

An aquatic macroinvertebrate and chemical database for riverine ecosystems

Dallas HF^{1*}, Janssens MP² and Day JA¹

¹ Freshwater Research Unit, Department of Zoology, University of Cape Town, Private Bag Rondebosch 7700, South Africa

² Soft Craft Systems cc, PO Box 30169, Tokai 7966, South Africa

Abstract

A database has been developed comprising biological (macroinvertebrate) and chemical data derived from documented studies of riverine ecosystems within South Africa. The intrinsic variability of biotic and chemical components of these ecosystems has necessitated the adoption of a three-level hierarchical framework within which the biological and chemical data are accessed and queried. The primary level is the regional or geographic framework and includes water quality management regions, bioregions and political regions; the secondary level differentiates longitudinal components or subregions and the tertiary level is the site. Biological data, as percentage abundance, are given for each biotope sampled. The associated chemical data, standardised into SI units, are given for each site. The South African Scoring System (SASS), which is a rapid bioassessment method used to detect water quality impairment in riverine ecosystems, has also been incorporated to enable an estimate of water quality impairment to be established based on historical data. An outline of the querying frameworks is given and uses and potential problems of the database are discussed.

Introduction

Research on the ecological aspects of rivers in South Africa began in the early 1950s (e.g. Harrison and Elsworth, 1958; Scott, 1958) and was followed by a number of studies in the 60s (e.g. Allanson 1961; Harrison and Agnew, 1962; Chutter, 1963; Hughes, 1966; Chutter, 1967; Brand et al., 1967; Allanson, 1968; Forbes, 1968; Archibald et al., 1969), 70s (e.g. Kemp et al., 1976; Coetzer, 1978; Fowles et al., 1979), 80s (e.g. Fowles, 1984a; 1984b; O'Keeffe, 1985; Coetzer, 1986) and 90s (e.g. Palmer and O'Keeffe 1990; Brown, 1993; King and Tharme, 1994; Dallas, 1995). Many recent studies utilise historical data from earlier studies which enable comparisons of biological and/or chemical data between current and historical conditions to be made and the degree of change, in for example, water quality, to be ascertained. Availability and accessibility of documented studies are often problematic since much of the early work was published in reports that are presently not readily available.

The compilation and development of the aquatic macroinvertebrate and chemical database (BioBase) have taken place over the last five years. Initially, the intention was to utilise these data to assist in the construction of water quality rating curves for use by the Department of Water Affairs and Forestry (DWAF). Subsequently this objective became inappropriate and it became clear that the development of a database derived from biological (macroinvertebrate) data and which included relevant chemical and physical parameters of the associated water body, would provide useful information for ascertaining the characteristics of water bodies with respect to both biota and water chemistry. Subsequent advances in associated projects and the initiation of the national biomonitoring programme for riverine ecosystems reinforced the potential usefulness of such a database, and led to a number of other features such as incorporation of spatial scales (e.g. bioregions, water quality management

regions, subregions etc.) and data related to SASS (South African Scoring System). One of the most important aspects of the database is that it enables the linking of biological and chemical variables on both spatial (data collected from the same place) and temporal (data collected at the same time) planes.

Sources of data

The database has been constructed using data pertaining to South African rivers and extracted from most of the available literature and unpublished reports, in which biological and chemical data were collected concurrently (**Appendix 1**). Most of the biological data that are available relate to the benthic invertebrate fauna, although some work has been done on fish. This bias is probably a result of the early recognition of the fact that the benthic fauna provides an easy and fairly reliable way of assessing pollution (Chutter, 1972). Records of the invertebrate riverine fauna thus form the biological component of this database. These data include those from intensive studies of individual systems (e.g. Harrison and Elsworth, 1958; Chutter, 1963; 1967), extensive one-off surveys of regions (e.g. Kemp et al., 1976), *ad hoc* surveys (e.g. Harrison and Agnew, 1960; 1962) and impact assessment reports (e.g. O'Keeffe, 1987; 1989). Thus far 43 studies, of which 40 had associated chemical data, have contributed to the biological records of the database. It is intended that updating of the records from fresh sources will be an ongoing exercise. Details of the history and source information for the database have been previously documented (Dallas et al., 1995; 1998).

The chemical data were extracted from the same literature sources as the biological data, but vary between studies in terms of the number of variables analysed. The main criteria for the inclusion of chemical data have been the exact or approximate coincidence of these measurements with those of the relevant invertebrate biological details. Suffice it to say that a total of 140 000 biological records have been entered into the database thus far, and most are accompanied by records of chemical conditions (between 1 and 48 chemical variables covered in each

* To whom all correspondence should be addressed.

☎ (021) 650-3603; fax (021) 650-3301; e-mail hdallas@botzoo.uct.ac.za
Received 5 June 1998; accepted in revised form 3 September 1998.