

# The geographical distribution of Ephemeroptera, Trichoptera, Coleoptera and Diptera in South Africa, Lesotho and Swaziland

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## Introduction

To the best of our knowledge, this is the first comprehensive study of the distribution of aquatic invertebrates in South Africa. Previous maps included those in Picker *et al.* (2002) of selected insect families drawn mostly from existing museum and literature records. Those distribution maps gave a broad indication of where the insects are likely to occur but were not intended to indicate precise and total distribution Picker *et al.* (2002).

In the past, distribution records of aquatic insects were constructed largely from collections of the terrestrial adult stages (Sutcliffe, 2003), although larval specimens provide a more accurate picture of where species are breeding and spend the majority of their lives. However, the use of larval specimens has the disadvantage that the information on taxonomy is often lacking and many recognised larval types have not been associated with adult species (Sutcliffe, 2003). The start of more systematic surveys of South African rivers with the development of the South African Scoring System (SASS: Chutter, 1998) and the subsequent development of the National Rivers Database to store the data (DWAF, 2007), support the development of more comprehensive distribution maps of aquatic invertebrates, at least at the family level.

The distributions of the families within the orders of Ephemeroptera, Trichoptera, Coleoptera and Diptera occurring in South Africa are presented, based on information obtained from several sources: Samples collected for a study to determine the environmental requirements of the aquatic stages of these families, the Rivers Database and the Biobase database (Dallas *et al.*, 1999). In addition to the data available from the Rivers Database, distribution records of the Coleopteran family Ptilodactylidae, which is not on the SASS datasheet but which has been recorded regularly in the Western and Southern Cape, were obtained from regional staff of the Department of Water Affairs in the Western and Eastern Cape. Historical records from the Freshwater Invertebrate Collection were also obtained from the Albany Museum in Grahamstown (AMGS, 2014). The majority of the information is from the national Rivers Database, so only families monitored under SASS, with the exception of Ptilodactylidae, are reported here.

Historical collections of aquatic invertebrates in South Africa, as elsewhere in the world, have been sporadic and patchy with some locations thoroughly sampled and others not at all.

## Methods

The results from the AMGS database were filtered to extract only results from South Africa, Lesotho and Swaziland. Only geo-referenced data records are included. The records were then plotted on Google Earth to ensure that all records plotted within the boundaries of South Africa, Lesotho and Swaziland. The locations outside the borders of South Africa, Lesotho and Swaziland were then checked against the descriptions and where possible the coordinates were corrected. Common geo-referencing errors included the transposing of latitudes and longitudes and the incorrect transcription of degrees, minutes and seconds or decimal degrees. The results from the different sources were filtered using a spreadsheet for each of the families and duplicate sites were removed. We used a script written in R (R Core Team, 2014) with packages XLConnect (Mirai Solutions GmbH, 2014) and maptools (Bivand and Lewin-Koh, 2014) to read spreadsheets containing family data and produce maps of distribution. Transparent symbols give an idea of data density: where many records were available, the overlapping symbols are darker.

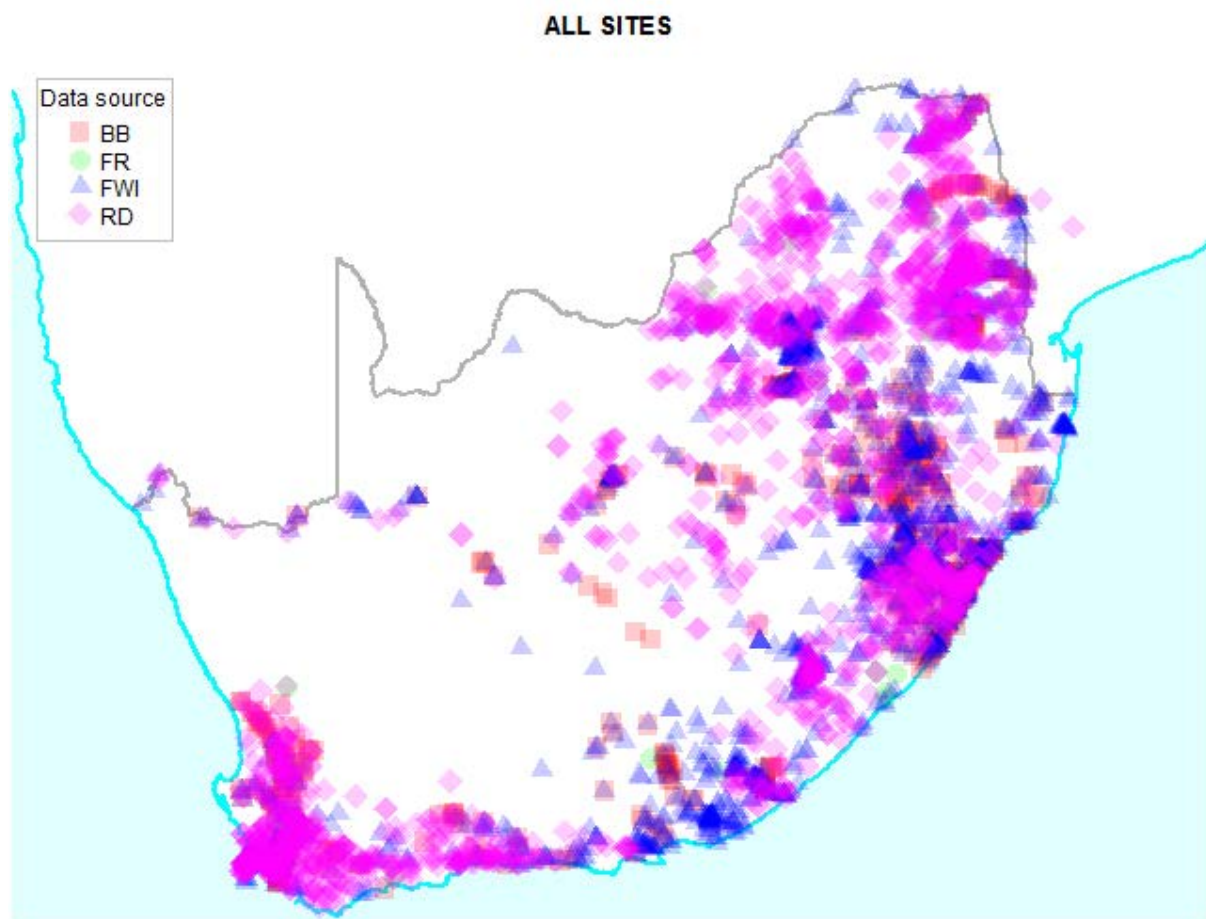


Figure 1. Distribution of all sampling sites used in this study. Data sources: Biobase (BB), Invertebrate Flow Requirements Study (FR), Albany Museum Records (FWI) and the Rivers Database (RD).

## Results

The map of sampling sites shows a reasonable spread over the majority of South Africa, except the very dry regions in the Karoo, Northern Cape and extreme north western areas (Figure 1). The

updated distribution ranges of the 50 families in the four orders are available as maps and as Google Earth overlays (<https://www.dwa.gov.za/iwqs/biomon/inverts/invertmaps.htm>). The only level I Ecoregion not sampled is the Namaqua Highlands located in the dry western part of the country (Kleynhans *et al.* 2005). Sites were present in all the geomorphological zones associated with the normal profile described in Rowntree and Wadeson (2000). The geozones were obtained from Google Earth overlays created from river long profiles (Moolman 2008).

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