

Spatio-temporal variation in some physicochemical and phytoplankton parameters were investigated at Turkwel Gorge Reservoir and its inflowing and outflowing rivers between 1994 and 1995. Seasonal variation in inflow volume had the most impact on the reservoir conditions investigated. A wide difference between wet and dry season inflow volume had the most impact on the reservoir conditions investigated. A wide difference between wet and dry season inflow volume combined with a regulated outflow independent of season resulted in a drawdown of over 10m in each year. Reservoir Secchi depth ranged from 0.09m (wet season) to 2.80 m (dry season). Low levels resulted from turbid flood inflows. Electrical conductivity (EC,  $\mu\text{S cm}^{-1}$ ) varied from 140-200 (reservoir), 107-210 (inflowing river) and 155-200 (outflowing river). Total alkalinity (TA, as  $\text{mg l}^{-1} \text{CaCO}_3$ ) ranged from 80-111 (reservoir), 62-125 (inflowing river) and 80-113 (outflowing river). Low levels of EC and TA were observed during the wet season. A functional relation between EC and TA ( $\text{TA} = 0.529 \text{ EC}$ ;  $R^2 = 0.876$ ) was established suggesting a predominance of carbonates among the anions. Variations in pH were from 6.7-8.9 (reservoir), 1.8 - 8.2 (inflowing river) and 0.4 - 6.4 (outflowing river). High pH and DO levels at the reservoir were observed during the wet season and were the result of higher phytoplankton photosynthesis. Floodwater inflow and hypolimnetic oxygen depletion possibly brought about low levels of pH and DO at the beginning of the wet season in the inflowing and outflowing river sections respectively.

Detectable levels of nitrite nitrogen ( $\text{NO}_2\text{-N}$ ) were noted at all study sites during the wet season. Nitrate nitrogen ( $\text{NO}_3\text{-N}$ ,  $\mu\text{g l}^{-1}$ ) varied from 6.7-111.1 (reservoir), 53.3-482.2 (inflowing river) and 8.9-111.1 (outflowing river). Total nitrogen (TN,  $\mu\text{g l}^{-1}$ ) ranged from 119-526 (reservoir), 205-3354 (inflowing river) and 82-624 (outflowing river). Phosphate phosphorus was mostly undetectable. Total phosphorus (TP,  $\mu\text{g l}^{-1}$ ) ranged from 8.9 -71.6 (reservoir), 101.8-1259.4 (inflowing river) and 8.6-31.3 (outflowing river). Variation in  $\text{NO}_3\text{-N}$  was mostly irregular except for a wet season increase at the inflowing river. In general, TN and TP showed a wet season increase explicable by an increase at the inflowing river loading. Dissolved reactive silica (DRS,  $\text{mg l}^{-1}$ ) varied from 0.41 to 9.77 (reservoir), 9.01-19.93 (inflowing river) and 5.07-9.77 (inflowing river). Reservoir DRS showed a wet season decline that had an inverse correlation to total diatom biomass ( $P=0.001$ ,  $n=12$ ). Estimates of input and output balance of  $\text{NO}_3\text{-N}$ , TN,  $\text{PO}_4\text{-P}$ , TP and DRS in 1994 revealed a reservoir areal loading rates of 5.98, 0.75, 10.90 and 408.5  $\text{mg m}^{-2}$  with a reservoir retention of 78, 74, 94, 95, and 46 percent respectively.

Reservoir chlorophyll a ( $\mu\text{g l}^{-1}$ ) ranged from 4.8 to 36.9 (1994) and 4.9 to 11.4 (1995) with coefficients of variation of 42% and 8% respectively. Greater variation in 1994 resulted from higher inflow volume. Outflowing river chlorophyll a ranged from 1.07 to 8.31  $\mu\text{g l}^{-1}$  with low levels resulting from reduced DO concentration. Positive correlation between mean reservoir chlorophyll a ( $n=13$ ) and inflow volume ( $P=0.007$ ),  $\text{NO}_3\text{-N}$  ( $P=0.04$ ), TN ( $P<0.001$ ), and TP ( $P<0.001$ ) was observed in 1994. A positive correlation with inflow volume ( $P=0.005$ ) and TN ( $P<0.001$ ) was observed in 1995.

Phytoplankton diversity (bits based on natural log) at the reservoir varied from 0.18 to 2.43 bits with an inverse correlation to total counts ( $P < 0.001$ ). Total counts ranged from 2.52 - 77.60 (1994) and 4.57-23.90 (1995) million units  $l^{-1}$ . Species density change varied from a distinct seasonality, through a wax and wane character to a nearly uniform density throughout the annual cycle. Throughout the study period, *Achnanthes* exhibited a distinct seasonality, characterized by a very high cell count during the wet season and very low counts during the dry season. However, the reservoir peak density in 1994 ( $75.6 \times 10^6$  cells  $l^{-1}$ ) was much higher than in 1995 ( $3.7 \times 10^6$  cells  $l^{-1}$ ). The majority of the other species exhibited a wax and wane pattern with greater amplitude in 1994. Dominance in unit counts varied throughout the study period. In 1994, while the dry season was characterized by a quick succession in dominance, *Achnanthes* dominated the wet season. Coccoid Cyanophyceae dominated most of 1995. Phytoplankton density changes at the outflowing river followed a pattern close to that of the reservoir with lower unit counts.

Total phytoplankton biomass ( $mg\ l^{-1}$ ) at the reservoir ranged from 0.44-11.17 (1994) and .49-1.35 (1995). Positive correlation between phytoplankton biomass and the loading rates of  $NO_3-N$  ( $P=0.009$ ), TN ( $P=0.040$ ), TP ( $P=0.011$ ) and DRS ( $P=0.033$ ) was established in 1994 suggesting the reliance of biomass increase on inflow nutrient recharge. Among the phytoplankton divisions represented, only the Bacillariophyceae showed a regular wet season peak biomass that can be explained by their dependence on the nutrient rich turbulent inflows of this season. Variation in the other divisions was less regular with peak biomass levels at different times of the intervening period. The Bacillariophyceae contributed biomass in both 1994 (88%) and 1995 (40%). Outflowing river phytoplankton biomass changes (range, 0.27-6.72  $mg\ l^{-1}$ ) showed a positive correlation to reservoir phytoplankton biomass ( $P < 0.001$ ) suggesting that the reservoir is the source of downstream flora. Reservoir primary production ranged from 1.85-9.67 (1994) and 3.00-5.41 (1995)  $g\ O_2\ m^{-2}\ day^{-1}$ . High rates were characteristic of the wet season while low rates occurred during the dry season especially following an overturn. High inflow volumes therefore transform the reservoir that is on average mesotrophic to a hypereutrophic state while low inflow volumes or mixing reduce the reservoir that is on average mesotrophic to a hypereutrophic state while low inflow volumes or mixing reduce the reservoir to an oligotrophic state.