todds Lake. The lake is also surrounded by urban development such as additional subdivisions, a strip mall and a gas station and may be receiving runoff from those areas that could be negatively affecting the water quality within the lake. Thecamoebians are benthic testate amoebae that have been used in multiple studies in North America and Europe as indicators of pollution and water quality in lacustrine environments. Analysis of thecamoebian populations from sediment samples collected in Todds Lake in recent years indicates that the lake is a stressed eutrophic environment with low diversity assemblages and abundant *Centropyxis aculeata* observed in the samples. The shells of thecamoebians preserve easily so these organisms can yield historical data on water quality. The fossilization potential of thecamoebians gives them an advantage over other freshwater micro- and macroinvertebrates. This study will compare populations of thecamoebians from sediment samples in Todds Lake with those found in samples taken from a sediment core to determine if there have been changes in the ecological condition of the lake and wetland over the last century.

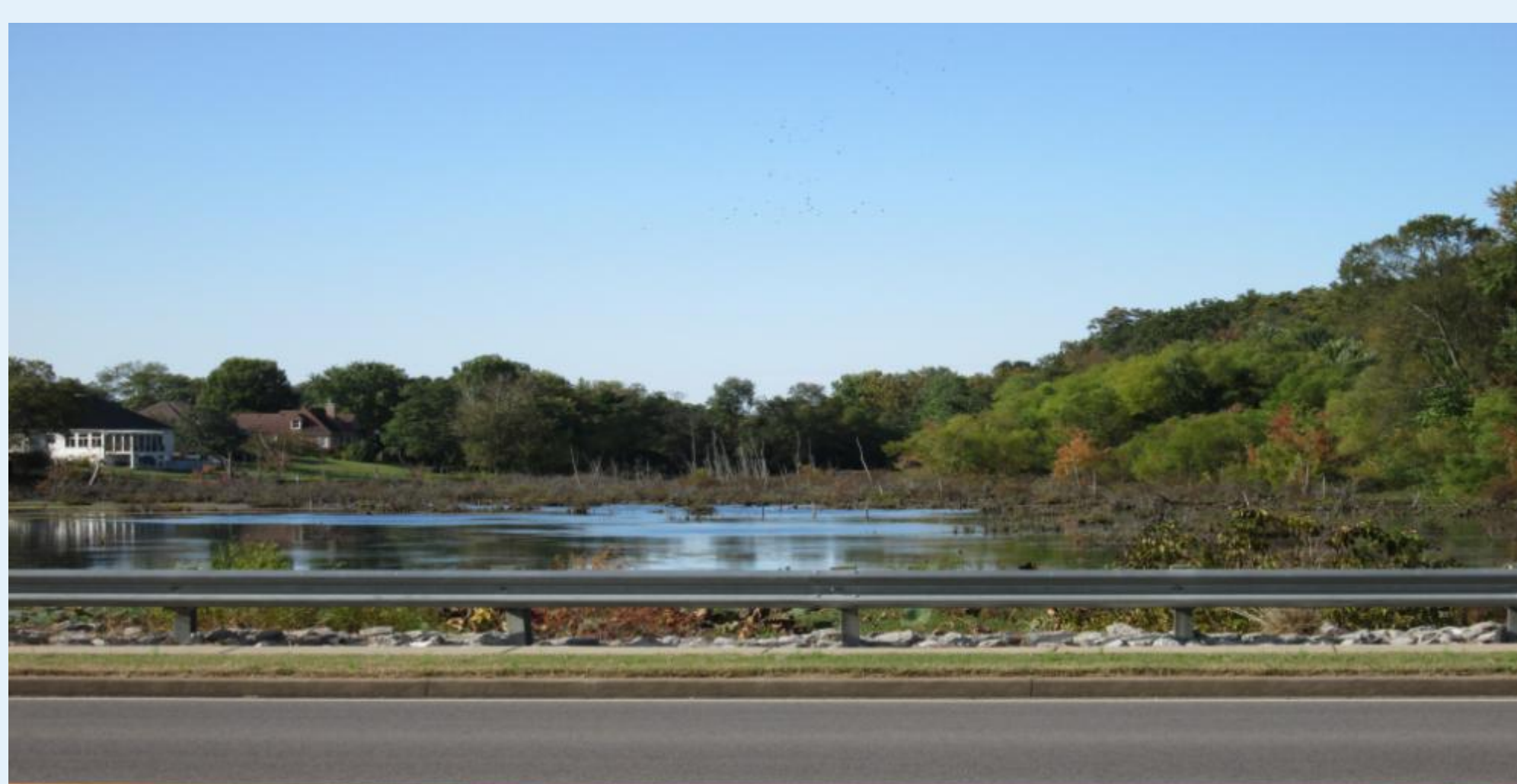


Figure 1: View to the northwest of Todds Lake across Rutherford Blvd.

