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DIATOM ASSEMBLAGE FROM SURFACE SEDIMENTS OF LOWER ASSAM FLOODPLAIN, NORTHEAST INDIA

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Diatoms and environmental conditions were characterized from 10 sampling points in two major wetlands namely Deepor and Kumuri beel in lower Assam floodplain. A total of 38 taxa identified, viz., planktonic (*Melosira granulata*, *Tabellaria flocculosa*, *Diploneis subovalis*, *Stauroneis anceps*, *Nitzchia palea*, *Fragilaria virescens*, etc.), epiphytic (*Eunotia pectinalis, Navicula hasta*, *Achnanthes brevipes, Pinnularia borealis*, etc.), episamic (*Surirella elegans*, *Gomphonema lanceolatum*, etc.), epipelic (*Rhopalodia gibberula*, *Synedra ulna*, etc.) and endozoic group (*Cymbella turgida*, *Pinnularia interrupta*, etc.) is suggesting that the wetland surface sediment diatom assemblage is heterogeneous and that hydrologic gradients may be an important structuring force. Our preliminary result from northeastern region could be potential to be a useful tool in assessing wetland environmental conditions, however, the shallow nature and complex hydrology of these systems require careful and precise sampling design for adequate characterization of diatom assemblages. Besides the diatom, other algal assemblages are also equally important to play a key role in wetland function and can be valuable indicators of biological integrity and ecological condition.

Key words: Diatoms, Lower Assam floodplain, Northeast India.

Diatoms, unicellular, photosynthetic algae of the class Bacillariophyceae abundant in most aquatic habitats are useful proxy for interpreting past and present environmental condition in wetlands. Their ubiquitous distribution, high species diversity and siliceous frustules all enable them to function as sound environmental indicators (Dixit *et al*. 1992). This intricate siliceous frustule (valve or shell) morphology is the basis for their taxonomy. Diatom species have clearly defined and frequently narrow preferences for particular habitats (e.g. there are open water-planktonic, plant dwelling-epiphytic, fine sediment-epipelic, sand associated-epissamic, animal parasite-endozoic, etc.) and water quality conditions. The assemblage is acutely sensitive to the impacts of human activities on aquatic habitats, including acidification, eutrophication, sedimentation and chemical pollution. Changing in diatom assemblages have been related quantitatively to water quality variables, including conductivity, pH, temperature, light, moisture, current velocity, salinity, oxygen, inorganic and organic nutrients along a human disturbance gradient (Anderson 2000). The purpose of bioassessment based on diatom is to examine its distributional pattern in surface sediment within the pristine wetlands in Assam. Based on diatoms recovered from sediments of two most important wetlands of Assam namely Deepor and Kumuri, a preliminary attempt has been made to understand the environmental conditions of these wetlands.

Deepor beel (Lat. 26°03'26" – 26°09'26" N & Long. 90°36'39"-90°41'25"E): A largest fresh water lake basin (Asian wetland directory ; Scott 1989), is situated 10 km south west of Guwahati, Kamrup District of Assam having an area of 10 km^2 a largest fresh water lake basin extended up to about 40 km^2 during flood and connected with a set of inflow and outflow channels receiving water mainly from Pojora stream from Garo hills of Meghalaya and rivulate Basistha-Bahini in its southern part (Figure 1). Physical factors such as high minerogenic erosion rates, high temperature and low light availability especially in Deepor beel may have regulated the micro assemblage favouring *Fragilaria* sp. (Figure 2a).

Kumuri beel (Lat. 25°28'-26°15' N & Long. 89°42'-90°15' E): is situated 14 km west of Goalpara town near Pancharatna Pahar. The beel, in the present time has been significantly

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extended up to 900-1000 hectares in present time. The water transparency, pH value, percentage of phytoplanktons and macrophytes generally seems more in winter. The overall aerial extent of water of Kumuri is maximum as compared to above mentioned beels. The coverage of Water hyacinth, *Salvinia* and *Trapa* becomes more during summer in the peripheral area. The large area of the beel has been encroached for the crop cultivation by the local tribes (Figure 2b). We have, so far, reported 38 species of diatom under 15 genera belonging to 8 families from the surface sediments of both the beels, excepting one taxa (*Melosira* sp.), all belongs to order pennales. These species are: *Pinnularia borealis, P. interrupta, P. gibba, P. viridis, Fragilaria virescens, F. intermedia, Navicula hasta, N. pinnata, N. gracilis, N. cuspidata, Cymbella turgida, C. cymbiformis, C. cistula, Nitzschia palea, N. obtusa, Rhopalodia gibberula, R. gibba, Stauroneis anceps, Diploneis subovalis, D. interrupta, Achnanthes brevipes, A. inflata, Eunotia pectinalis, E. zygodon, E. arcus, Surirella elegans, S. ovalis, Gomphonema lanceolatum, G. gracile, G. sphaerophorum, G. constrictum, G. lacusrankala, Melosira granulata, M. moniliformis , Tabellaria flocculosa, T. fenestrata, Synedra ulna* and *S. bacillaris*.

