Dragonflies as indicators of aquatic ecosystem health

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Manual of freshwater assessment for South Africa: Dragonfly Biotic Index

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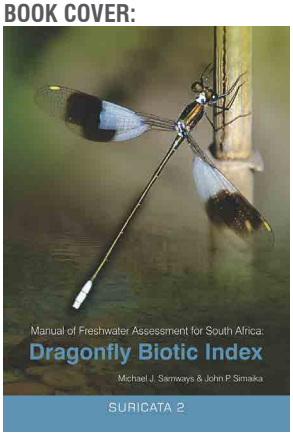

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Fresh waters are the most threatened ecosystems in the world. In South Africa, water abstraction, alteration of riverine ecosystems through dam building, inter-basin water transfer, introduction of alien aquatic organisms and organic and industrial pollution have left few freshwater ecosystems in a natural state. Because of their size and interesting behaviour, dragonflies and damselflies (Order: Odonata) are considered to be the most charismatic of all aquatic insects. They have attracted the attention of amateur societies and clubs in the Americas, Europe and Japan. In South Africa, the study of dragonflies has been well established scientifically through the works of pioneering entomologists such as Elliot Pinhey and Boris Balinski. Warwick and Michelle Tarboton have done much to transform this information on South African Odonata to a more popular media through the production of several guides and fold-out identification guides. Michael Samways and John Simaika now take this one step further in developing an index that uses the identification of Odonata to species level, to assess and monitor the health of aquatic ecosystems.

Of the 162 recorded species of Odonata in the book, about 20% are endemic to South Africa and these species require special conservation efforts to ensure their survival. There are also sufficient numbers of species that show strong preferences for narrowly defined aquatic and riparian biotopes, which allows for the identification and refined description of species-specific habitats. Odonata are considered to be good indicators of environmental health and water quality because all the species within this order are dependent on water for the development of their pre-adult stages (commonly known as nymphs, naiads or larvae). With a wealth of research information and good distribution records of these insects, the concept of using dragonflies as surrogate indicators of the conservation status of the immediate environment where these insects are recorded, was evaluated by the authors. This resulted in the development of the Dragonfly Biotic Index (DBI).

The emphasis of the DBI is on identification of adult dragonflies and damselflies to species level. At the species level, the range of climatic and environmental conditions can be accurately assessed and a tolerance value for each species can be defined. This assessment is not possible when dealing with genera or families which comprise large numbers of species, some with very different and non-overlapping ecological requirements.

To calculate the DBI, each species is given a value (between 0 and 9) based on scores ranging from 0 to 3 derived for each of three sub-indices. The first sub-index evaluates the geographical distribution range of a species. A rare, narrowly distributed endemic species would score the highest value of 3 and a widespread common species would score 0. The second sub-index is based on the threatened status of a species and the five red-list categories developed by the International Union for Conservation of Nature, which range from Critically Endangered to Least Concern status. Global or national evaluations are used to allocate a value from 0 to 3 for each species. The final sub-index relates to the sensitivity of a particular species to anthropogenic disturbance of its natural habitat, such as alien invasive riparian vegetation, water pollution or abstraction. Species found in pristine undisturbed sections of river are given a score of 3, whereas species tolerant of disturbance would get a score of 0 or 1. The DBI can be used for assessing environmental health and conservation status of aquatic ecosystems or for monitoring changes that occur over time.

The habitat condition scale – a metric derived from the DBI – is used to assess the status of the 'biotope diversity' in an ecosystem. To develop this metric, at least 20 sites in an ecoregion need to be comprehensively evaluated for DBI scores. The total DBI value per site (summed DBI values of all species) is plotted against the average DBI value per site (total DBI/number of species). This plot is then used to select the top 10% of sites that qualify for the highest biotope diversity classification. An example is given for the SE Coastal belt ecoregion in which DBI scores higher than 46 and average DBI scores greater than 5.4 rank as the highest biotope diversity category whereas DBI scores lower than 25 and average DBI scores less than 3.5 rank as the lowest.

