

Influence of habitat structure and mouth dynamics on avifauna of intermittently-open estuaries: A study of four small South African estuaries

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ABSTRACT

Habitat composition was a major factor in determining waterbird species composition and abundance, particularly the area of floodplain and vegetated channel in four intermittently open estuaries (IOEs) in the warm-temperate coastal biogeographical region of South Africa. Average bird densities on the four estuaries varied from 0.5 to 4.2 birds per hectare, and community composition differed significantly between estuaries. However, the considerable variation in abundance of macrophytes did not have a detectable effect on waterbirds. Under closed mouth conditions, piscivorous birds dominated the avifauna. Each estuary's avifauna responded differently in terms of changes in feeding guild composition when the mouth opened. Bird abundance changed immediately after breaching, but not consistently. Diversity was significantly higher under open-mouth conditions for three of the four estuaries, and species composition was significantly different from that under closed-mouth conditions at all four estuaries. Changes in mouth dynamics as a result of climate change, water abstraction and artificial breaching could lead to significant changes in estuarine fauna.

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1. Introduction

Estuaries provide important habitats for a number of waterbird species at global and national scales (Hockey and Turpie, 1999; Turpie et al., 2002; Calbrade et al., 2010), but the way in which they are used is influenced by their type, size and location. While most work on estuarine avifauna has taken place on large, permanently open systems which often attract large aggregations of birds relatively little is known about the avifauna of small, intermittently open or closed estuaries (Teroerde and Turpie, 2012). These estuaries occur worldwide and are the commonest type of estuary in South Africa.

There are 290 estuaries in South Africa, of which 70% are small systems that are closed for varying amounts of time (Lamberth and

IOE, intermittently open estuary; ICE, intermittently closed estuary; POE, permanently open estuary.

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Turpie, 2003; Harrison, 2004). These temporarily open/closed systems are termed either intermittently-open estuaries (IOEs), which are closed most of the time, or intermittently closed estuaries (ICEs), which are predominantly open to the marine environment. They are distinctly different from permanently open estuaries (POEs), due to the largely unpredictable temporal variation in habitat and food availability (Whitfield and Bate, 2007).

Small temporarily open/closed estuaries are not only in the majority in some areas, but are also understood to be relatively sensitive to changes in water supply and management interventions (Whitfield et al., 2012). Thus, it is important to understand the biodiversity in these systems in order to make informed management decisions. The main aim of this study was to investigate the avifauna of a variety of IOEs and identify factors influencing community composition and abundance. Specifically, the following key questions were addressed:

- What characterises the avifauna of intermittently open estuaries?
- How does habitat composition influence the bird community composition?

- How do bird abundance, community composition and diversity change with fluctuations in estuary mouth state and vegetation?

2. Materials and methods

2.1. Study site

This study was conducted at four intermittently-open estuaries along the Eastern Cape coast of South Africa, between the towns of Port Alfred (33°35'54"S, 26°53'39"E) and Hamburg (33°17'25"S, 27°27'42"E): the Riet (33°33'S, 27°00'E), West Kleinemonde (33°32'S, 27°02'E), East Kleinemonde 33°32'S, 27°03'E and Bira (33°22'S, 27°19'E) estuaries (Fig. 1). Rainfall in this area is not as seasonal as in other parts of the country (Stone, 1988). During the study period (2005–11), rainfall occurred in all months, with peaks in December 2005 and September 2006 and ranged from 7.6 mm in July 2006 to 209.2 mm in August 2006. Mean monthly air temperatures ranged from 7.9 °C in July to 26.7 °C in February (South African Weather Bureau). The catchments of the estuaries along this coast are mainly used for cattle and pineapple farming, and all of the estuaries have small resort developments on their lower banks and are used for recreational activities such as fishing, swimming and power boating.

The Riet estuary is largely supratidal and only shows tidal influence above the mouth when a deep channel is formed after very heavy rainfall. The West Kleinemonde estuary has large areas of floodplains (approximately 58.3 ha) which are inundated when water levels in the estuary are high. The mouth is generally more stable than the adjacent East Kleinemonde estuary and often remains closed for periods exceeding one year. Salinity in the estuary under closed conditions ranges from 5 to 10 in the upper reaches to 25–30 in the lower reaches. Water temperatures show a high variation with a summer range between 22 °C and 29 °C and a winter minimum of 12 °C (Cowley et al., 2003).

