Ichthyofaunal assemblages in estuaries: A South African case study

Alan K. Whitfield

J.L.B. Smith Institute of Ichthyology, Private Bag 1015, Grahamstown 6140, South Africa (E-mail: a.whitfield@ru.ac.za)

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Abstract

This review places the life-history styles of fishes associated with South African estuaries in a global context and presents a classification system incorporating all the major life-history categories for estuary-associated fish species around the world. In addition, it documents the early life histories of the major fish groups in South African estuaries, with particular emphasis on the differing modes of estuarine utilization by marine, estuarine and freshwater taxa.

This review details factors influencing the ichthyofaunal community structure in South African estuaries. The availability of fish for recruitment into an estuary depends primarily upon the distributional range of euryhaline marine and estuarine species, with tropical and temperate taxa showing marked abundance trends. Within a particular biogeographic region, however, estuarine type and prevailing salinity regime have a major influence on the detailed ichthyofaunal structure that develops. There is an increasing preponderance of marine fish taxa when moving from a freshwater-dominated towards a seawater-dominated type of system, and a decline in species diversity between subtropical estuaries in the north-east and cool temperate systems in the south-west. Similar declines in fish species diversity between tropical and temperate estuaries in other parts of the world are highlighted.

Fish assemblages in estuaries adjust constantly in response to changing seasons, salinities, turbidities, etc. Despite persistent fluctuations in both the biotic and abiotic environment, the basic ichthyofaunal structure appears to have an underlying stability and to be predictable in terms of the response of individual species to specific conditions. This stability seems to be governed by factors such as the dominance of eurytopic taxa within estuarine assemblages and the robust nature of food webs within these systems. The predictability arises from factors such
as the seasonality associated with estuarine spawning cycles and juvenile fish recruitment patterns. These patterns, together with a well-documented resilience to a wide range of physico-chemical and biotic perturbations, appear to be an underlying feature of fish assemblages in estuaries around the world.

In contrast to marine fish species, estuary-associated taxa have received little conservation attention. Apart from the designation of protected areas, the main direct means of conserving estuary-associated fish stocks include habitat conservation and controls over fishing methods, effort, efficiency and seasonality. Of these, the conservation of fish habitats is the most important, because healthy aquatic environments invariably support healthy fish populations. The use of estuarine sanctuaries for fish conservation is briefly reviewed, as well as the legislation governing the USA National Estuarine Research Reserve System (NERRS) and the Australian Marine and Estuarine Protected Area (MEPA) system. It is concluded that South Africa requires an expansion of the existing Estuarine Protected Area (EPA) network, as well as the upgrading of selected ‘estuarine reserves’ where fishing is permitted, into ‘estuarine sanctuaries’ where no exploitation of biological resources is allowed.

Key words: aquatic conservation, estuaries, fish assemblages, life histories, South Africa, zoogeography

Introduction

Estuaries are regions where marine and fresh waters meet, where environmental gradients are steep, and where exceptionally high levels of primary and secondary production are often recorded (J.W. Day et al., 1989). These factors have a major influence on the density, diversity and biomass of fishes that can be supported in these systems. In particular, the often abrupt changes in salinity, water temperature, dissolved oxygen and turbidity place considerable physiological demands on the fishes that utilize estuaries. However, species that are broadly tolerant of biotic and abiotic variability are at a considerable advantage over those fishes that cannot survive such fluctuations, because the former group are able to occupy a food-rich environment from which many potential competitors are excluded (Whitfield, 1998).

In this review, the life-history styles and attributes of fishes utilizing subtropical and warm-temperate South African estuaries (Figure 1, Table 1) are examined and compared with ichthyofaunal assemblages elsewhere in the world.

It has been postulated by several authors (Blaber, 1981; Cooper et al., 1995) that South African estuaries are ecologically important because they provide the only significant sheltered areas for the juveniles of certain marine fish species. Potter et al. (1990) suggested that in contrast to the high-energy coastline associated with the African subcontinent, the southwestern Australian inshore marine waters are used as an alternative nursery habitat by many estuary-associated marine species owing to the physical protection afforded by fringing reefs and rocky headlands. Similarly, the embayments associated with many large North American and European estuaries provide protection, not only for resident estuarine fish species, but also for a wide range of marine taxa (Weinstein, 1985).

A variety of factors influence the utilization of South African estuaries by fishes (Whitfield, 1983; Blaber, 1985; Marais, 1988). Because no two estuaries are identical in terms of either biotic or abiotic characteristics, it could be postulated that the ichthyofaunas of each estuary will also differ. However, if the resident and marine migrant fishes respond to the environment in a consistent manner, then the communities occupying similar types of estuaries in a particular region would be expected to reflect this similarity. In the following sections, the fish assemblages from various types of estuaries in the different biogeographic regions (Figure 1) are reviewed and compared, and the importance of estuarine protected areas in achieving fish conservation goals is highlighted.

Life-history patterns

Apart from a few freshwater species, the fishes inhabiting South African estuaries may be divided into two major groups according to their ability to breed within the estuarine environment (Whitfield, 1990). The first group is dominant and comprises euryhaline marine species that spawn at sea. The second group spawn within the estuarine environment, although certain species may also breed at sea or in fresh water (Whitfield, 1998). For the purposes of this review, the former group has been classified as marine and the latter as estuarine. A similar division has been used