

# **Prioritisation of South African Estuaries Based on their Potential Importance to Estuarine- Associated Fish Species**

Prepared for the  
Water Research Commission

by

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## EXECUTIVE SUMMARY

The National Water Act of 1998 ensures that estuaries are regarded as a water resource, and are therefore subject to legislation regarding water resources. Consequently, the monitoring of estuarine water quality and quantity is important to maintain a desired level of structure and function within an aquatic ecosystem. Because biological communities are regarded as an integral component of the estuarine water resource, the prioritization of potential conservation areas are often necessary for the successful determination of aquatic reserve sites. This exercise, referred to as the 'Fish Importance Rating' (FIR), aims to prioritize South African estuaries in terms of their importance to estuarine-associated fish species. The FIR complements similar procedures undertaken for botanical and waterbird communities.

The FIR is based on a scoring system of seven criteria that are considered to reflect the importance of estuaries to estuarine-associated ichthyofauna. Scores are allocated to criteria, where factors that influence the estuarine fish community positively are allocated higher scores than those that influence fish communities negatively. Allocated scores within each criterion are subjected to various weighting factors, after which the products are added to generate a fish-based estuarine hierarchy.

This prioritization exercise presents a ranking of South African estuarine systems based on their importance to estuarine-associated fish species, and aims to facilitate the identification of South African estuaries with a high conservation priority, by placing all South African systems in a regional and national context.

## TABLE OF CONTENTS

<b>1. Introduction.....</b>	<b>1</b>
<b>2. Methods.....</b>	<b>2</b>
2.1. Species Importance .....	2
2.1.1. Estuarine-Ichthyofaunal Distribution Database .....	2
2.1.2. Species Richness.....	3
2.1.3. Endemic Richness .....	3
2.1.4. Exploitable Richness.....	3
2.2. Estuarine Importance.....	8
2.2.1. Estuarine Type .....	8
2.2.2. Estuarine Size .....	8
2.2.3. Estuarine Condition.....	9
2.2.4. Estuarine Isolation.....	9
2.3. Estuarine Ranking .....	10
2.3.1. Score Allocation .....	10
2.3.1.1. Continuous Data.....	10
2.3.1.2. Categorical Data.....	10
2.3.2. Weighting .....	13
2.3.3. Ranking.....	13
<b>3. Results.....</b>	<b>15</b>
3.1. Species Importance .....	15
3.1.1. Estuarine Ichthyofaunal Research Effort.....	15
3.1.2. Species Richness.....	15
3.1.3. Endemic Richness .....	15
3.1.4. Exploitable Richness.....	16
3.2. Estuarine Importance.....	18
3.2.1. Estuarine Size.....	18
3.2.2. Estuarine Type .....	19
3.2.3. Estuarine Condition.....	20
3.2.4. Estuarine Isolation.....	20
3.3. Estuarine Ranking .....	23
<b>4. Recommendations .....</b>	<b>28</b>
References.....	29
Appendix A.....	30
Appendix B.....	41
Appendix C.....	47
Appendix D.....	54

## 1. INTRODUCTION

Estuaries, like many other types of wetlands, are under long-term threat of damage and destruction. In an attempt to minimise ecological deterioration, while facilitating optimal utilisation of South Africa's water resources, the National Water Act of 1998 ensures that, as is the case with fresh water, the estuarine environment is regarded as a water resource and not a user of water. This allows for an 'environmental' or 'ecological reserve', which requires the implementation of 'Resource Directed Measures' (RDM) for effective estuarine management and protection. Because, in terms of the new Act, estuaries are subject to legislation regarding water resources, the maintenance of a national estuary water resource monitoring program is necessary to determine the quantity and quality of water required to maintain a desired level of structure and function within an aquatic system. Biomonitoring is particularly important in this regard, because biological communities are regarded as an integral element of the estuarine water resource.

By making use of available information, this report aims to propose a ranking of South African estuaries in terms of their importance to estuarine-associated fish species. This will provide a prioritization that includes all functional South African estuaries, and will complement similar procedures undertaken for botanical (Coetzee *et al.* 1997, Colloty *et al.* 2000) and waterbird (Turpie 1995) communities. This prioritization exercise may be particularly relevant where RDM are concerned because it potentially allows for the incorporation of an estuarine ichthyofaunal index into biodiversity importance scores required by RDM management procedures. Because the maintenance of a natural range of dynamic states within estuaries is vital for proper estuarine functioning (Heydorn 1989, Whitfield and Bruton 1989), freshwater requirements of estuaries with high conservation priorities need to be met (Coetzee *et al.* 1996). This prioritization exercise aims to facilitate the identification of South African estuaries with a high conservation priority, by placing all South African systems in a regional and national context. A 'fish-based' prioritization of South African estuaries is highly relevant for estuarine reserve determination, because these systems play a vital role in the life cycles of many fish species, while some function as 'endemic sites' for various species (e.g. Whitfield 1995, 1996, 1997).

The prioritization of potential conservation areas, based on various selection criteria, may often be necessary for the successful determination of aquatic reserve sites (Turpie 1995). This prioritization process, referred to as the 'Fish Importance Rating' (FIR), incorporates 248 South African estuaries (from the Orange River mouth in the west to the Kosi estuary in the east) and forms the basis of this analysis (Figure 1).

## 2. METHODS

The FIR process is based on a scoring system of seven criteria that are considered to reflect the importance of estuaries to estuarine-associated ichthyofauna. The FIR process is illustrated in Figure 1, showing each of the seven criteria in black boxes with white font. These criteria may be divided into two primary components;

- a) Species Importance
- b) Estuarine Importance

Scores are allocated to criteria within the above components based on their importance to estuarine-associated ichthyofauna. Values that influence the estuarine fish community positively receive higher scores than those that influence fish communities negatively. After allocated scores within each criterion are subjected to various weighting factors, the products are added to generate a fish-based estuarine hierarchy (Figure 1).

### 2.1. Species Importance

The species importance component of the FIR incorporates ichthyofaunal distribution patterns throughout 248 functional estuaries along the South African coast. This component incorporates three criteria, namely species richness, endemic richness and exploitable richness. The number of species within each criterion, for each of the 248 estuaries is incorporated into the FIR. The number of species in each criterion within the species importance component is derived from a national estuarine-ichthyofaunal distribution database.

#### 2.1.1. Estuarine-Ichthyofaunal Distribution Database

Scientific publications and reports incorporating fish distribution and abundance records throughout South African estuaries were compiled to create a national 'estuarine-ichthyofaunal' bibliography (Appendix A). The bibliography, along with reliable, unpublished information received from local estuarine ichthyologists, were reviewed to create an 'estuarine-associated' ichthyofaunal distribution database which was used to describe the distribution of selected estuary-associated fish species in South African estuaries from the Orange River mouth in the west to the Kosi estuarine system in the east. The distribution database included;

- a) Qualitative records, where the presence/absence of species were considered, and
- b) Quantitative records, where only species that contributed to more than 1% of the total numbers caught of any catches were included.

According to estuarine-association categories defined by Whitfield (1994, 1998), species belonging to categories I, II and V were included in the analysis (Table 1). These categories include species that are estuarine residents and breed in estuaries (Category I), euryhaline marine species that usually breed at sea but whose juveniles show varying degrees of dependence on estuaries (Category II) and catadromous species that need estuaries as a link between freshwater and marine spawning or feeding habitats (Category V). Species belonging to association categories III and IV (marine stragglers and freshwater migrants, respectively) display no 'life-dependent' association with estuaries during any stage of their life cycle, and therefore were omitted from the study.

Literature regarding the distribution and abundance of ichthyoplankton in estuaries has been omitted from the review as the collection of samples was limited to only a few localities in the warm temperate and subtropical regions of South Africa.

#### 2.1.2. Species Richness

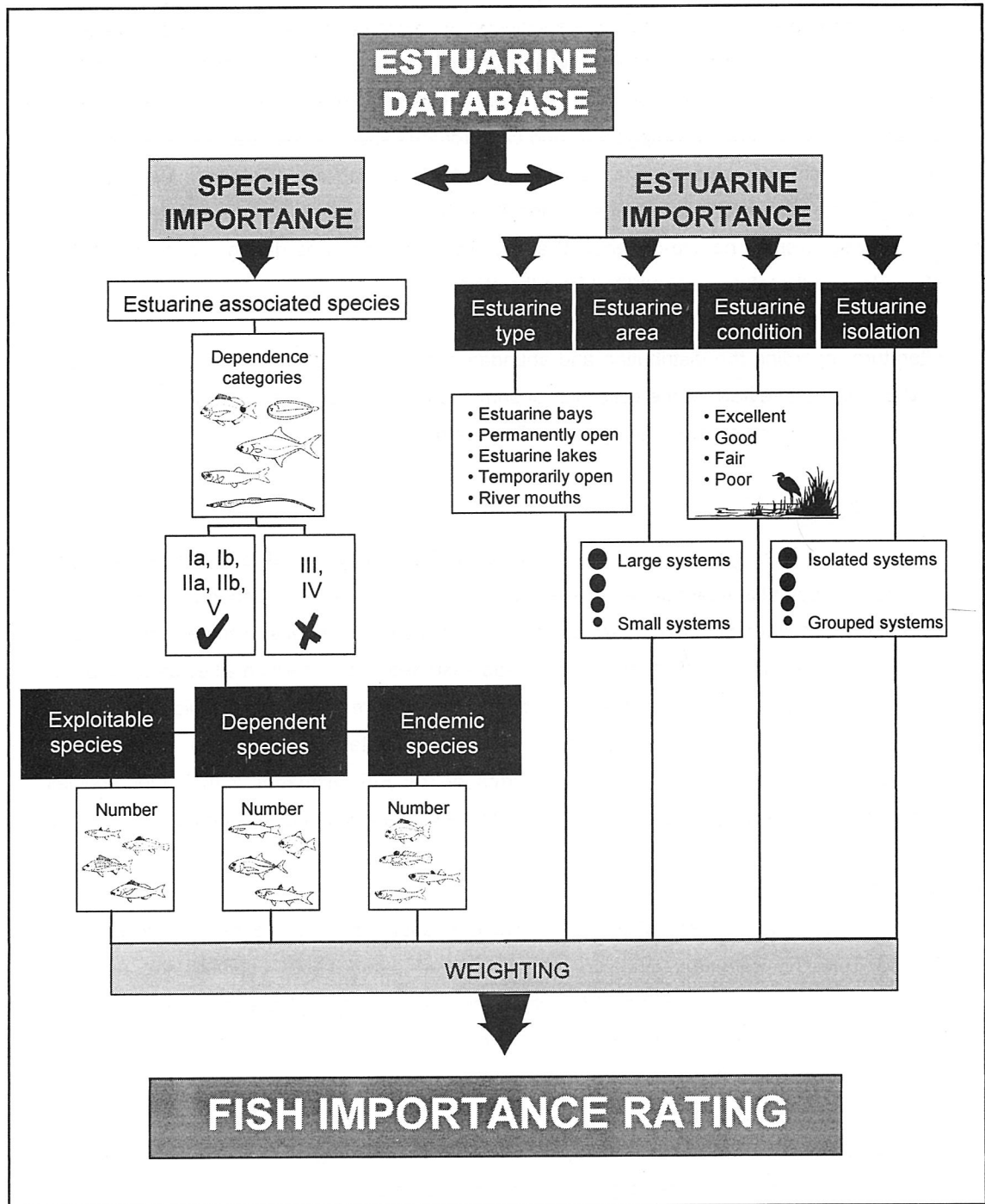
Fish distribution ranges derived from the estuarine ichthyofaunal distribution database provides the potential total number of species within each estuary included in the FIR. Due to the disparity of fish distribution data, a potential species richness was assumed for individual estuaries. When not recorded, any species was assumed to occur within all estuaries that fall between systems where the species had been recorded, regardless of individual estuarine characteristics. All species, therefore, occupied a potential distribution range within temperate and/or subtropical zones. In terms of the FIR, estuaries with higher species richness were considered more important than those with a lower species richness.