MATERIALS AND METHODS

Diatom preparation of ten sediments (silty clay to organic mud, pH alkaline), five each from Deepor and Kumuri beel which were procured in a transect (N-S to E-W) was made using chemical concentration method (Setty 1966). In this method samples were treated with hydrogen peroxide, hydrochloric acid and nitric acid. Distilled water was used after each chemical treatment as washing agent. Minimum 150 diatoms per sample were counted for reconstruction of diatom spectra, on the basis of morphology of frustule of individual taxa each has been identified upto specific level (Desikachary 1987). However, the assemblage has been segregated up to generic level in making diatom spectra for both the beels for the ease of understanding the percentages of each genus. Microphotographs were taken using Olympus – BX 50 Microscope with x1200 magnification(Plate I).

!OBSERVATIONS AND CONCLUSIONS

The quantitative and qualitative analysis of 10 mud samples from Deepor and Kumuri beel reflects:

Deepor beel: Five samples were studied for diatom analysis. The major taxa encountered rankwise are, *Pinnularia* sp. (19.6%), *Fragilaria* sp. (14.80%), and *Navicula* sp. (12.80%) along with other important taxa like *Gomphonema* sp. (8.40%), *Achnanthes* and *Melosira* sp. (6.80% each), *Synedra* and *Cymbella* sp. (6.40% each), *Nitzschia* sp. (6.20%), *Eunotia* sp. (6%) and *Tabellaria* sp. (5.8%) respectively (Figure 3a).

Kumuri beel: Five samples were studied from this wetland. The major taxa encountered rankwise are, *Pinnularia* sp. (17.03%) and *Navicula* sp. (16.34%) along with other major taxa like *Cymbella* sp. (9.88%), *Eunotia* sp. (9.08%), *Fragilaria* sp. (9.06%), *Gomphonema* sp. (8.13%), *Synedra* sp. (7.86%), *Achnanthes* sp. (4.42%), *Stauroneis* sp. (4.18%), *Nitzschia* sp. (3.22%), *Melosira* sp. (2.84), *Rhopalodia* sp. (2.75%), *Tabellaria* sp. (2.01%), *Diploneis* sp. (1.79%), *Surirella* sp. (1.35%) respectively (Figure 3b).

It appears that development of diatom assemblages seems to be similar in all lakes excepting a little alteration in frequency and most strongly controlled by environmental conditions of a mainly physical character (i.e., higher temperature, low light intensity, high erosion rates and mineral turbidity). Subsequently, diatom assemblages are regulated by many factors, such as changes in catchments acidification and lake water pH, succession of vegetation, climate, in lake processes and differences in the hydrologic setting, leading to variability in rate and scale

of diatom community development among lakes. The inference may builds upon three steps that are closely related. Firstly, a calibration set had to be developed for northeastern India to collect information about present day diatom distribution and to empirically model the species-environment relationships. Secondly, the developed quantitative inference models for temperature and lake water pH were validated and verified with monitoring data for lake water pH and instrumental meteorological records. The third step involved the application of the quantitative inference model on a Holocene time scale in order to reconstruct past environmental condition in the region and assess the responses of ecosystems to climate change. Future emphasis should be put also on a shorter time scale than the entire Holocene, as the density of independent palaeoclimate information is much higher and allows a better validation of diatom based inferences.

