

A quantitative assessment of the biotic integrity of the Okavango River, Namibia, based on fish

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Abstract

This is the first calculation of an index of biotic integrity (IBI) for the Okavango River to quantitatively assess the biological status of the river. The assessment indicated a definite degradation of the biotic component of the Okavango River. Furthermore isolated problem areas were also identified such as habitat and trophic level degradation, increased pollution and reduced fish stocks at several localities along the river. Several measures were proposed to counteract this trend, to ensure a sustainable fisheries component of the Okavango River in future.

Introduction

The northern areas of Namibia, especially the Cuvelai System, the Okavango River and the Zambezi floodplains in the Caprivi have always been important regions for subsistence fishery (Van der Waal, 1976; 1991a; b; Van Zyl, 1992 and Tvedten et al., 1994). A major concern has been the possible depletion of the fish resource in the Okavango and Zambezi Rivers as a result of increased subsistence fishing due to the high population growth. Several other factors may also indirectly influence the fish stock, such as the effects of overgrazing, soil erosion, deforestation, siltation of the rivers, pollution and low floods. Fish are an important protein supplement in the diet of the people along the Okavango River and the perceived "shortage of fish" in the river is therefore of major concern (Tvedten et al., 1994). If historic data are insufficient to serve as a good baseline, it is difficult to determine whether fish abundance is declining, and if so, the reasons for it. For this reason an index of biotic integrity (IBI) was compiled to quantitatively express the present biotic status of the Okavango River.

An IBI based on fish was developed by Karr (1981) to assess the biological status of aquatic systems and is designed to incorporate all relevant information. Parameters used in the index are sensitive to several types of degradation, including sewage effluents, pollution by mining, runoff sediment, nutrients and toxic chemicals from agricultural lands, wood debris removal and habitat destruction (Fausch et al., 1990). Other indices which have been used in the past are:

- indicator taxa or guilds;
- indices of species richness, diversity and evenness; and
- multivariate methods (Fausch et al., 1990).

The disadvantage of using taxa indicators is that few guidelines are present for choosing appropriate taxa. It is, therefore, difficult to determine whether a species is sensitive to degradation solely on the basis of empirical evidence or whether other factors may have influenced it. When using species richness, diversity and evenness indices, the disadvantage is that the

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information conveys limited information on the fish community. The multivariate method requires a computer for calculation, statistical calculations as well as biological information to interpret.

A useful feature of the IBI is that direct observation is used which limits the possibility for errors. Although several taxonomic groups of organisms had been used for the IBI, such as aquatic macrophytes (Canfield and Jones, 1984), amphibians (Moyle et al., 1986) and macroinvertebrates (Schaeffer et al., 1985), freshwater fish in general is used in North America (Hocutt, 1985 and Karr et al., 1986). Freshwater fish is widely used for the following reasons:

- The taxonomic status and ecological aspects have been sorted out to a large extent.
- Freshwater fish occupies several trophic levels including the top of the food chain, and any disturbance in the system will be reflected by the fish.
- Freshwater fish occupies a variety of habitat and food niches.
- Direct observation can be done in the field.

Using fish as biological monitors, however, is not without problems. Sampling gear is selective and will affect the species richness as would the experience of the field team. The problem of sampling is best minimised by using a wide variety of sampling gear for the collection of data. During an assessment it is assumed that the sample represents the community. Therefore the sampling must be thorough to be representative of the fish community.

According to Herricks and Schaeffer (1985) biomonitoring should satisfy several criteria before it could be classified as valid for the assessment of a system. These criteria are as follows:

- The measure must be biological - The IBI meets this criterion as biological monitoring is done.
- Several trophic levels must be included - The IBI includes four trophic levels.
- The measure must be sensitive to the environmental conditions - The IBI includes the assessment of pollution, river flow and habitat degradation.
- The response range of the measure must be suitable for the intended application - The IBI is sensitive to small changes as well as to a broad range of conditions.