#### 2.1.3. Endemic Richness

The potential estuarine distributions of 30 (Table 1) southern African endemic species were derived from the estuarine ichthyofaunal distribution database to establish the endemic richness criterion. In terms of the FIR, higher estuarine endemic richness is considered more important than lower endemic richness, and therefore receives a higher score.

#### 2.1.4. Exploitable Richness

The exploitable richness criterion incorporated all species belonging to estuarine-association categories I, II and V that are targeted by commercial, recreational or subsistence fisheries. Because these species are exploited in one way or another, estuaries that provide them with habitats are considered more important than estuaries that do not. Species are incorporated whether they are primarily targeted in the marine or estuarine environment. A total of 57 species contributed to this criterion (Table 1).



**Figure 1.** Diagrammatic outline of the FIR process. Species importance and estuarine importance components include three and four criteria, respectively (black boxes with white font).

**Table 1.** Ichthyofauna included in the FIR process. Solid circles (●) depict those species that are endemic to southern Africa and/or are important from a commercial, recreational or subsistence perspective. Family and scientific names after Smith & Heemstra (1986) and estuarine-association categories after Whitfield (1998).

Family	Scientific name	Common name	Estuarine-association category	Endemic	Exploitable
Ambassidae	<i>Ambassis gymnocephalus</i>	Bald glassy	Ib?		●
	<i>Ambassis natalensis</i>	Slender glassy	Ib?		●
	<i>Ambassis productus</i>	Longspine glassy	Ia?		●
Anguillidae	<i>Anguilla bengalensis labiata</i>	African mottled eel	Va		●
	<i>Anguilla bicolor bicolor</i>	Shortfin eel	Va		●
	<i>Anguilla marmorata</i>	Giant mottled eel	Va		●
	<i>Anguilla mossambica</i>	Longfin eel	Va		●
Ariidae	<i>Galeichthys feliceps</i>	White seacatfish	IIb	●	●
Atherinidae	<i>Atherina breviceps</i>	Cape silverside	Ib	●	
	<i>Atherinomorus lacunosus</i>	Hardyhead silverside	Ib		
Belonidae	<i>Strongylura leiura</i>	Yellowfin needlefish	IIc		●
Blenniidae	<i>Omobranchus woodi</i>	Kappie blenny	Ia	●	
Carangidae	<i>Caranx ignobilis</i>	Giant kingfish	IIb?		●
	<i>Caranx melampygus</i>	Bluefin kingfish	IIc?		●
	<i>Caranx papuensis</i>	Brassy kingfish	IIc?		●
	<i>Caranx sexfasciatus</i>	Bigeye kingfish	IIb?		●
	<i>Lichia amia</i>	Garrick/Leervis	IIa		●
	<i>Scomberoides lysan</i>	Doublespotted queenfish	IIb?		●
Carcharhinidae	<i>Carcharhinus leucas</i>	Bullshark	IIc		●
Chanidae	<i>Chanos chanos</i>	Milkfish	IIc		●
Clinidae	<i>Clinus spatulatus</i>	Estuary klipfish	Ib	●	
	<i>Clinus superciliosus</i>	Super klipfish	Ib	●	
Clupeidae	<i>Gilchristella aestuaria</i>	Estuarine roundherring	Ia	●	
	<i>Hilsa kelee</i>	Kelee shad	IIc		
Eleotridae	<i>Butis butis</i>	Duckbill sleeper	Ia?		
	<i>Eleotris fusca</i>	Dusky sleeper	Ia?		
	<i>Eleotris mauritianus</i>	Widehead sleeper	Ia?		
	<i>Eleotris melanosoma</i>	Broadhead sleeper	Ia?		
Elopidae	<i>Elops machnata</i>	Ladyfish	IIa		●
Engraulidae	<i>Stolephorus holodon</i>	Thorny anchovy	IIc		
	<i>Thryssa vitrirostris</i>	Orangemouth glassnose	IIb		●
Gerreidae	<i>Gerres acinaces</i>	Smallscale pursemouth	IIb		●
	<i>Gerres filamentosus</i>	Longspine pursemouth	IIb		●
	<i>Gerres methueni</i>	Evenfin pursemouth	IIb	●	●
	<i>Gerres oyena</i>	Slenderspine pursemouth	IIc		
Gobidae	<i>Caffrogobius gilchristi</i>	Prison goby	Ib	●	

Table 1. Continued.

Family	Scientific name	Common name	Estuarine-association category	Endemic	Exploitable
Gobidae	<i>Caffrogobius natalensis</i>	Baldy	lb	•	
	<i>Caffrogobius nudiceps</i>	Barehead goby	lb	•	
	<i>Croilia mossambica</i>	Naked goby	lb	•	
	<i>Glossogobius biocellatus</i>	Sleepy goby	la?		
	<i>Glossogobius callidus</i>	River goby	lb	•	
	<i>Oligolepis acutipennis</i>	Sharptail goby	la?		
	<i>Oligolepis keiensis</i>	Speartail goby	la?		
	<i>Pandaka silvana</i>	Dwarf goby	la?		
	<i>Papillogobius melanobranchus</i>	Blackthroat goby	lb?		
	<i>Papillogobius reichei</i>	Spotted sandgoby	lb?		
	<i>Periophthalmus koelreuteri</i>	African mudskipper	la		
	<i>Periophthalmus argentilineatus</i>	Bigfin mudskipper	la		
	<i>Psammogobius knysnaensis</i>	Speckled sandgoby	lb?	•	
	<i>Redigobius bikolanus</i>	Bigmouth goby	la?		
	<i>Redigobius dewaali</i>	Checked goby	lb	•	
	<i>Silhouettea sibayi</i>	Barebreast goby	lb	•	
	<i>Taenioides esquivel</i>	Bulldog eelgoby	lb?	•	
	<i>Taenioides jacksoni</i>	Bearded eelgoby	la?	•	
	<i>Trypauchen microcephalus</i>	Comb goby	lb?		
<i>Yongeichthys nebulosus</i>	Shadow goby	lb?			
Haemulidae	<i>Pomadasys commersonnii</i>	Spotted grunter	lla		•
	<i>Pomadasys kaakan</i>	Javelin grunter	llc		•
Hemiramphidae	<i>Hemiramphus far</i>	Spotted halfbeak	llc		
	<i>Hyporhamphus capensis</i>	Cape halfbeak	la	•	
Leiognathidae	<i>Leiognathus equula</i>	Slimy	llb		•
Lutjanidae	<i>Lutjanus argentimaculatus</i>	Mangrove snapper	llc		•
	<i>Lutjanus fulviflamma</i>	Dory snapper	llc		•
Megalopidae	<i>Megalops cyprinoides</i>	Oxeye tarpon	Vb		•
Monodactylidae	<i>Monodactylus argenteus</i>	Round moony	llb		•
	<i>Monodactylus falciformis</i>	Oval moony	lla		•
Mugilidae	<i>Crenimugil crenilabis</i>	Fringelip mullet	llb		
	<i>Liza alata</i>	Diamond mullet	llb		•
	<i>Liza dumerilii</i>	Groovy mullet	llb		•
	<i>Liza luciae</i>	St Lucia mullet	llb		
	<i>Liza macrolepis</i>	Largescale mullet	lla		•
	<i>Liza richardsonii</i>	Southern mullet	llc	•	•
	<i>Liza tricuspidens</i>	Striped mullet	llb	•	•
	<i>Mugil cephalus</i>	Flathead mullet	lla		•

Table 1. Continued.

