3.3.6 Identification of environmental variables for future predictive systems

Riverine ecosystems are extremely complex systems composed of a multitude of abiotic factors (e.g. water chemistry, geomorphology, flow) which interact with one another and with the biotic components (e.g. algae, invertebrates, fish). Changes in one or more abiotic component are often reflected as a change in one or more biotic component. Linking "cause" and "effect" of a change is however problematic. A technique whereby abiotic or environmental variables responsible for differentiating between observed biotic groupings has been used in the United Kingdom and Australia. Environmental variables are used in predictive systems such as RIVPACS (Wright 1995) and AusRivAS (Smith *et al*. 1999), in order to enable prediction of a target or expected faunal community against which a test community can be compared. The prediction system is heavily dependent on the strength of the relationship between the biological and environmental attributes of the reference sites. Stratification of reference sites on the basis of geographical and other factors is therefore critical so that variability between reference sites is reduced. This is achieved by identifying environmental variables which provide the maximum discrimination between the faunal groups and which therefore become the predictor variable(s). Such predictor variable(s) must describe, either directly or indirectly, the habitat of the stream pertinent to the invertebrate community, be relatively easy to measure, and be unaffected by disturbance (Bailey *et al*. 1998). Table 3.2 lists those environmental variables used in the United Kingdom and Australia in the generation of their predictive models.

Although the RHP was not developed along the lines of the RIVPACS or AusRivAS systems, it is likely that including such analyses in the future would be of enormous benefit to the RHP and biomonitoring in South Africa in general. The protocol for the collection of reference condition data (Dallas 2000) was developed with the view to ultimately using the data collected to develop a system along the lines of AusRivAS. Again, it needs to be emphasised, that to achieve this, the data collection protocol needs to be adhered to. In the current project, a set of variables which best discriminate between sites will be identified, and predictive modelling explored.

3.4 DATA STORAGE: THE RIVERS DATABASE

To encourage standardisation of data collection and facilitate future access to the data, a database storage system has been developed. The Rivers Database (Fowler *et al*. 2000) incorporates all the components included in the ecological reference condition field-manual (Dallas 2000). In addition, two other components, namely the Riparian Vegetation Index (RVI, Kemper 1999) and Fish Assemblage Integrity Index (FAII, Kleynhans 1999), are included. The Rivers Database is a dynamic system, aimed at incorporating the needs of RHP practitioners and technological advancements in the RHP. As such it is continually being tested and improved, and its ongoing development forms part of the new "Anchoring Phase" of the RHP. It is hoped that by 2003 all provinces will have an active RHP programme and will be capturing data into the Rivers Database. The database is the main vehicle chosen to facilitate future advances in the RHP in terms of ecological reference conditions and the development of predictive modelling.

Table 3.2 Environmental variables identified in previous studies as predictive variables used in the development of models.

Variable Type	Variable	References					
		1	2	3	4	5	6
Catchment variables	Latitude			✓	✓		✓
	Longitude			✓		✓	✓
	Altitude[1]	✓		✓		✓	✓
	Slope[1]						✓
	Distance from source[1]	✓	✓	✓		✓	✓
	Upstream catchment area[1]	✓	✓				
Site variables	Mean stream width[1]		✓		✓		✓
	Mean stream depth[1]			✓			✓
	Maximum depth[1]				✓		
	Discharge category			✓			✓
	Flow pattern			✓			
	Maximum velocity				✓		
Habitat variables	Substratum: diversity					✓	
	Substratum: mean						✓
	Substrate diversity: reach		✓				
	Substrate diversity: riffle		✓				
	% silt				✓		
	Biotope/habitat: diversity		✓				
Water chemistry variables	Conductivity[1]					✓	
	Alkalinity[1]				✓		✓
	Mean air temperature						✓
	Air temperature range						✓
Factors included for separate model development	Biotope/habitat*			✓		✓	
	Season*		✓	✓			✓
	Year*	✓					

* : Separate models were developed taking the marked variables into consideration;

[1]: Data were log transformed.

References: **1**. Bailey *et al.* 1998; **2**. Linke *et al*. 1998; **3**. Smith *et al*. 1999; **4**. Reynoldson *et al.* 1997; **5**. Marchant *et al*. 1997; **6**. Wright 1995.