Study Area

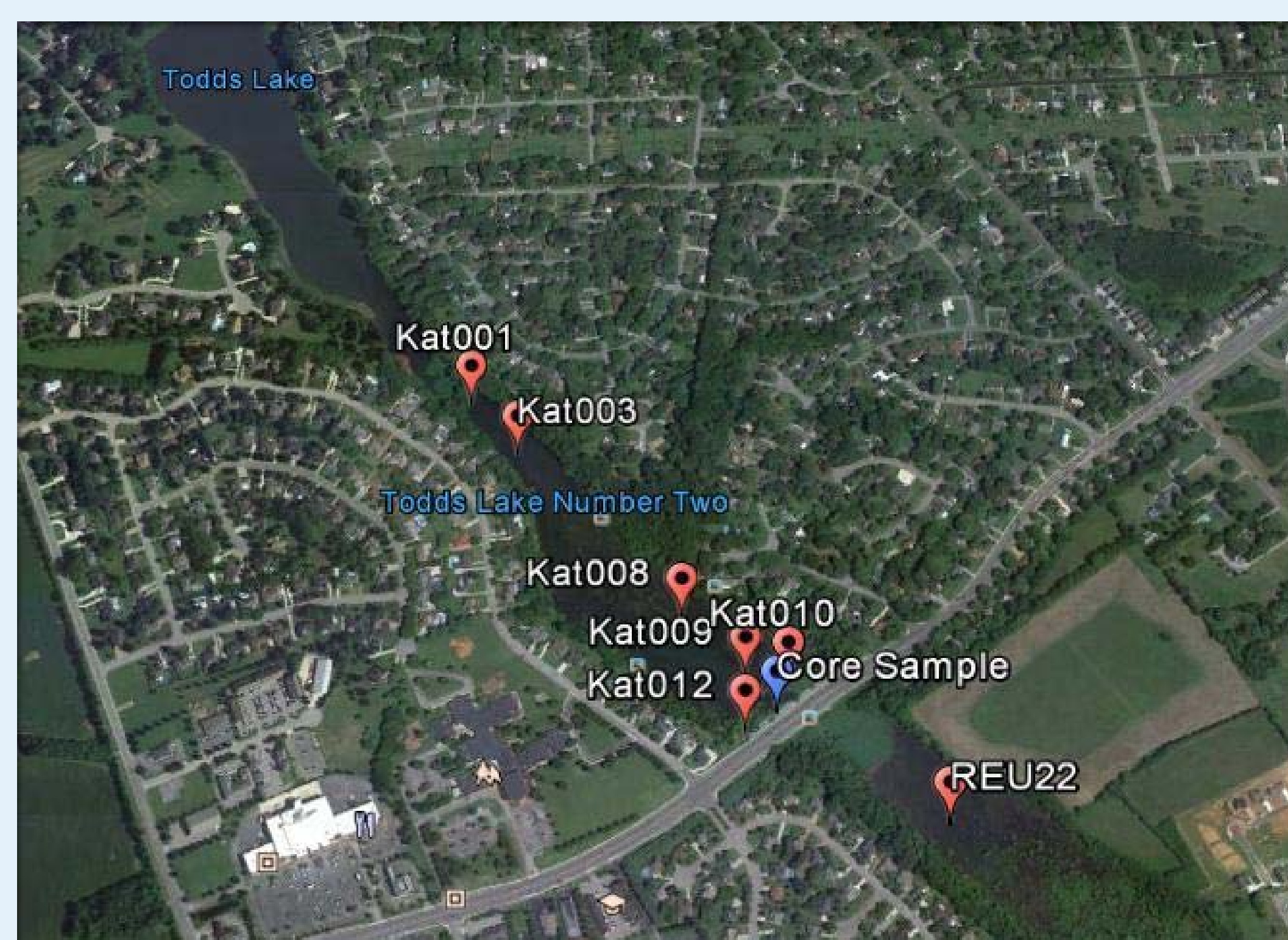


Figure 2: Map of sediment collection sites in Todds Lake. Rutherford Blvd. is the road that cuts across the lake (Map by: Google Earth)