Family	Scientific name	Common name	Estuarine-association category	Endemic	Exploitable
Mugilidae	<i>Myxus capensis</i>	Freshwater mullet	Vb	•	•
	<i>Valamugil buchanani</i>	Bluetail mullet	IIc		•
	<i>Valamugil cunnesius</i>	Longarm mullet	IIa		•
	<i>Valamugil robustus</i>	Robust mullet	IIa		•
	<i>Valamugil seheli</i>	Bluespot mullet	IIc		•
Ophichthidae	<i>Ophisurus serpens</i>	Sand snake-eel	IIc		
Platycephalidae	<i>Platycephalus indicus</i>	Bartail flathead	IIc		•
Pomatomidae	<i>Pomatomus saltatrix</i>	Elf	IIc		•
Pristidae	<i>Pristis zijsron</i>	Green sawfish	IIc		
Sciaenidae	<i>Argyrosomus japonicus</i>	Dusky kob	IIa		•
	<i>Johnius dorsalis</i>	Small kob	IIc		•
Sillaginidae	<i>Sillago sihama</i>	Silver sillago	IIc		•
Soleidae	<i>Heteromycteris capensis</i>	Cape sole	IIb	•	
	<i>Solea bleekeri</i>	Blackhand sole	IIb	•	
Sparidae	<i>Acanthopagrus berda</i>	Estuarine bream	IIa		•
	<i>Diplodus sargus capensis</i>	Blacktail	IIc	•	•
	<i>Lithognathus lithognathus</i>	White steenbras	IIa	•	•
	<i>Rhabdosargus globiceps</i>	White stumpnose	IIc	•	•
	<i>Rhabdosargus holubi</i>	Cape stumpnose	IIa	•	•
	<i>Rhabdosargus sarba</i>	Tropical stumpnose	IIb		•
	<i>Rhabdosargus thorpei</i>	Bigeye stumpnose	IIb	•	•
Sphyraenidae	<i>Sarpa salpa</i>	Strepie	IIc		•
	<i>Sphyræna barracuda</i>	Great barracuda	IIb		•
Sphyraenidae	<i>Sphyræna jello</i>	Pickhandle barracuda	IIc		•
	Syngnathidae	<i>Hippichthys heptagonus</i>	Belly pipefish	Ib?	
<i>Hippichthys spicifer</i>		Bellybarred pipefish	Ib?		
<i>Hippocampus capensis</i>		Knysna seahorse	Ia	•	
<i>Microphis brachyurus</i>		Short-tail pipefish	Ib?		
<i>Microphis fluviatilis</i>		Freshwater pipefish	Ib?		
<i>Syngnathus acus</i>		Longsnout pipefish	Ib		
<i>Syngnathus watermeyer</i>		Estuarine pipefish	Ia	•	
Teraponidae	<i>Pelates quadrilineatus</i>	Trumpeter	IIc		
	<i>Terapon jarbua</i>	Thornfish	IIa		•
Torpedinidae	<i>Torpedo fuscomaculata</i>	Blackspotted electric ray	IIc?		
	<i>Torpedo sinuspersici</i>	Marbled electric ray	IIc?		

'?' in the estuarine-association category column indicates that further information is required to confirm the allocation of a species to the particular estuarine-association category.

## 2.2. Estuarine Importance

The estuarine importance component introduces four physical measures to the FIR, namely estuarine type, size, condition and isolation (Figure 1). The inclusion of physical measures within the FIR is necessary primarily due to the disparity of quantitative fish distribution data across the range of South African estuaries. These physical measures influence the abundance of fish in estuaries and may therefore be included as a surrogate for the lack of quantitative data. Criteria within the estuarine importance component are thus scored according to their positive or negative influence on fish abundance. The estuarine importance component is, therefore, an essential part of the FIR, and should not be regarded as an independent estuarine importance rating that may be removed from the species importance component.

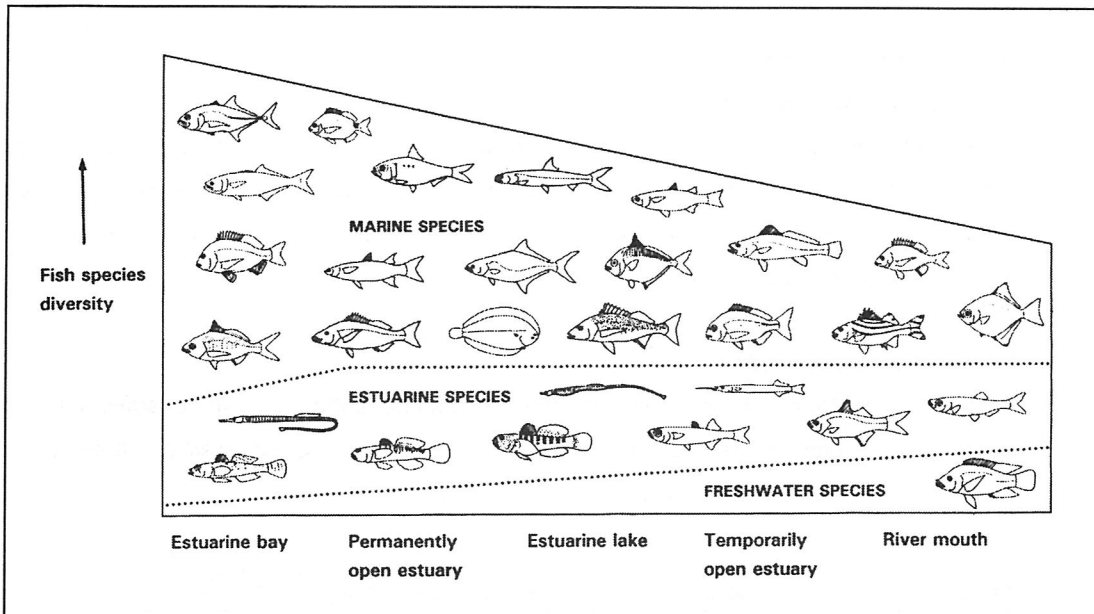
Although numerous estuarine environmental factors influence the utilization of southern African estuaries by fish (Whitfield 1983, Marais 1988), many are difficult to quantify. Because the FIR includes 248 estuaries along the South African coast, estuarine measures incorporated into the process need to both influence fish abundance, and be easily quantified for all these systems. Four criteria were considered suitable in terms of the above requirements and are discussed below.

### 2.2.1. Estuarine Type

Within a particular biogeographic region, the type of estuary has a major influence on the ichthyofaunal structure within the system (Whitfield 1998). Generally, a gradual decline in biodiversity occurs between estuarine bays and river mouths (Figure 2). Estuarine bays, estuarine lakes and permanently open systems were therefore allocated higher scores than temporarily open/closed systems and river mouths. Coetzee *et al.* (1997) excluded estuarine lakes and estuarine bays from a botanical importance rating system for selected South African estuaries, arguing that these unique systems should enjoy a high conservation status regardless, and therefore need not be included in a scoring system. Although estuarine lakes and bays are incorporated into the FIR, their importance is reflected by the high scores that are allocated to these systems (see Section 2.3.1). Estuarine types were derived from Whitfield (2000).

### 2.2.2. Estuarine Size

Estuarine area is an important factor influencing fish species diversity and abundance (Whitfield 1983, Marais 1988). Larger estuaries have the potential to support a greater number of species than smaller estuaries, and generally have more diverse habitats and therefore greater species diversity. Larger estuaries also have the potential to support more fish than smaller estuaries. Larger estuaries are, therefore, allocated higher scores than smaller systems. To ensure standardization between systems, open water surface area (as opposed to total estuarine area) calculated by Colloty *et al.* (2000) was used for this analysis.



**Figure 2.** Diagrammatic representation of the influence of estuarine type on fish species diversity (after Whitfield 1998).

### 2.2.3. Estuarine Condition

The condition of estuaries along the South African coastline may have a large impact on fish species diversity and abundance within estuaries (Whitfield 1997). Within the FIR, estuarine condition is based on the degree to which human activity has changed the functioning of a particular system. Estuarine condition categories are allocated according to the opinion of scientists from various regions along the coast, as documented by Whitfield (2000). The classification ranges from excellent to poor:

- Excellent:** estuary in a near pristine condition (negligible human impact).
- Good:** no major negative anthropogenic influences on either the estuary or the catchment (low impact).
- Fair:** noticeable degree of ecological degradation in the catchment and/or estuary (moderate impact).
- Poor:** major ecological degradation arising from a combination of anthropogenic influences (high impact).

### 2.2.4. Estuarine Isolation

The estuarine isolation criterion aims to increase the importance of estuaries that are isolated from other systems, primarily because remote systems provide local estuarine-dependent fish species with valuable habitats. Estuarine isolation values for each estuary was determined by calculating the mean distance between the previous and the next estuary along the coastline:

$$\frac{\text{distance}_{\text{prev}} + \text{distance}_{\text{next}}}{2}$$

## 2.3. Estuarine Ranking

### 2.3.1. Score Allocation

Scores were allocated to the species importance and estuarine importance criteria to reflect the relative importance of each value to estuarine-associated fish. Five criteria incorporated 'continuous' data that were directly applied to the analysis, while the two remaining criteria incorporated 'categorical' data.

#### 2.3.1.1. Continuous Data

Table 2 shows the estuarine criteria and their data sources that incorporate 'continuous' data. Scores for all criteria were generated (and standardised) by expressing values for each estuary as a percentage of the maximum value within each criterion.

**Table 2.** Five criteria, and data sources, that incorporate 'continuous' data.

Criterion	Data
Species richness	Number of species
Endemic richness	Number of species
Exploitable richness	Number of species
Estuarine size	Estuarine open water surface area (ha)
Estuarine isolation	Mean distance between neighbouring estuaries (km)

#### 2.3.1.2. Categorical Data

The estuarine type and estuarine condition criteria were based on categorical data, and were standardised by allocating the scores in Tables 3 and 4, respectively.