Finally, the analysis of contiguous sedimentary interval with high temporal resolution is needed to improve the understanding of effects of short term climate changes on aquatic ecosystems. Annually, the laminated sediments provide undoubtedly the best sediment archive to assess the length of environmental memory and response time of aquatic ecosystems to known environmental extreme events though the annually laminated sediments appear to be very rare in the alluvial terrain. However, the collection of long term water temperature data is time-and cost-intensive and logistically challenging. Though the study restricted to only two wetlands from Northeastern region, more deeper sediment from other potential site may provide better representation of diatom

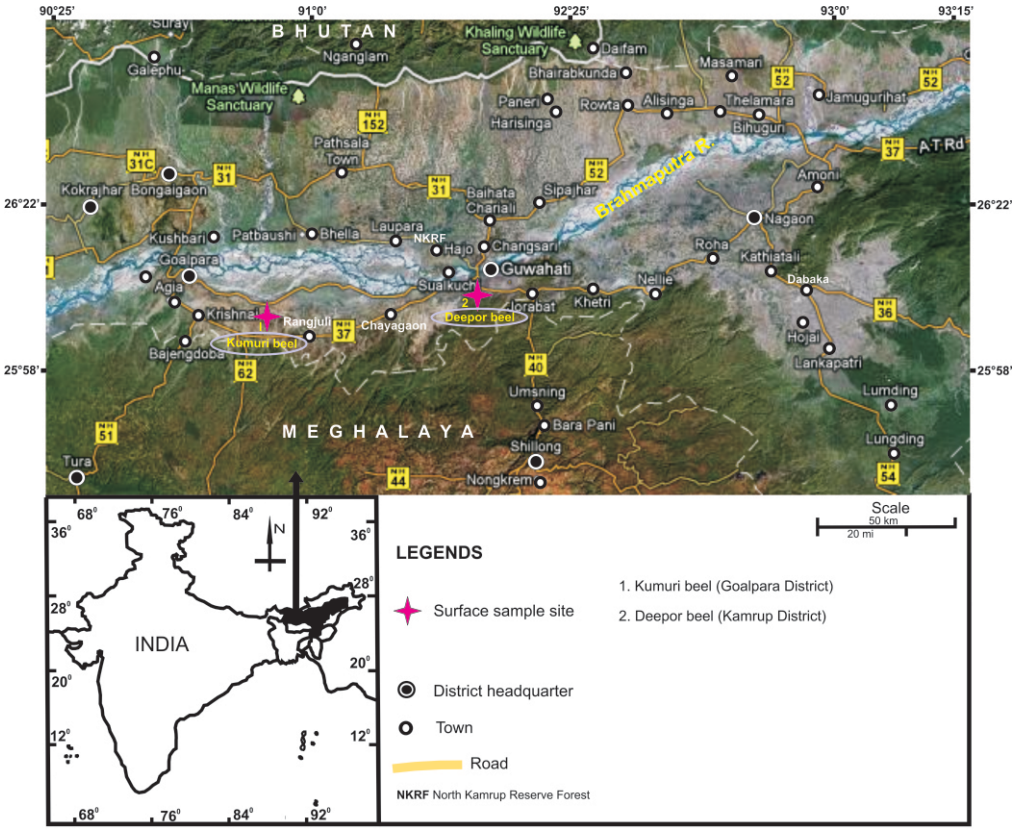

Fig.1
Location map showing study areas.

Figure 2 a A portion of Deepor beel encroached for rice cultivation and fishing.

assemblage for climatic interpretation. A study was done to compare diatom frequency in Kumuri and Deepor beel on the basis of habitat acquired by them viz., planktonic, benthic (epissamic, epipelic), epiphytic and endozoic.

It was noticed that benthic and planktonic species are dominant in both Kumuri and Deepor beel. Water level in Deepor beel is higher as compared to Kumuri beel therefore, water dwelling- planktonic and animal

Figure 2 b A view of Kumuri beel.