The East Kleinemonde estuary is mostly shallow with a main channel depth of 1–2 m (Cowley and Whitfield, 2002). Tidal influence can be strong after breaching events caused by large river floods which scour a deep channel in the mouth region. Between

1993 and 2006 the estuary was closed to the sea 74% of days, experienced overwash on 11% of days and was completely open on 15% of days (van Niekerk et al., 2008). The longest recorded period that the estuary was connected to the marine environment was 32 days in 2004. River base flow and tidal exchange in this system are insufficient to maintain open mouth conditions and the mouth generally closes a few days after river flooding has subsided (van Niekerk et al., 2008). Mean monthly salinity ranges from 0 to 25, depending on mouth condition and freshwater inflows (Cowley et al., 2003).

The Bira estuary was the largest of the four systems studied. It can stay open for extended periods of time (several weeks to months), but once closed, it usually remains so for several months.

2.2. Bird counts

2.2.1. Seasonal monitoring

All four estuaries were sampled from a motorised boat or on foot along their navigable length. Sampling was carried out from December 2005 until November 2006. Each estuary was divided into four regions and all water-associated birds encountered in each region were recorded. Terrestrial-feeding birds such as Black-headed Heron, Cattle Egret and Brown-hooded Kingfisher were excluded from the study. The status of each estuary mouth (open/closed) was recorded daily during the entire study period. Each estuary was counted one to three times per month on randomly-selected days over the period of one year, apart from during the period immediately after breaching, when counts took place every day for a week. A total of 110 waterbird counts were conducted of which 52 and 58 were carried out under open and closed estuary mouth conditions, respectively (Table 1). Summer was defined as November to April and winter as May to October, according to the presence or absence of the majority of Palearctic-breeding migrants.

2.2.2. Long term monitoring

Following the intensive first year of monitoring, summer and winter bird counts were conducted at the East Kleinemonde and West Kleinemonde estuaries until February 2011, over a period during which macrophyte cover was recorded in detail by Riddin (2011).

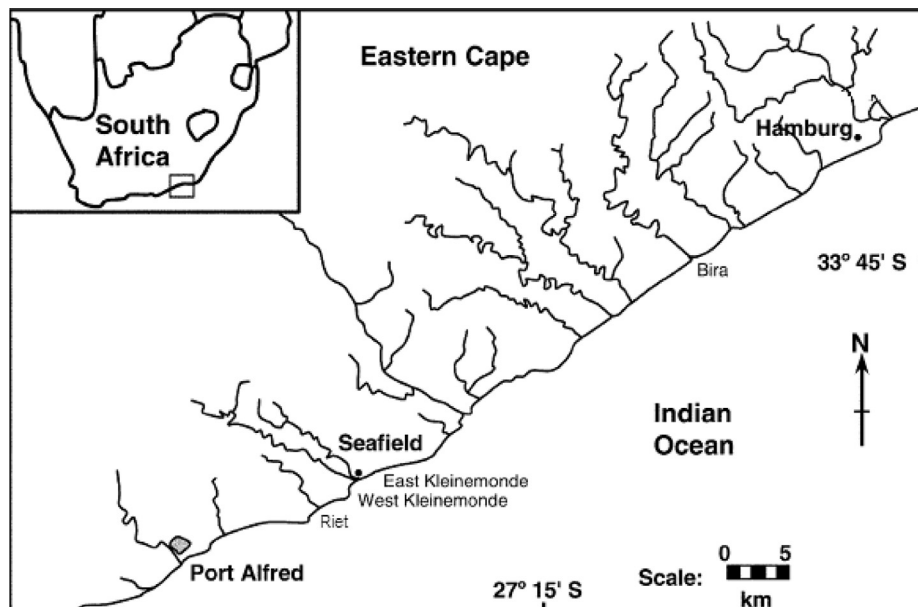


Fig. 1. Map of the study area and sampled estuaries (modified from Walton, 1984).

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