**Table 3.** Scores allocated to categories within the estuarine type criterion.

	Estuarine bay	Permanently open	Estuarine lake	Temporarily open/closed	River mouth
<b>Score allocated (%)</b>	100	100	100	75	50

**Table 4.** Scores allocated to categories within the estuarine condition criterion.

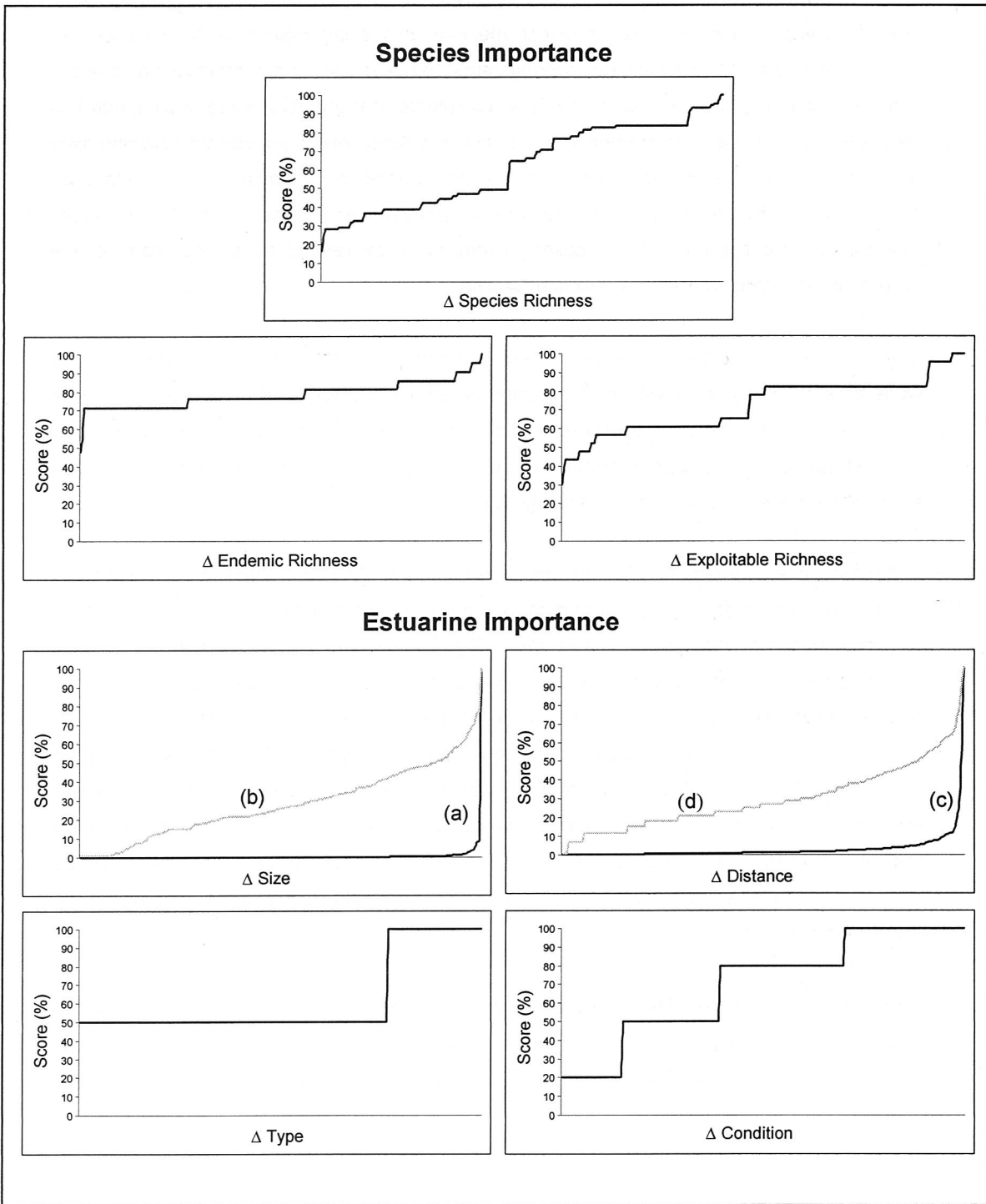
	Excellent	Good	Fair	Poor
<b>Score allocated (%)</b>	100	90	50	20

When allocating scores to criteria, it is important to consider whether the scoring ratios between values within the criterion reflect intended (or logical) differences in terms of their importance to fish. If the intended scoring ratios between values are proportional to those reflected within the scoring allocations, it is acceptable that the scores are implemented as they are. If, however, the scoring ratios between values reflect an illogical or unintended effect in terms of the importance to fish, the data needs to be transformed to obtain the desired effect. Figure 3 illustrates the ranked, standardised scores for the seven criteria incorporated into the FIR. In all cases, scores were expressed as a percentage of the maximum value, and ranked in a descending order.

Species importance criteria (species richness, endemic richness, exploitable richness) scores were acceptable; systems with more species within each criterion score higher than those with less species. Among the estuarine importance criteria, those incorporating categorical data (estuarine type, estuarine condition) were acceptable, because values (and therefore scores) in these criteria were defined categorically.

In the estuarine size criterion, the second largest system along the entire coast represented merely 7% of the largest system, with most South African systems falling well below 1% of the largest estuary's surface area. Curve (a) in Figure 3 shows that this results in few large estuaries being allocated a very high score, while smaller systems across a wide size range receive similar scores. A logarithmic transformation of estuarine surface area data is represented by curve (b) in Figure 3, and provides an acceptable alternative to the former scenario. While maintaining an increase in score with an increase in size, changes in estuarine size within the lower portion of the curve are accounted for. This is particularly relevant within the FIR, because to serve its function, it is vital that the prioritization can be used to compare all estuaries within the list, and not only to highlight systems towards the top of the hierarchy.

A similar situation to the above applies to the estuarine isolation criterion, where isolated estuaries score significantly higher than grouped systems (Figure 3, curve (c)). A logarithmic transformation of the data (Figure 3, curve (d)) provides an acceptable alternative.



**Figure 3.** Ranked scores allocated, according to changes within the respective criteria, to seven criteria within the FIR. In all graphs, criteria values increase from left to right.

### 2.3.2. Weighting

The application of weighting factors to define the relative importance of each criterion to estuarine-associated fish species is the most subjective element of the prioritization analysis. The weighting factors presented in Table 5 are based on the opinion of the authors of this document, where the importance of each criterion to estuarine associated species was considered individually in relation to all other criteria. Three weighting scenarios have been applied to the FIR criteria (Table 5), to explore the influence that various weighting combinations have on the final estuarine ranking hierarchy. For the purpose of this document, however, scenario A was considered most suitable and, therefore, all estuarine ranking results from weighting scenario A are presented later in this document.

**Table 5.** Three weighting factor scenarios applied to FIR criteria.

	<b>A</b>	<b>B</b>	<b>C</b>
<b>Species Importance</b>			
Species Richness	0.15	0.2	0.15
Endemic Richness	0.15	0.15	0.1
Exploitable Richness	0.05	0.05	0.05
Species Importance total	0.35	0.4	0.3
<b>Estuarine Importance</b>			
Estuarine Size	0.30	0.3	0.35
Estuarine Condition	0.15	0.2	0.2
Estuarine Isolation	0.15	0.05	0.1
Estuarine Type	0.05	0.05	0.05
Estuarine Importance total	0.65	0.6	0.7
<b>Total</b>	<b>1</b>	<b>1</b>	<b>1</b>

### 2.3.3. Ranking

The total importance score for each estuary is calculated as the arithmetic sum of all criteria after each has been subjected to a weighting factor, as follows:

**Species Importance score:**

$$[(SR \times WF_{SR}) + (EnR \times WF_{EnR}) + (ExR \times WF_{ExR})]$$

**Estuarine Importance score:**

$$[(ET \times WF_{ET}) + (ES \times WF_{ES}) + (EC \times WF_{EC}) + (EI \times WF_{EI})]$$

**Total Importance score:**

$$[\textit{species importance score}] + [\textit{estuarine importance score}]$$

where:	<i>SR</i>	Species richness
	<i>EnR</i>	Endemic richness
	<i>ExR</i>	Exploitable richness
	<i>ET</i>	Estuarine type
	<i>ES</i>	Estuarine size
	<i>EC</i>	Estuarine condition
	<i>EI</i>	Estuarine isolation
	<i>WF</i>	Weighting factor

### 3. RESULTS

#### 3.1. Species Importance

##### 3.1.1. Estuarine Ichthyofaunal Research Effort

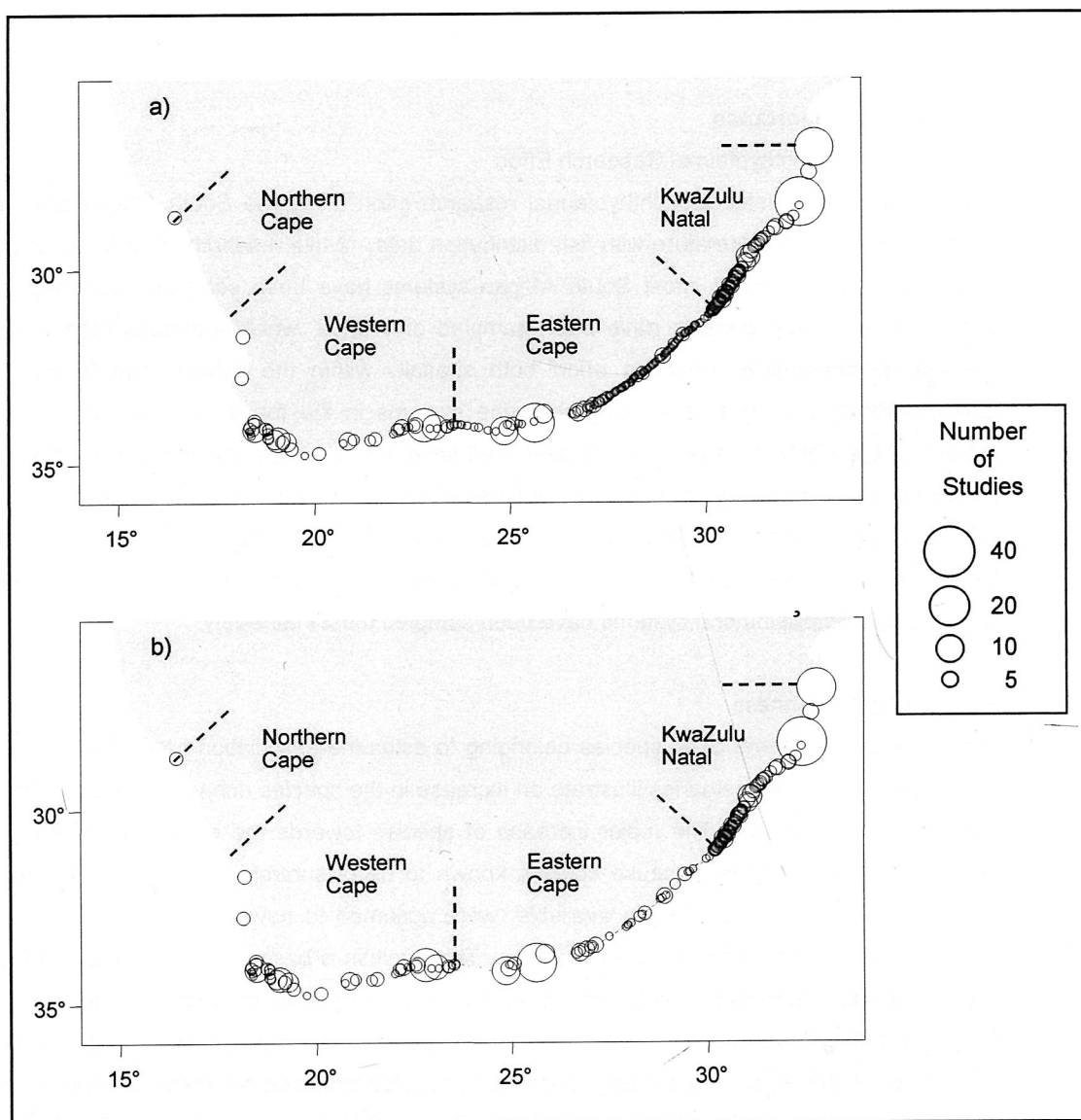
Figure 4 illustrates estuarine ichthyofaunal research effort along the South African coast as indicated by published literature with fish distribution data. While research effort is variable in estuaries along the coast, most South African systems have been sampled qualitatively to some extent. Many systems have been sampled only once, while numerous others have enjoyed comprehensive sampling effort both spatially within the estuary and temporally. Quantitative data suggest that many estuarine systems in the former Transkei and Ciskei regions of the Eastern Cape have not been well sampled. Perhaps unsurprisingly, estuaries surrounding major metropolitan centres have benefited from numerous studies, as is the case with estuaries along the KwaZulu-Natal coast, and within the Algoa Bay, Knysna and Western Cape regions. Along the entire coast, the St Lucia, Kosi, Swartkops, Knysna, Swartvlei, Kromme and Bot/Kleinmond systems have been sampled most intensively.

