little rise in SLA tries to compensate for the light intensity.

In *Chenopodium album*, the S/R ratio remains more or less same between full sunlight and 50% sunlight but falls sharply thereafter. In *E. indica* as also *Tribulus terrestris*[9], the situation is just the reverse. The S/R ratio shows little change from full sunlight to 50% sunlight but rises steeply at 40% sunlight.

These observations lead to the following conclusions: At lowered light intensities the plants may adapt through diversion of assimilates to the shoot but this diversion may be limited only upto certain light levels as in *Amaranthus spinosus*. In those plants which exhibit best growth in full sunlight and ordinarily do not show diversion of assimilates to shoots at low light levels, the assimilates may still be diverted at very low light intensities though without any effect on total growth. It is interesting to note that such plants show a change in habit from prostrate to erect (*Eleusine indica*[8], *Tribulus terrestris*[9], *Portulaca oleracea*[10]) at low light intensities. Thus it seems that the assimilates that are diverted to shoots are utilised in building up of more mechanical tissue to keep the plants erect.

The adaptive mechanism in the plants further involves either an increase in ULR or SLA or both. Both the ULR and SLA are independent of the capability of the plant to divert photosynthates to the shoot for build up of more leaf area (LAR). The same plant may show increase in ULR at one light level and an increase in SLA at the other. This has been amply shown by *A. spinosus*.

It is concluded that various plant species are equipped with different adaptive mechanisms to light intensity factor and of these the light regulated distribution of photosynthates to various plant parts is most important. Besides this, the changes in SLA and ULR also play important role in light adaptation.

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A NOTE ON FIXATION AND PRESERVATION OF CALCAREOUS ZOOPLANKTON

PROPER preservation of Zooplankton with calcareous tests and shells (Foraminifera, Radiolaria, Atlantidae, meroplanktonic gastropoda, Thecosomata, etc.), is of prime importance since studies on taxonomy and morphometry are to be based only on the morphological characters of their shells. A simple way of preservation for this purpose is to keep them as dry specimens in tubes lined with cotton. But, for anatomical and histological studies, necessitating intact preservation of soft parts, other methods are necessary. Due to high cost and great evaporation rate, the conventional preservation in ethanol was replaced by formaldehyde. The problem in formaldehyde preservation and storage is the dissolution and breakdown of the shells over a wide range of pH in varying ambient temperatures. Shelled organisms preserved in formaldehyde show varying stages of deterioration (Balachandran, 1973). Hence it was needed to evolve a formula for a suitable and cheap preservative.

About 200 formulae were tried at Indian Ocean Biological Centre in addition to 45 formulae evolved by SCOR/UNESCO/WG 23 for preservation of calcareous plankton. Formaldehyde, Dowicil 100, Ethylene glycol and phenoxetol in varying concentrations diluted with distilled water, tap water and sea water were used for these experiments. Borax, Hexamine, Calcium carbonate, Sodium acetate, Sodium ascorbate and Potassium oxalate in concentrations of 0·5 to 15% were used as neutralising agents and additives. After proper fixation of fresh plankton in 2% formaldehyde based on the results of the earlier experiments (Balachandran, 1973) shelled taxa were sorted out, transferred to the various preservatives and their conditions were periodically observed. The nature of breakdown, degree of dissolution, fragility to applied pressure and transparent and translucent state of shelled

forms and the change in PH and formaldehyde content of the preservatives were recorded.

The results show that 2% formaldehyde in distilled water formalin neutralised with excess Sodium tetraborate—($Na_2B_4O_7.10H_2O$) with 3% to 5% Potassium oxalate is the best preservative. Sea water is not used for dilution since on addition of potassium oxalate, it precipitates Calcium oxalate. Distilled water rinse is therefore preferable. The Potassium oxalate combines with Calcium carbonate of shells forming insoluble Calcium oxalate, thus preventing their dissolution. 2% formaldehyde in sea water with Calcium carbonate added to saturation is found to be another satisfactory preservative. The excess Calcium carbonate in the preservative can neutralise the acidity and also saturate it to prevent dissolution of calcit in shells. Neutralised formaldehyde is added to specimen tubes to avoid excess Calcium carbonate settling on shells. For maintaining a pH between 7·0 and 7·5, it is necessary to change the preservative once in 6 months. At low pH, owing to its acidity, Calcium carbonate in the shells tend to dissolve. At higher pH (above 8·0) calcareous plankton disintegrate because of the swelling and gelatinisation of protein binding the calcareous salts. Sea water, close to saturation in its calcium content and acting as a buffer, has less dissolution rate. This may explain why huge deposits of shells lie at the bottom of sea undissolved. Brittle nature of the shells is best prevented by the addition of a few drops of glycerine into the preservative.

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Cochin-18, Kerala, *September 13, 1973.*

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ON METHODS OF COLLECTION, HANDLING AND STORAGE OF ZOOPLANKTON IN TROPICS

INVESTIGATIONS undertaken to locate the factors causing damage and deterioration in zooplankton samples under tropical conditions (Balachandran, 1973) suggest the use of the following improved field and laboratory techniques for their better maintenance.

The plankton net with mesh size ranging from 150 μ to 500 μ is found to be the best as the larger mesh size of the gear causes damage to organisms due to increased flow of water, and the smaller size, due to clogging. The condition of the catch may be improved by lowering the speed of tow, by reducing the mouth area of the net and by increasing the area of the gauze. Hauls should be of short duration as long hauls which collect large amount of plankton may cause damage to the catch. The closed plankton buckets are preferrable to the one with a side window or a bottom filter in order to prevent frictional damage. The practice of hosing down the sides of the net with a strong jet of water must be discontinued to prevent rupture or loss of appendages to zooplankton. During transfer of plankton from the bucket o the fixative, exposure to air must be avoided to prevent formation of artefacts. The fixation has to be carried out without delay to prevent histolysis and bacterial growth. The volume of plankton to that of fixative should be in the ratio 1 : 9. Plankton must be preserved in previously numbered plastic bottles or translucent, strong, elatively unbreakable and if possible impermeable styrene jars having phenolic cap with plastic coated liners with suitable labels. Against the sample number all relevant data shall be entered in the log book. It is advisable to fill the containers completely to avoid sloshing of organisms. Separate hauls must be made for different purposes rather than splitting the same sample. Plankton samples for biochemical studies and biomass estimations are best preserved by freeze-drying. For minimal mechanical damage of the organisms, lengthy cruises must be avoided. During transport to the laboratory and on board the ship, detention of samples at improperly ventilated, warm and humid custom warehouses and on the deck for lengthy periods are best avoided.

When subsampling is inevitable, tap water should not be used without sufficient preservative so as to prevent initiation of bacterial activity and osmotic damage. Measurement of biomass by the method of displacement volume is not advisable since, during this process, the removal of interstitial fluids by shaking, blotting, filtration, etc., are found to cause damage to zooplankton. Use of plankton fractionators and dividers for subsampling may be kept to the minimum. During sorting, exposure to air must be considerably reduced. In tropics, as the laboratory temperature rises upto 32° C, formaldehyde evaporates causing irritation and unpleasant vapours. This can be substituted with 0·5%