Materials and methods

Surface sediment samples and short cores were taken by hand at various sites and the locations were recorded with a GPS device. Each sample is sieved using 45 and 500 μm sieves. This process removes the large organic matter from the sample and the mud is separated from the thecamoebians. Once washed the sediment is preserved in isopropyl alcohol, and refrigerated. Using a microscope and a fine tipped brush, the thecamoebians are picked out of each sample and then placed onto a numbered slide.

Two cores were collected. One was collected using a small-diameter coring device and the other was collected using a universal coring device. Age dating using Pb-210 isotopic dating will be completed in the next few months. The cores were sectioned in 1 cm slices and then washed in the same way as the sediment samples.

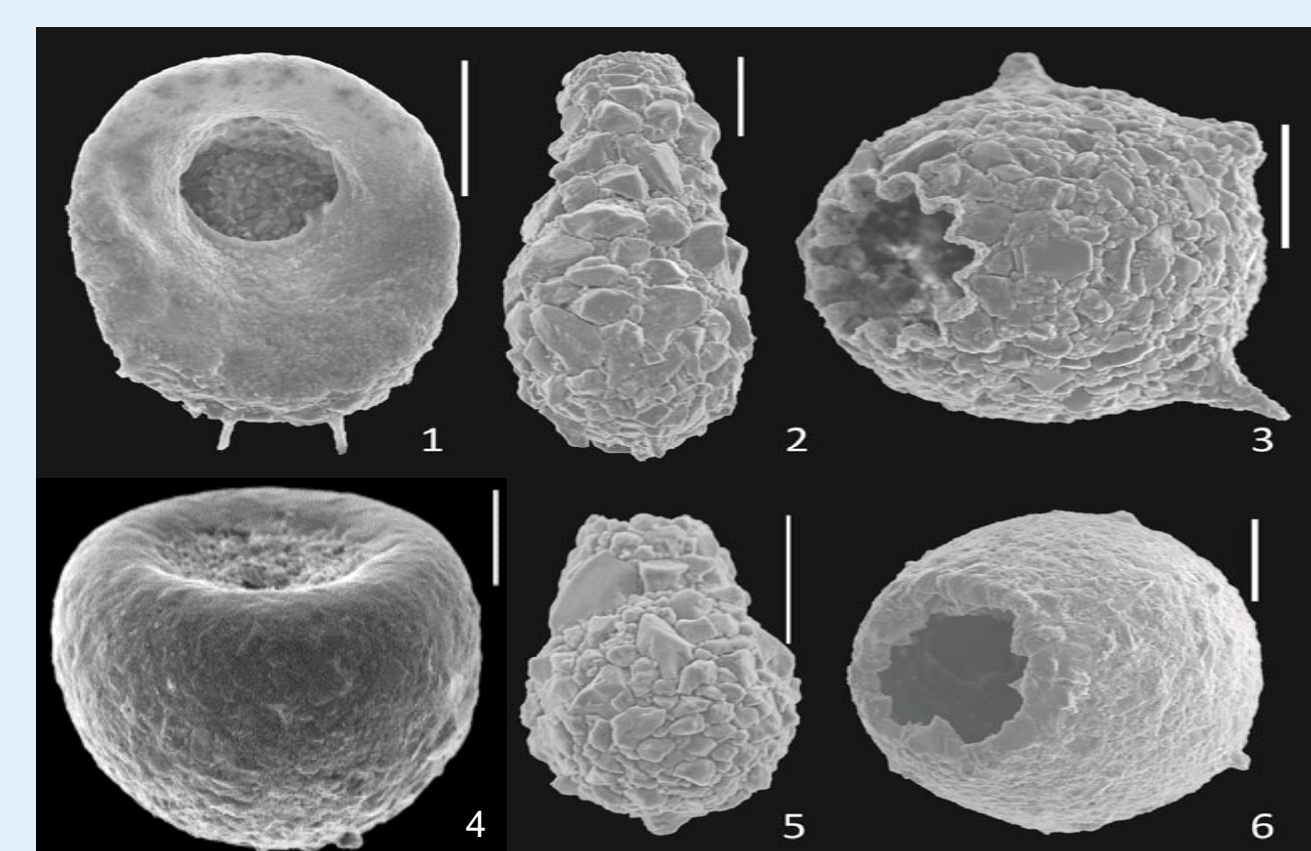


Figure 3: Electron scanning microscope image of (1) *Centropyxis aculeata* "aculeata", (2) *Diffugia oblonga* "tenuis", (3) *Diffugia corona*, (4) *Cyclopyxis kahli*, (5) *Diffugia oblonga* "spinosa", (6) *Diffugia corona*



Figure 4: A view of lily pads to the southeast toward the head waters of the lake

Results

Todds Lake appears to be more negatively impacted closer to the busy Rutherford Boulevard. Sample KAT012, which is located closest to the road (Figs 1 and 2), shows an increase in the relative abundance of *Centropyxis aculeata* "aculeata" and *Centropyxis aculeata* "discoidea" (Fig. 5). Centropyxids are environmental generalists that can tolerate intermediate to poor water quality environments. KAT001 and KAT003, located furthest from Rutherford Blvd., have absent to low relative abundances of centropyxids, suggesting a relative increase in water quality further away from the drainage coming from the road.