##### 3.1.2. Species Richness

The distribution patterns of all species belonging to estuarine-association categories I, II and V (109 species) in 248 estuaries illustrate an increase in the species richness of systems from west to east (Figure 5). The major increase of species towards the east at the Great Kei estuary may be imprecise because species known to be of subtropical origin, for which no accurate distribution records were available, were assumed to have a southern distribution limit within the vicinity of the Great Kei estuary. This position is based upon the location of the subtropical/warm temperate biogeographical boundary proposed by Maree *et al.* (2000). Despite the likelihood that the southern limit of these species' distributions will occur within the vicinity of the Great Kei estuary, distribution records obtained for these species in the future may alter the number of species within the Great Kei system as illustrated in Figure 5.

##### 3.1.3. Endemic Richness

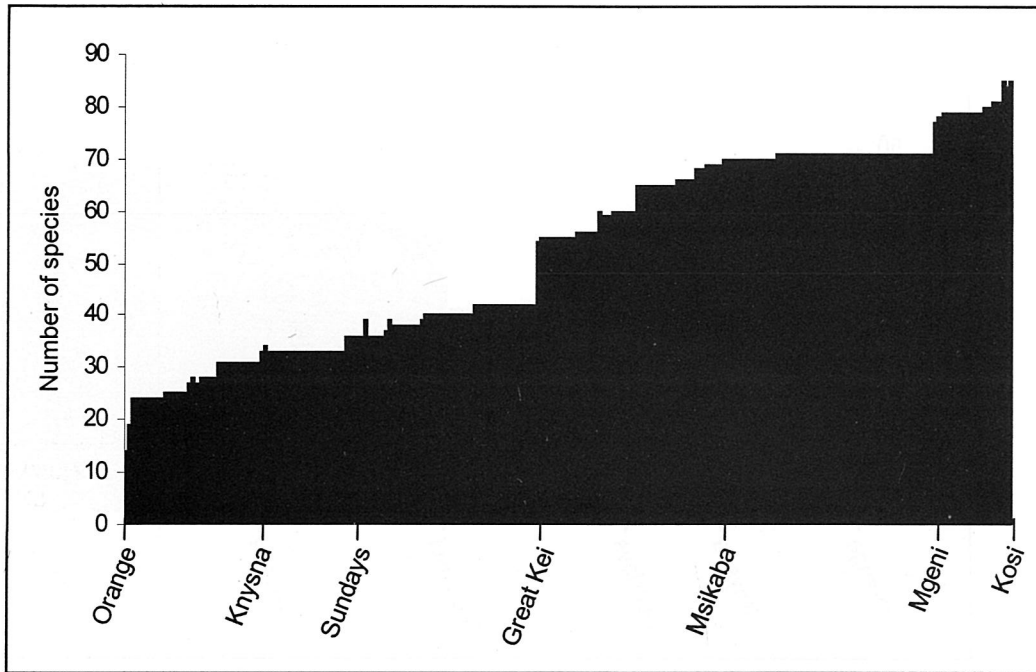
Estuarine systems along the south and south-east coast contain the highest number of endemic species along the South African coast (Figure 6). A minimum of 10 endemic species potentially occur in all South African estuaries, while estuaries along the south-east coast may contain up to 21 species. The Kariega estuary in the Eastern Cape has the highest number of endemic species.



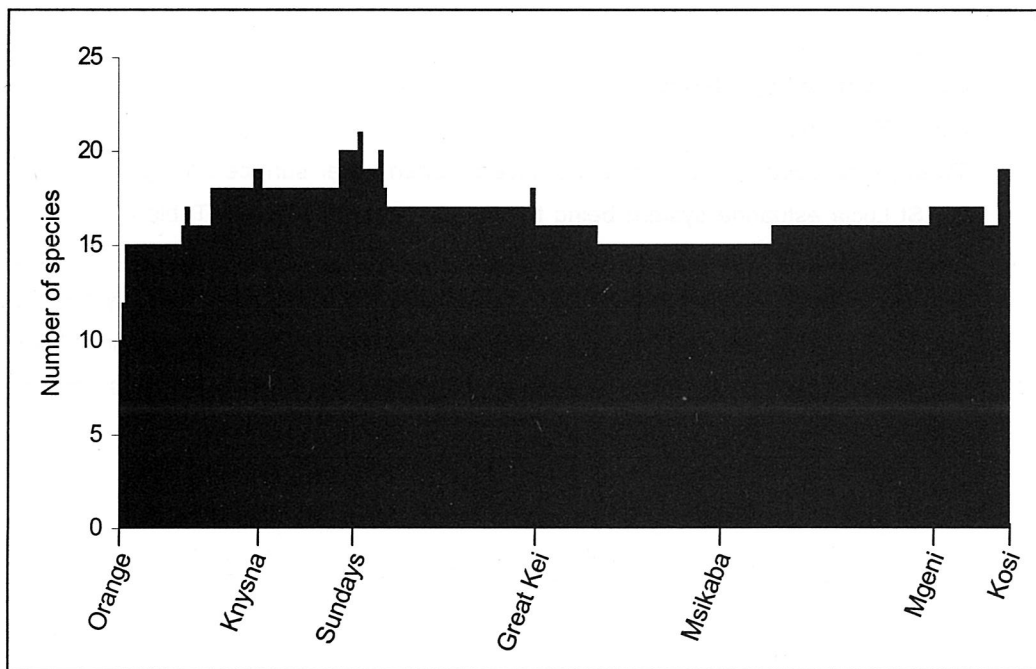
**Figure 4.** Diagrammatic representation of ichthyofaunal research effort in South African estuaries according to literature where qualitative (a) and quantitative (b) fish distribution data are presented. Provincial boundaries are indicated by the dashed lines. The low number of symbols along the west coast occur due to the paucity of estuaries in this region, and do not suggest a lack of effort. Because most South African estuaries have been sampled qualitatively to some extent, the estuaries presented in Figure 4a is representative of the geographical spread of South African estuarine systems.

#### 3.1.4. Exploitable Richness

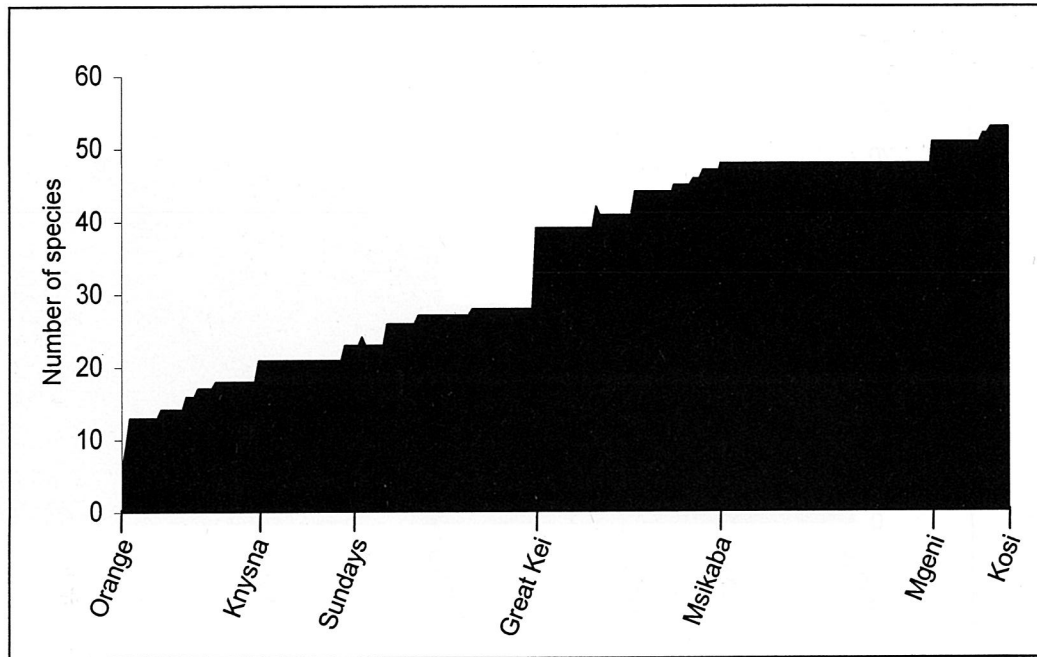
As is the case with species richness throughout South African estuaries, the number of exploitable species increases from west to east (Figure 7). Species within this criterion include tropical and temperate species, with the result that the increase in the number of species towards the east is similar to that shown by the species richness criterion.