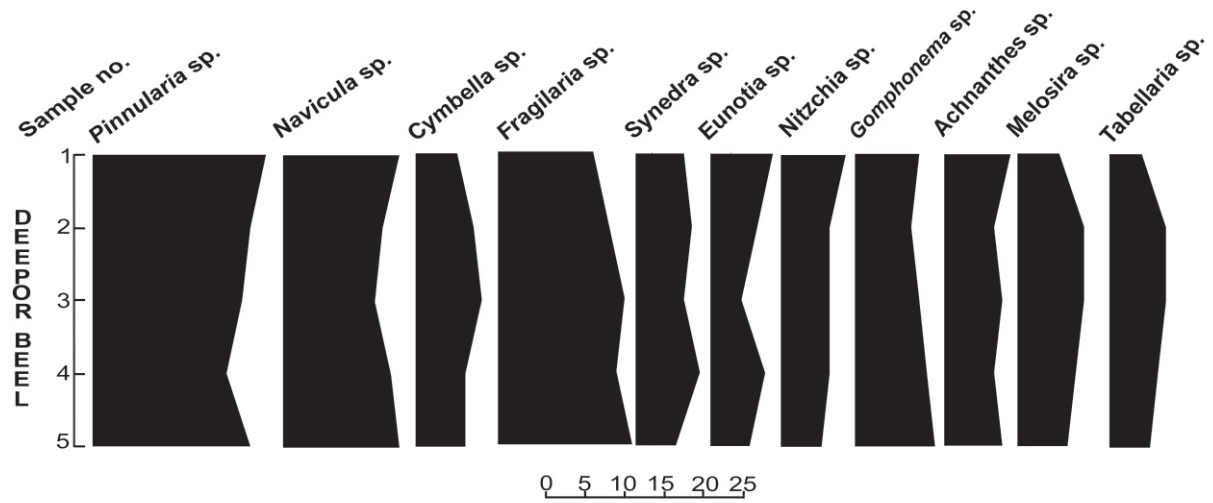

Figure 3a. Diatom spectra from surface sediments of Deepor beel wetland

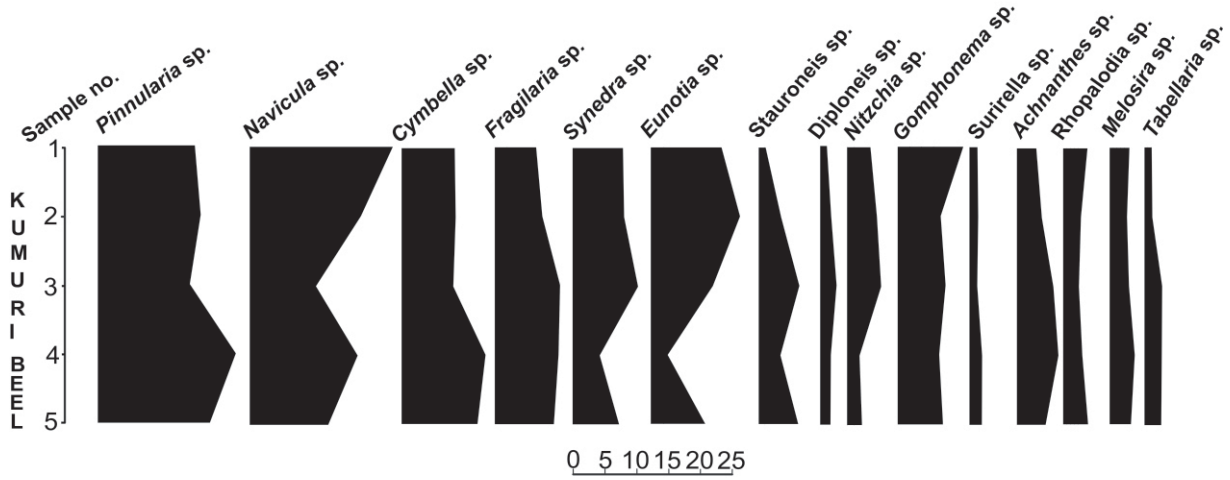

Figure 3b. Diatom spectra from surface sediments of Kumuri beel wetland

parasitic- endozoic species thrive well in former as compared to latter which is clearly indicated in pie diagram (Figure 4). High water level due to extensive flood disturbs the sedimentation process inside the beel and therefore benthic species are lesser in Deepor as compared to Kumuri beel to survive.

Kumuri beel lies adjacent to thick reserve forest. High frequency of winds coming through this forest laden with adequate organic matter incorporating sedimentation process inside the beel, due to which epiphytic species thrive well in Kumuri as compared to Deepor. Diatoms are ubiquitous in both lakes and rivers as well as in other moist conditions where there is sufficient light for photosynthesis. Analysis of diatom species assemblages has also led to substantial advances in the understanding of human impact on aquatic habitats from sub-decadal to millenial. Changes in diatom species composition along dated sediment cores can thus be highly valuable for determining whether the contemporary conditions of a wetland are within the range of natural variability.