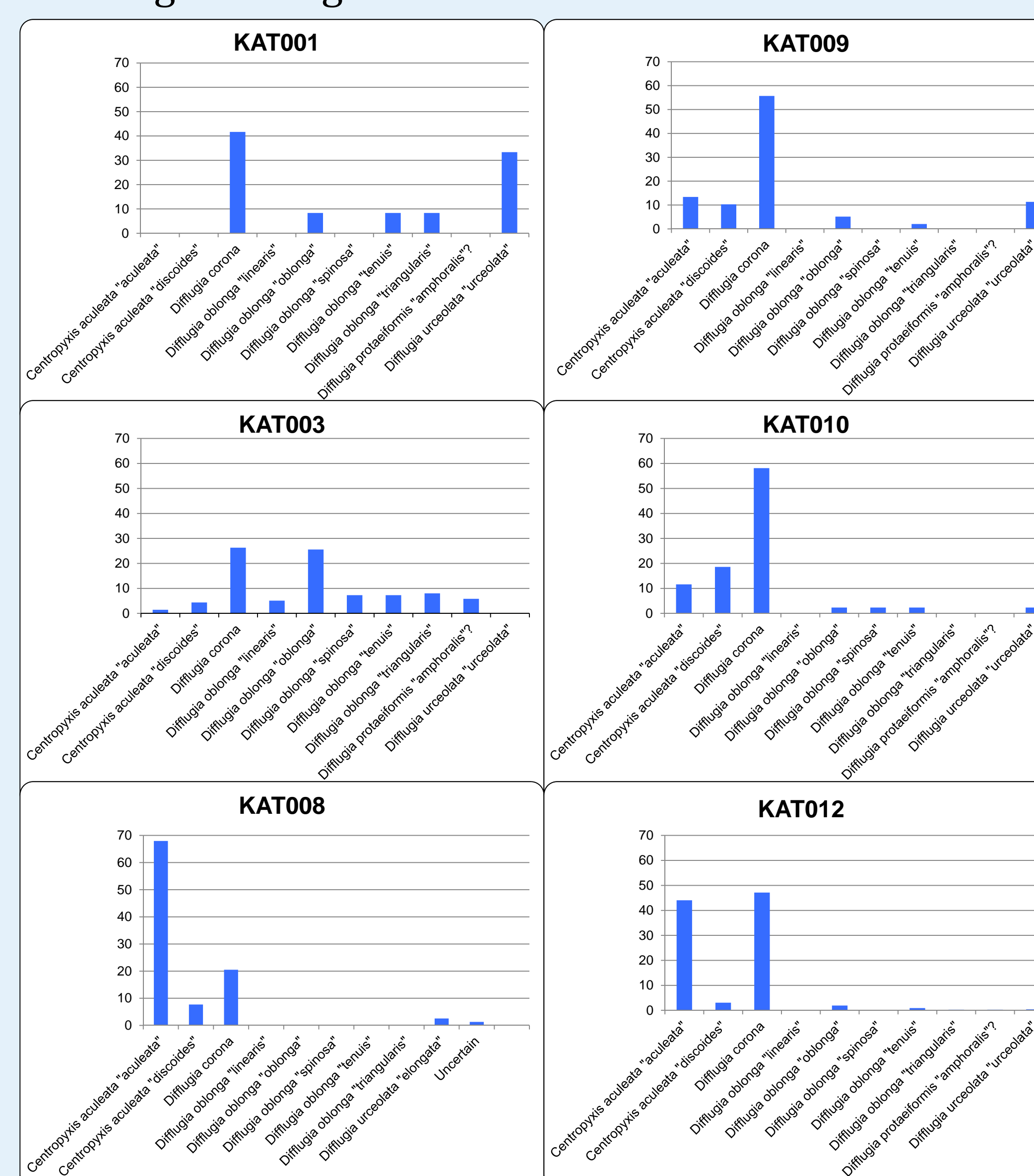


Figure 5: Histograms of the relative abundance of thecamoebian species in surface samples