**Figure 5.** Distribution patterns of 109 estuarine-associated fish species in 248 South African systems from the Orange River mouth to the Kosi estuary.



**Figure 6.** Distribution patterns of 30 endemic estuarine-associated fish species in 248 South African systems from the Orange River mouth to the Kosi estuary.



**Figure 7.** Distribution patterns of 57 exploitable estuarine-associated fish species in 248 South African systems from the Orange River mouth to the Kosi estuary.

### 3.2. Estuarine Importance

#### 3.2.1. Estuarine Size

Twenty-nine South African estuaries have an open water surface area greater than 100 ha, the St Lucia estuarine system being the largest by some margin (Table 6). Along the east coast, relatively larger systems are situated north of Durban Bay. The Knysna estuarine bay along with the Wilderness and Swartvlei estuarine lakes are the largest systems along the south coast. In the western Cape region, the Bot/Kleinmond and Klein estuarine lakes are the largest systems, with the Orange, Olifants, Great Berg and Breë estuaries having an open water surface area larger than 100 ha.

**Table 6.** South African estuaries with an open water surface area greater than 100 ha (after Colloty *et al.* 2000).

<b>Estuary</b>	<b>Surface area (ha)</b>
St Lucia	31610
Klein	2250
Knysna	1633
Wilderness	1500
Kosi	1450
Bot/Kleinmond	1340
Durban Bay	1080
Richard's Bay	1000
Mhlatuze	679
Orange	653
Swartvlei	631
Groot Berg	522
Breë	371
Keiskamma	278
Gamtoos	215
Keurbooms	192
Great Kei	189
Mtati	180
Olifants	164
Mgwalana	154
Sundays	145
Great Fish	140
Swartkops	135
Nxaxo	124
Bira	122
Matigulu/Nyoni	122
Krom (Oos)	103
Mtata	102
Mzimvubu	102

### 3.2.2. Estuarine Type

A major proportion (72%) of South African estuaries are temporarily open/closed systems, with the majority situated along the east coast (Figure 8). Permanently open systems constitute 19% of all South African estuaries, being situated primarily along the south and east coasts. Estuarine bays, estuarine lakes and river mouths constitute 1%, 3% and 5% of South African estuarine systems, respectively. The geographical positions of the above systems are illustrated in Figure 8.

### 3.2.3. Estuarine Condition

Figure 9 illustrates the estuaries along the South African coast that are in an excellent, good, fair and poor condition. Estuaries in excellent condition are concentrated in two regions along the coast. The majority are situated in the former Ciskei and Transkei, with a concentration of estuaries within the confines of the Tsitsikamma National Park on the south coast. There are no estuaries in an excellent condition along the KwaZulu-Natal coast. Estuaries in a good condition are fairly uniformly spread along the South African coast, with most of the south eastern Cape estuaries being in a good condition. Most estuaries in a poor condition are concentrated within the vicinity of developed centres such as Durban and Cape Town.

### 3.2.4. Estuarine Isolation

South African estuaries along the west and south coasts are generally situated further apart than those along the east coast (Figure 10). East of Algoa Bay, most estuaries are located within 10 km of a neighbouring system. North of Durban, however, estuarine systems are located further apart than the majority of estuaries along the east coast.

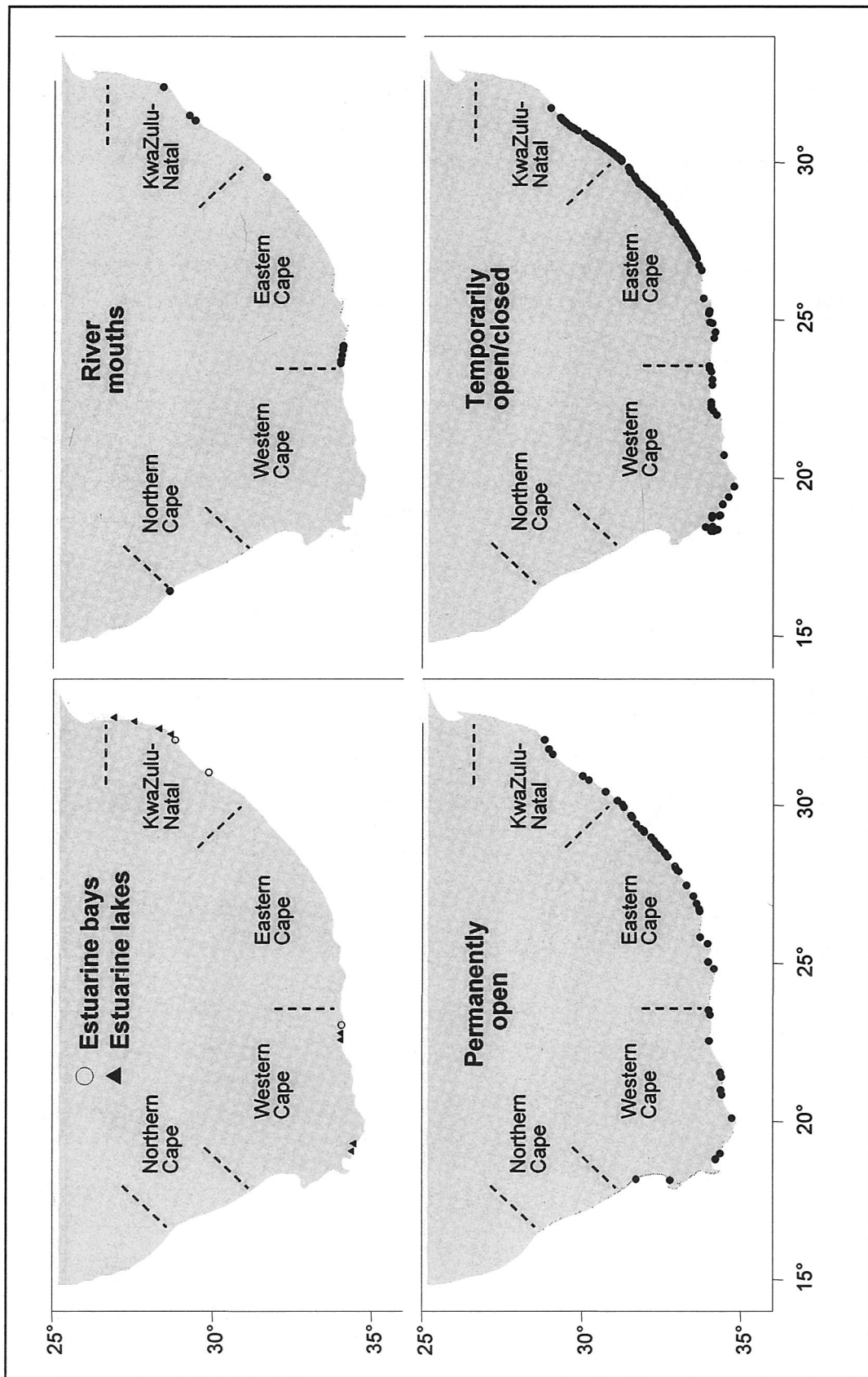
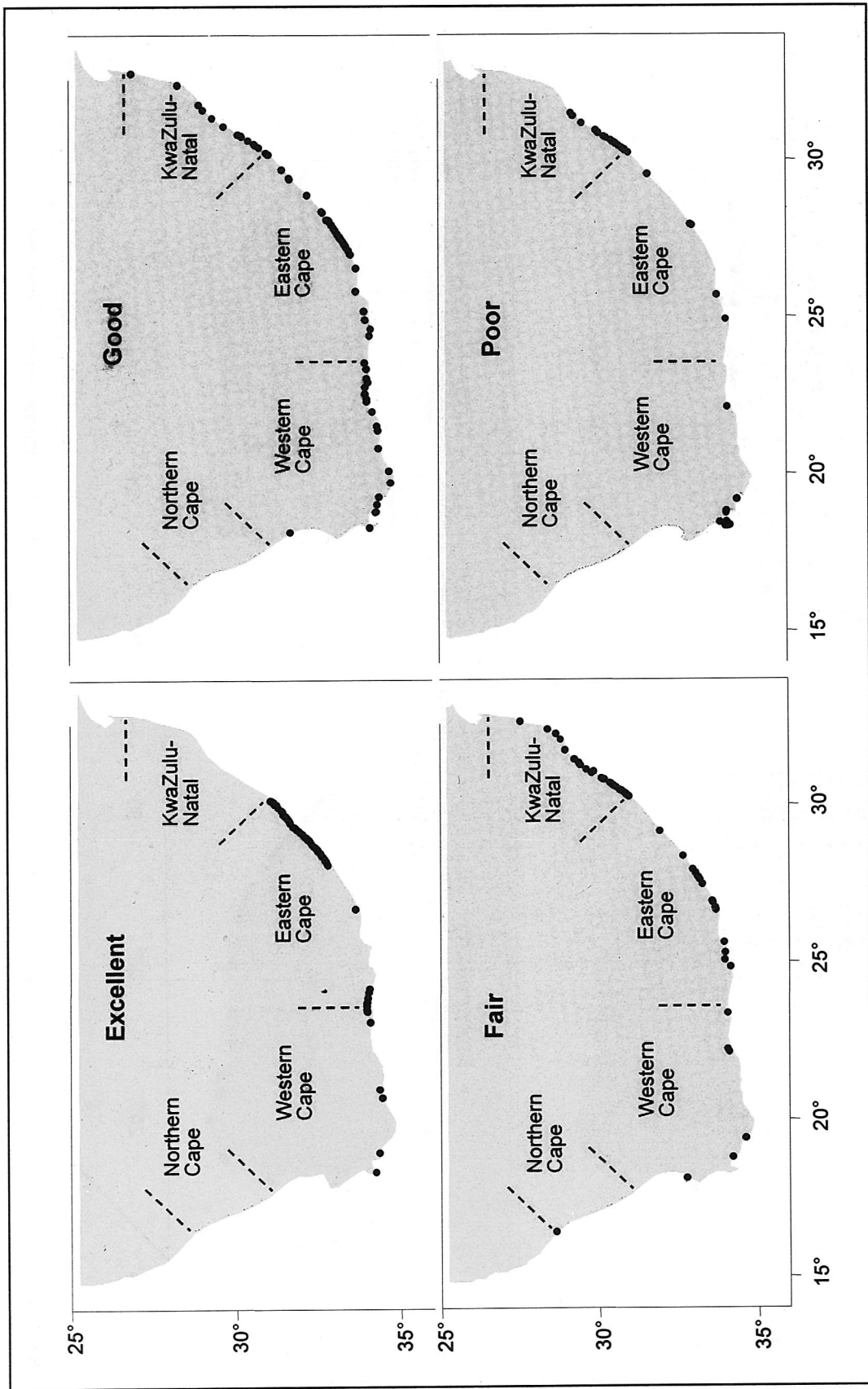
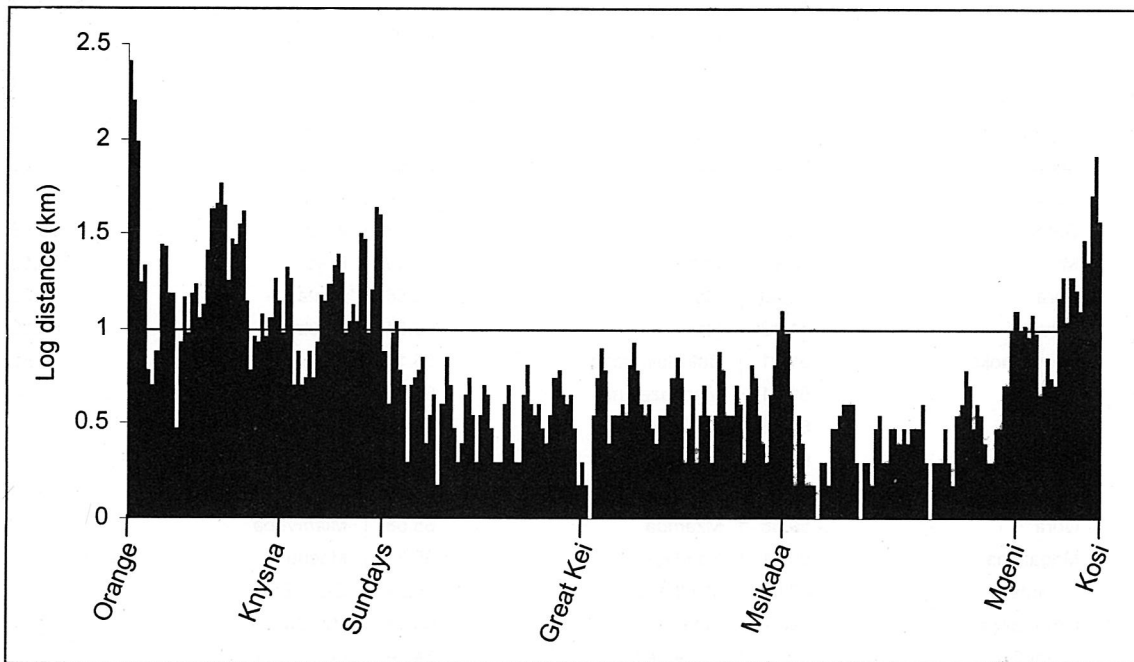