The book is well laid out and the authors explain in detail how each species' DBI is calculated and how the combined values for all species recorded at a site are used to obtain a DBI site score. The equipment needed to undertake a DBI survey is listed, and the optimal conditions for when and how surveys should be undertaken are clearly explained. In more sub-tropical realms, a minimum of two visits on warm, humid days during the late spring to autumn should cover the majority of species at a site. These visits do not need to be evenly spaced in time and can take place within a month. It is noted, however, that in the cooler southern and southwestern Cape, a survey during late spring to early summer and another one in late summer should be undertaken as there are distinct early- and late-season species in that region. The book also includes a wealth of valuable information on each species in tables, which include species distribution in all 31 ecoregions, the national and global red-listed status for each species and all sub-indices and the final DBI score for each species. At the end of the book there is also an alphabetical checklist of all taxa in the 10 recorded Odonata families.

There is a detailed full-page description for each species, with large, clear distribution maps, DBI scores and red-list threat status, as well as colour photographs of all species indicating diagnostic identification features and line drawings highlighting features useful for identification. For each species, a common vernacular name and the detailed binomial taxonomic name (including name and date of authority originally describing the species) are given. It is a pity that the authors did not include a key or some guide to help identify and separate the different families and genera. I recommend that readers acquire a copy of one of the identification guides produced by Tarboton and Tarboton[1-4] or Samways[5] in order to identify the species.

The authors explain that the 31 ecoregions of South Africa used to record dragonfly distribution ranges are based on terrestrial rather than aquatic ecoregions. This is not entirely correct because the original publication[6] defines these ecoregions as 'Level 1 River Ecoregions' based on physiography, climate, geology and soils, potential natural vegetation, and hydrology. These 31 ecoregions also differ somewhat from the 35 bioregions[7] which are based mostly on terrestrial plant communities. A comparison of the DBI with the SASS5 (South African scoring system version 5) Biotic Index to explain that these indices can be interchangeably used is not warranted. The SASS Biotic Index was exclusively designed and refined for assessing water quality in rivers from a large database of water quality and macroinvertebrate distribution data, gathered throughout South Africa over many years. SASS is largely based on the original Chutter's Biotic Index[8] that used detailed species identification and abundance enumeration of taxa. This biotic index approach was simplified for SASS to require only family-level identification and relative abundance of aquatic invertebrates collected in a specific manner from selected biotopes in a river.[9] The SASS protocol enabled practitioners to perform a survey of water quality, based on the family identification of living invertebrates collected and evaluated directly in the field. The DBI actually complements the SASS Biotic Index because of the more exacting species identification and the more integrated aspect of evaluating the overall environmental quality and conservation status of the ecosystem under investigation.

I would recommend this book to anyone interested in dragonflies and damselflies, as well as to anyone needing information on the assessment of the ecological status, environmental health, conservation and management of freshwater ecosystems.

References

1. Tarboton W, Tarboton M. A fieldguide to the dragonflies of South Africa. Modimolle: privately published; 2002.
2. Tarboton W, Tarboton M. A fieldguide to the damselflies of South Africa. Modimolle: privately published; 2005.
3. Tarboton W, Tarboton M. South African dragonflies: A quick guide. Johannesburg: Graphic Touch Guides; 2009.
4. Tarboton W, Tarboton M. A guide to the dragonflies & damselflies of South Africa. Cape Town: Struik Nature; 2015.
5. Samways MJ. Dragonflies and damselflies of South Africa. Sofia: Pensoft Publishers; 2008.
6. Kleynhans CJ, Thirion C, Moolman J. A level 1 ecoregion classification system for South Africa, Lesotho and Swaziland. Report no. N/0000/00/REQ0104. Pretoria: Resource Quality Services, Department of Water Affairs and Forestry; 2005.
7. Rutherford MC, Mucina L, Powrie W. Biomes and bioregions of southern Africa. Strelitzia. 2006;19:31–51.
8. Chutter FM. An empirical biotic index of the quality of water in South African streams and rivers. Water Res.1972;6:19–30. https://doi.org/10.1016/0043-1354(72)90170-4
9. Chutter FM. Report on the rapid biological assessment of water quality impacts in streams and rivers. Report no. 422/1/98. Pretoria: Water Research Commission; 1998.