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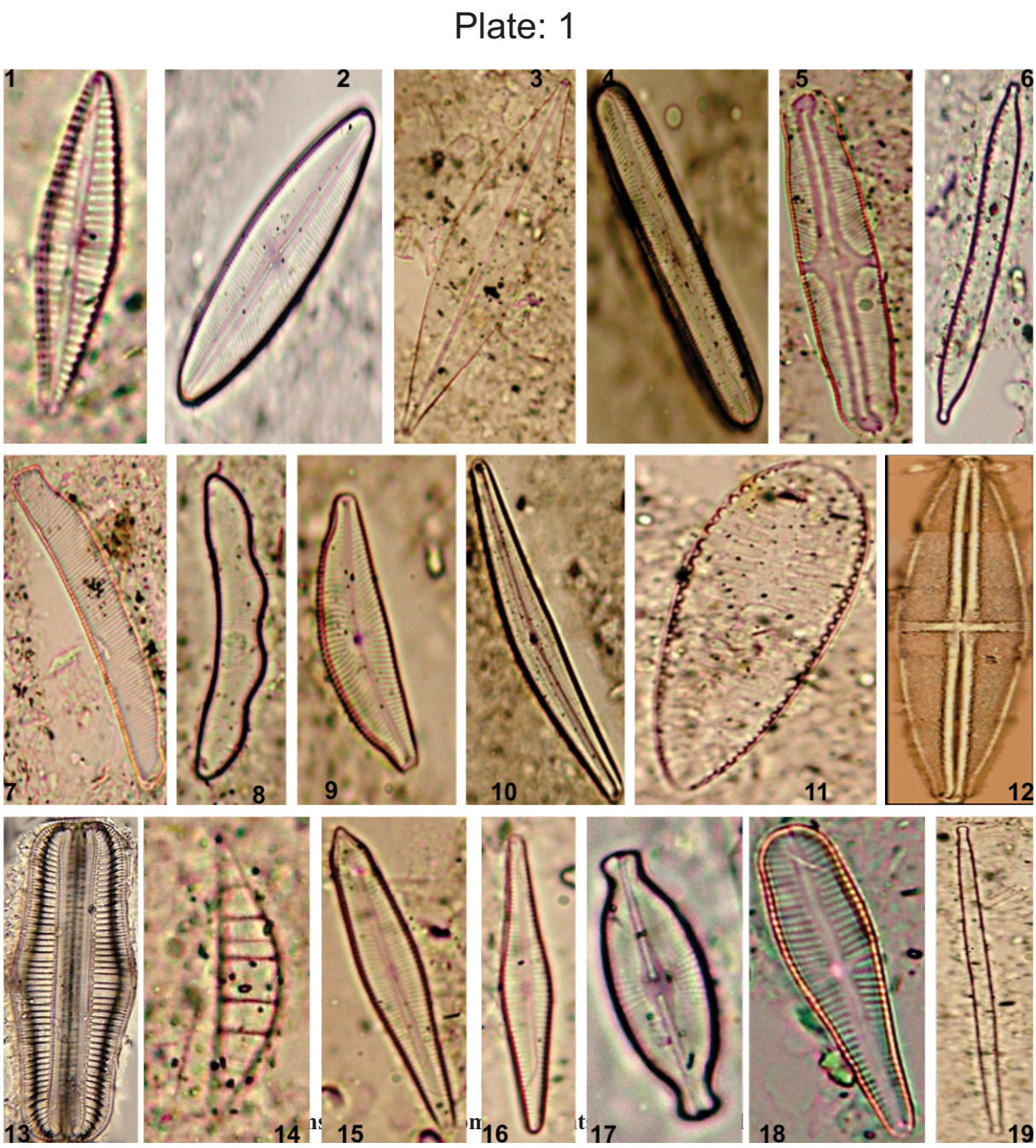

Figures 1-19 1. *Navicula pinnata* x1500, 2. *N. gracilis* x1500, 3. *N. cuspidata* x 1500, 4. *Pinnularia gibba* x2000, 5. *P. interrupta* x2000, 6. *Nitzchia palea* x1800, 7. *Eunotia arcus* x1500, 8. *E. zygodon* x1500, 9. *Cymbella turgida* x1500, 10. *C. cymbiformis* x2000, 11. *Surirella ovalis* x2000, 12. *Stauroneis anceps* x2000, 13. *Rhopalodia gibba* x1800, 14. *R. gibberula* x 1200, 15. *Gomphonema lacusrankala* x2000, 16. *G. gracile* x2000, 17. *G. sphaerophorum* x1800, 18. *G. constrictum* x2000, 19. *Synedra ulna* x1800.