Figure 8. Distribution of estuary types (Whitfield 2000) along the coast of South Africa. Dashed lines indicate provincial boundaries.



**Figure 9.** Estuarine condition, per estuarine condition category (Whitfield 2000), of 248 estuaries along the coast of South Africa. Dashed lines indicate provincial boundaries.



**Figure 10.** Mean distance between neighbouring estuaries, from west to east, along the South African coast. The horizontal line represents 10 kilometres.

### 3.3. Estuarine ranking

Table 7 presents three estuarine hierarchies based on different weighting scenarios. Despite variation in the ranked positions of various estuaries between scenarios A, B and C, most estuaries occur within the same region of the hierarchy.

**Table 7.** South African estuarine ranking hierarchy for the top 40 systems using three different weighting scenarios.

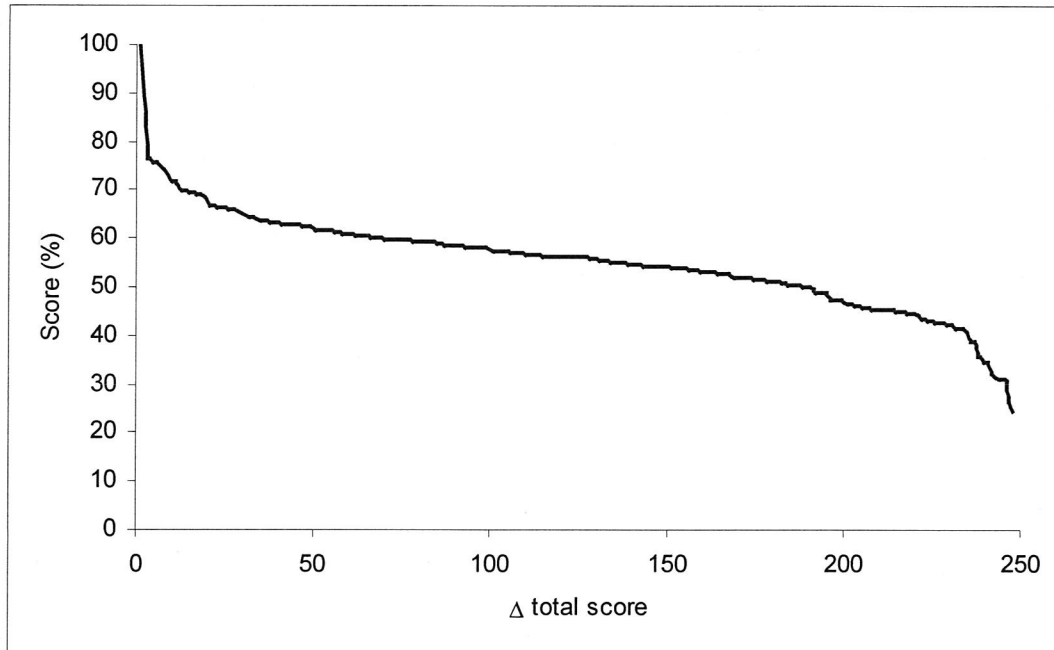
Weighting scenario					
A		B		C	
Estuary	Score	Estuary	Score	Estuary	Score
St Lucia	91.97	St Lucia	94.87	St Lucia	93.65
Kosi	82.28	Kosi	85.69	Kosi	82.72
Matigulu/Nyoni	70.72	Matigulu/Nyoni	74.92	Matigulu/Nyoni	71.02
Mlalazi	70.29	Mlalazi	74.56	Mlalazi	70.48
Durban Bay	69.63	Richard's Bay	72.61	Richard's Bay	69.49
Richard's Bay	69.58	Durban Bay	72.42	Knysna	69.45
Mhlatuze	68.81	Mhlatuze	71.37	Durban Bay	69.33
Knysna	68.12	Knysna	70.19	Klein	68.71
Klein	67.03	Mhlanga	69.11	Mhlatuze	68.32
Swartvlei	65.89	Mtakatye	69.03	Wilderness	67.54
Wilderness	65.85	Mtentu	68.89	Swartvlei	66.53

Sundays	65.22	Nxaxo	68.76	Bot/Kleinmond	65.97
Bot/Kleinmond	64.09	Nqabara	68.09	Nxaxo	65.79
Nxaxo	64.02	Wilderness	68.07	Mtakatye	65.08
Mhlanga	63.92	Xora	67.83	Nqabara	64.96
Mgobezeleni	63.80	Klein	67.70	Mtentu	64.81
Mtentu	63.56	Mtata	67.48	Sundays	64.20
Nqabara	63.39	Mdumbi	67.48	Mhlanga	64.03
Breë	62.93	Swartvlei	67.43	Xora	63.96
Mtakatye	62.91	Mtamvuna	66.58	Breë	63.58
Xora	61.40	Mbashe	66.56	Mtata	63.25
Mdumbi	61.18	Qora	66.54	Mdumbi	63.19
Duiwenhoks	61.01	Bot/Kleinmond	66.14	Qora	62.62
Mtata	61.01	Mgobezeleni	65.81	Mbashe	62.44
Msikaba	60.88	Msikaba	65.76	Mngazana	61.68
Mbashe	60.64	Mngazana	65.72	Msikaba	61.35
Gourits	60.59	Mnenu	65.60	Duiwenhoks	60.94
Qora	60.58	Mzamba	65.58	Mtamvuna	60.78
Mngazana	60.41	Sundays	65.51	Mnenu	60.64
Olifants	60.03	Mzintlava	65.21	Great Fish	60.45
Groot Berg	59.57	Fafa	65.18	Mzintlava	60.36
Great Fish	59.28	Mnyameni	64.74	Mgobezeleni	60.19
Mzintlava	59.07	Nkodusweni	64.50	Mgwalana	60.13
Mgeni	58.98	Breë	64.40	Mtati	60.09
Keurbooms	58.44	Mdlotane	64.28	Gourits	59.99
Mdlotane	58.40	Mbotyi	63.97	Mzamba	59.98
Fafa	58.35	Mntafufu	63.52	Keurbooms	59.84
Nkodusweni	58.15	Umgababa	63.33	Nkodusweni	59.81
Goukou	58.11	Great Fish	63.22	Bira	59.77
Mnenu	57.94	Sikombe	63.15	Fafa	59.76

The total importance rating produced by the FIR (weighting scenario A) for all South African estuaries is presented in Appendix B. Species importance and estuarine importance component scores are also given. The St Lucia estuary ranks well above all other systems, ranking highest in all three components presented in Appendix B. Figure 11 illustrates the ranked total scores generated by the FIR. The rate of score change is relatively large between higher scores and decreases between scores of 70 and 40%. Within this region, there are relatively small changes in score with large changes in rank. Below scores of approximately 40% the rate of change increases once again. It is therefore important to consider both the relative scores and the rank when comparing between estuarine systems. Appendix C presents the individual scores from all criteria that contributed to the prioritization analysis. The ranking of estuaries within the three biogeographical regions is presented in Appendix D.