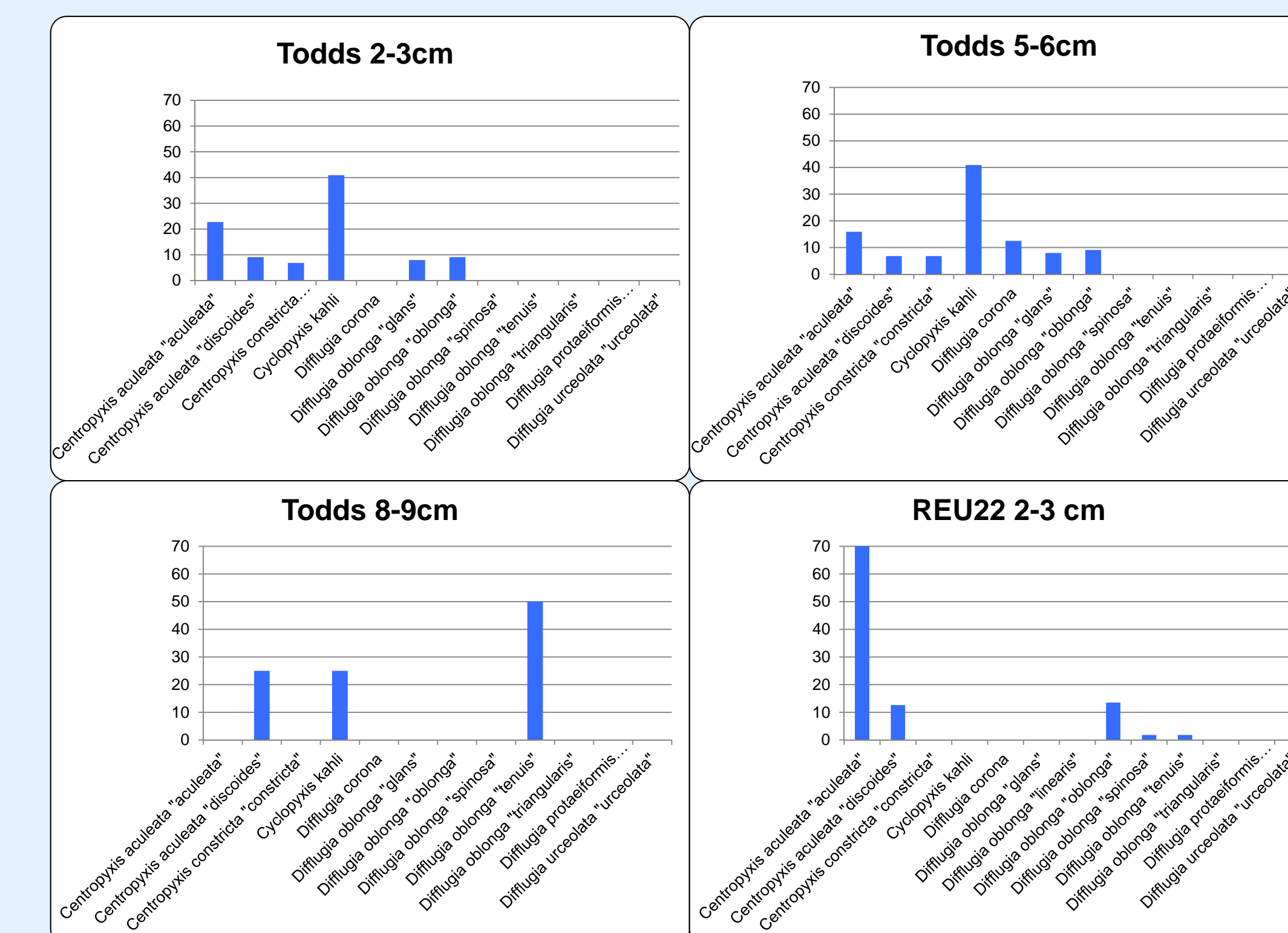


Figure 6: Histograms of the relative abundance of thecamoebian species in core samples

We found a high relative abundance of *Cyclopyxis kahli* in the Todds Lake core samples. *Cyclopyxis kahli* is known to inhabit soils as well as fresh water environments (Ogden, 1988). The abundance of this species may show that soil erosion could have potentially introduced them into the lake.

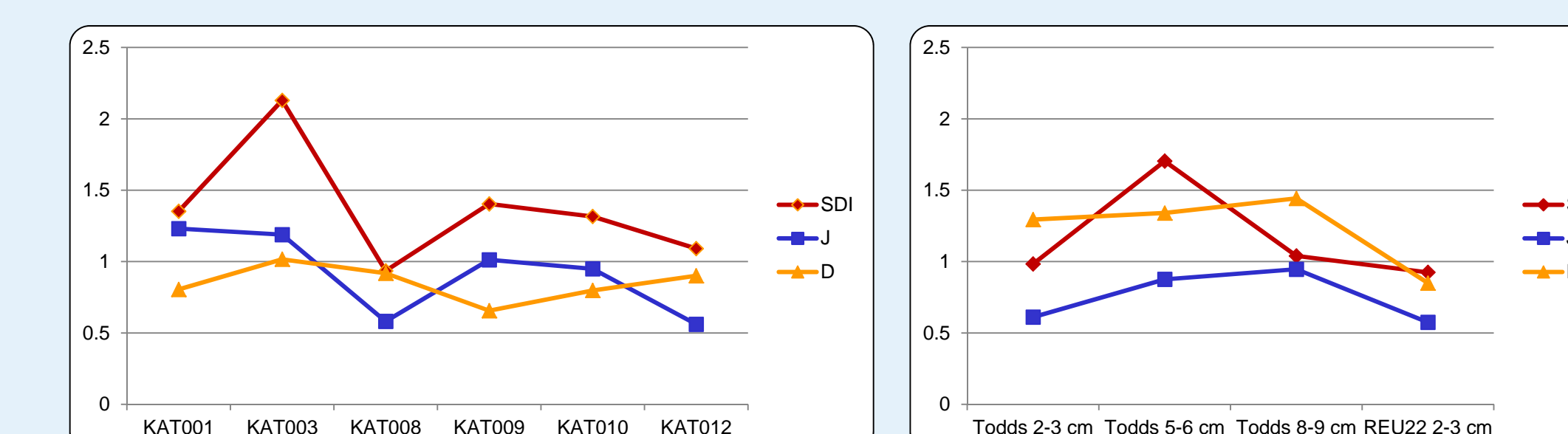


Figure 7: Calculated values for the Shannon Diversity Index (SDI), Pielou's equitability index (j) values and Margalef's richness index (d) values for the surface samples and core samples

The Shannon Diversity Indices for both the surface samples and core samples are between 2.13 and 0.92. Surface samples further from Rutherford Blvd., KAT001 and KAT003, have higher SDI values than the sample closest to the road, KAT012. This indicates that environmental impacts are greater closer to the road.

Literature Cited

Ogden, C.G., 1988, Fine structure of the shell wall in the soil testate amoeba *Cyclopyxis kahli* (Rhizopoda), *Journal of Protozoology*, **35**, p. 537-540.

Acknowledgments

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