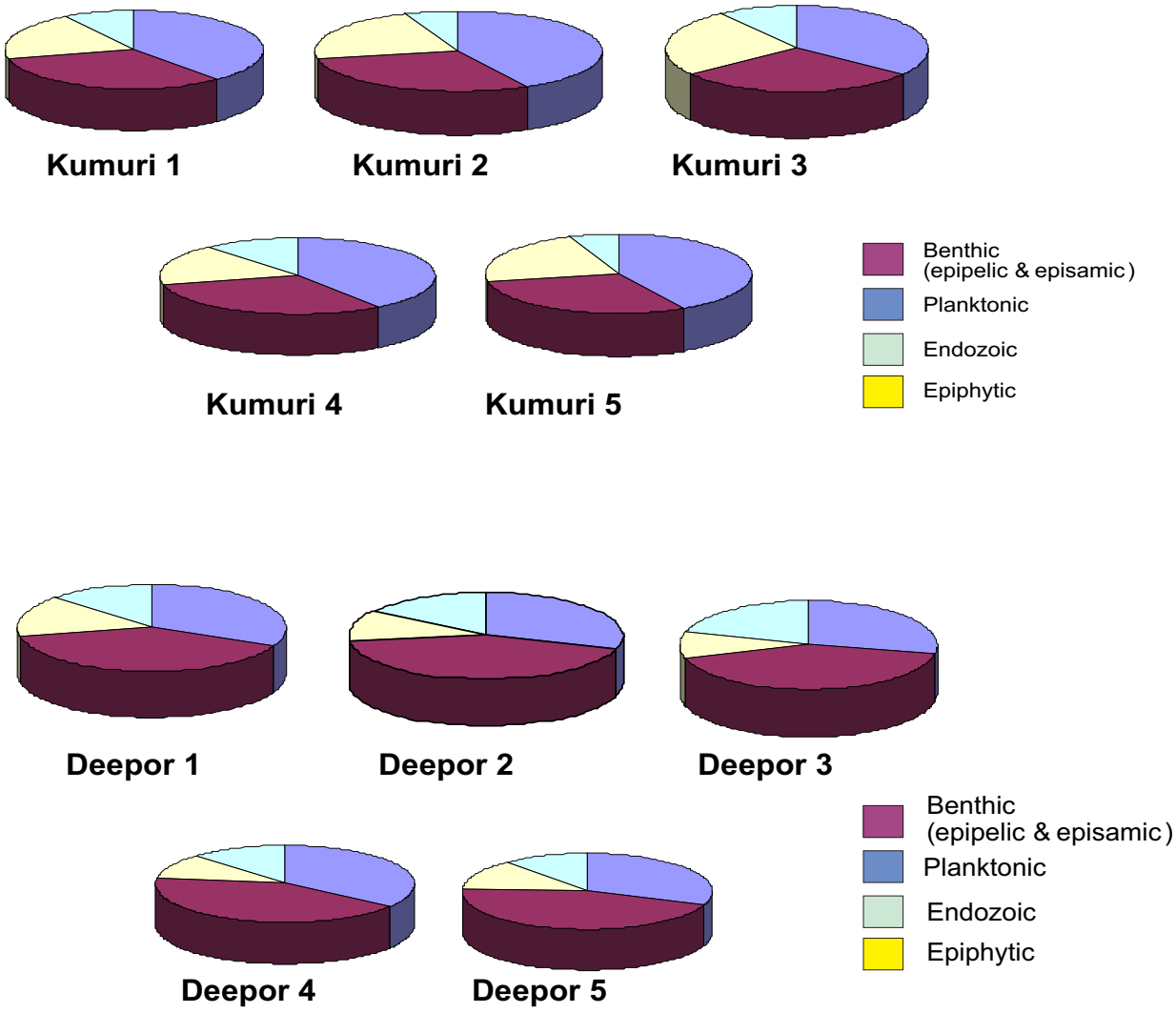

Figure 4. A comparative diatom frequency of different habitat in Kumuri and Deepor beel, Assam.

REFERENCES

Anderson NJ 2000 Diatoms, temperature and climatic change. *European Journal of Phycology* **35** 307-314.

Desikachary TV 1987. Atlas of Diatoms. Madras science foundation. Vol II-IV, Madras.

Dixit SS, Smol JP, Kingston JC & Charles DF 1992. Diatoms: powerful indicators of environmental change. *Environ. Sci. Technol.* **26** 23-33.

Setty MG 1966. Preparation and method of study of fossil diatom. *Micropalaeon-tology* **12** 511-514.