

Ecological impacts of small dams on South African rivers

Part 1: Drivers of change – water quantity and quality

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Abstract

Impacts of large dams are well-known and quantifiable, while small dams have generally been perceived as benign, both socially and environmentally. The present study quantifies the cumulative impacts of small dams on the water quality (physico-chemistry and invertebrate biotic indices) and quantity (discharge) of downstream rivers in 2 South African regions. The information from 2 South African national databases was used for evaluating the cumulative impacts on water quality and quantity. Physico-chemistry and biological data were obtained from the River Health Programme, and discharge data at stream flow gauges was obtained from the Hydrological Information System. Multivariate analyses were conducted to establish broad patterns for cumulative impacts of small dams across the 2 regions – Western Cape (winter rainfall, temperate, south-western coast) and Mpumalanga (summer rainfall, tropical, eastern coast). Multivariate analyses found that the changes in macroinvertebrate indices and the stream's physico-chemistry were more strongly correlated with the density of small dams in the catchment (as a measure of cumulative impact potential) relative to the storage capacity of large dams. T-tests on the data, not including samples with upstream large dams, indicated that the high density of small dams significantly reduced low flows and increased certain physico-chemistry variables (particularly total dissolved salts) in both the regions, along with associated significant reductions in a macroinvertebrate index (SASS4 average score per taxon). Regional differences were apparent in the results for discharge reductions and the macroinvertebrate index. The results suggest that the cumulative effect of a high number of small dams is impacting the quality and quantity of waters in South African rivers and that these impacts need to be systematically incorporated into the monitoring protocol of the environmental water requirements.

Keywords: cumulative impacts, regional comparison, macroinvertebrate indices, measures of small-dam impact potential, average score per taxon