A comparative ranking of various estuaries according to various ranking procedures is presented in Table 8. South African estuaries that were considered by Colloty *et al.* (2000) for a botanical importance rating (BIR), and Turpie (1995) for a waterbird prioritization analysis are compared. The Conservation Status Index (CSI) and the Abundance Index (AI)

presented by Turpie (1995) are included in Table 8. The St Lucia estuarine system scored strongly within the BIR and waterbird analysis, ranking first and second respectively. The Richard's Bay estuary ranked highest and third for the CSI and AI indices respectively, while ranking sixth in the FIR. The rank and normalised scores for other systems considered by Colloty *et al.* (2000) and Turpie (1995) are also presented in Table 8.



**Figure 11.** Ranked total scores generated by the FIR.

**Table 8.** Comparative ranking of various estuaries according to fish (this study), botanical (Colloty *et al.* 2000) and waterbird (Turpie 1995) prioritization analyses. Estuaries are listed in descending order according to the FIR ranking.

	Fish Importance Rating		Botanical Importance Rating		Estuarine Waterbird Prioritization			
	Rank	Normalised Score	Rank	Normalised Score	Conservation Status Index (CSI)		Abundance Index (AI)	
Estuary	Rank	Normalised Score	Rank	Normalised Score	Rank	Normalised Score	Rank	Normalised Score
St Lucia	1	100.00	1	100	2	96	2	98
Kosi	2	89.46			31	34	25	31
Matigulu/Nyoni	3	76.89			41	22	39	19
Mlalazi	4	76.43	10	83.75				
Durban Bay	5	75.70			21	41	16	40
Richard's Bay	6	75.66			1	100	3	83
Mhlathuze	7	74.82	12	81.25				
Knysna	8	74.06	3	90	20	42	14	41
Klein	9	72.88			9	61	11	53
Swartvlei	10	71.74			14	48	12	51
Wilderness	11	71.60			12	50	9	60
Sundays	12	70.92	17	76.25	34	29	37	22
Bot/Kleinmond	13	69.69	33	63.75	10	59	10	57
Nxaxo	14	69.60	8	85				
Mhlanga	15	69.49	44	57.5				
Mtentu	16	69.10	29	66.25				
Nqabara	17	68.93	21	70				
Breë	18	68.43			24	38	22	33
Mtakatye	19	68.40	35	62.5				
Xora	20	66.76	13	80				
Mdumbi	21	66.52	25	67.5				
Mtata	22	66.33	24	68.75				
Msikaba	23	66.20	65	45				
Mbashe	24	65.93	6	86.25				
Gourits	25	65.88			15	45	26	30
Qora	26	65.86	52	53.75				
Mngazana	27	65.68	2	96.25				
Olifants	28	65.26	6	86.25	7	72	7	64
Groot Berg	29	64.77	4	87.5	3	89	1	100
Great Fish	30	64.46	17	76.25				
Mzintlava	31	64.23	39	61.25				
Mgeni	32	64.12			16	44	21	34
Keurbooms	33	63.54	43	58.75	19	42	19	36
Mdlotane	34	63.49	44	57.5				
Goukou	35	63.18			39	25	36	22
Mnenu	36	63.00	55	47.5				
Mdloti	37	62.85	53	50				
Mgwalana	38	62.84	14	78.75				
Bira	39	62.80	21	70				
Mnyameni	40	62.76	55	47.5				
Mntafufu	41	62.69	39	61.25				

**Table 8.** Continued.

	Fish Importance Rating		Botanical Importance Rating		Estuarine Waterbird Prioritization			
					Conservation Status Index (CSI)		Abundance Index (AI)	
Mzamba	42	62.67	29	66.25				
Mtamvuna	43	62.58	55	47.5				
Mtati	44	62.41	14	78.75				
Heuningnes	45	62.36			36	28	38	21
Mbotyi	46	61.92	55	47.5				
Mhlali	47	61.57			37	27	40	19
Nhlabane	48	61.50	47	56.25				
Kabeljous	49	61.48	29	66.25	30	35	34	23
Mkomazi	50	61.03	55	47.5				
Gqunube	51	60.99	29	66.25				
Tyolomnqa	52	60.61	50	55				
Mpekweni	53	60.31	21	70				
Gamtoos	54	60.09	14	78.75	23	39	17	38
Swartkops	55	60.00	4	87.5	29	36	18	38
Zinkwasi	56	59.72	60	46.25				
Great Kei	57	59.55	20	71.25				
Tugela	58	59.51			26	37	30	27
Kobonqaba	59	59.34	25	67.5				
Keiskamma	60	59.17	8	85	33	31	35	23
Krom (Oos)	61	58.78	11	82.5	25	38	23	33
Orange	62	58.65			4	78	4	74
Mzimvubu	63	58.16	47	56.25				
Qinira	64	58.15	50	55				
Ngqwara	65	58.12	66	42.5				
Bulungulu	66	58.07	60	46.25				
Mvoti	67	58.04			28	37	32	26
Mbhanyana	68	57.47	60	46.25				
Gqutywa	69	56.12	35	62.5				
Kowie	70	56.03			27	37	27	28
Tongati	71	56.02	68	40				
Gxara	72	55.99	66	42.5				
Mtana	73	55.05	25	67.5				
Old Woman's	74	54.28	54	48.75				
Qolora	75	53.83	60	46.25				
Lovu	76	53.61			40	25	41	16
Kiwane	77	53.45	47	56.25				
Ngqinisa	78	52.87	60	46.25				
Rietvlei/Diep	79	51.94			5	76	6	68
Nahoon	80	51.76	19	72.5				
Uilkraals	81	51.63	33	63.75	35	28	33	25
Siyaya	82	51.53	39	61.25				
Groot Brak	83	51.51	25	67.5				
Klein Brak	84	51.23			13	49	13	45
Shwele-Shwele	85	50.86	68	40				

**Table 8.** Continued.

	Fish Importance Rating		Botanical Importance Rating		Estuarine Waterbird Prioritization			
					Conservation Status Index (CSI)		Abundance Index (AI)	
Seekoei	86	49.89	39	61.25	17	43	24	32
Mbokodweni	87	48.95			38	26	31	26
Sand	88	47.13			11	52	15	41
Bloukrans	89	45.29	68	40				
Hartenbos	90	45.01	35	62.5				
Ngculura	91	43.53	71	21.25				
Koega	92	42.35	35	62.5	32	33	28	28
Lourens	93	31.11			42	4	42	2
Silwermyn	94	26.37	44	57.5				

#### 4. RECOMMENDATIONS

The FIR provides an efficient yet simple method for fish based prioritization of South African estuaries. Despite the inclusion of comprehensive estuarine data sets, the ranking process remains subjective in that weighting fractions form the basis of the ranking procedure. It is recommended that various scenarios and assumptions under the current ranking procedure be tested statistically, and quantified in order to provide plausible alternatives. Sensitivity analyses incorporating various assumptions may be highly relevant.

Because factors contributing to an estuary's importance need to be explicit to decision-makers, it is recommended that estuaries which have unique characteristics (and should therefore receive a high conservation status) should be 'flagged', irrespective of their position within the list. Similarly, estuarine systems that occupy an improbable position within the hierarchy due to explicit factors that are not considered in the FIR process may be promoted or relegated accordingly.

Because some exploited species may be considered more important than others, the relative importance of exploited species should be quantified (when suitable data become available) in order to rank estuaries according to the relative composition of exploited species within a system. Species may be scored on this basis prior to the weighting process, and such a study will provide a refinement of the FIR results. Currently, the FIR considers all exploited species with an equal weighting by merely considering the total number of exploited species within an estuarine system.

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## APPENDIX A

National Estuarine Ichthyofaunal Bibliography used in this study.

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## APPENDIX B

Ranking hierarchy of 248 estuaries according to total, species and estuarine importance scores. Estuaries are ranked according to the total importance score. Weighting scenario A was used to generate scores.

Estuary	TOTAL IMPORTANCE SCORE		SPECIES IMPORTANCE SCORE		ESTUARINE IMPORTANCE SCORE	
	Rank	Normalised score	Rank	Normalised score	Rank	Normalised score
St Lucia	1	100.00	1	100.00	1	100.00
Kosi	2	89.46	1	100.00	3	83.39
Matigulu/Nyoni	3	76.89	5	92.03	15	68.19
Mlalazi	4	76.43	4	92.84	18	67.00
Durban Bay	5	75.70	21	90.98	19	66.92
Richard's Bay	6	75.66	17	91.51	20	66.54
Mhlatuze	7	74.82	22	90.71	22	65.69
Knysna	8	74.06	181	64.20	5	79.74
Klein	9	72.88	225	53.54	2	83.99
Swartvlei	10	71.64	182	63.67	8	76.22
Wilderness	11	71.60	212	59.65	6	78.47
Sundays	12	70.92	137	67.94	12	72.63
Bot/Kleinmond	13	69.69	224	55.38	7	77.91
Nxaxo	14	69.60	125	73.91	17	67.12
Mhlanga	15	69.49	5	92.03	48	56.54
Mgobezeleni	16	69.37	3	99.47	72	52.06
Mtentu	17	69.10	68	82.20	32	61.57
Nqabara	18	68.93	119	74.44	21	65.76
Breë	19	68.43	212	59.65	11	73.47
Mtakatye	20	68.40	96	78.45	26	62.63
Xora	21	66.76	109	74.98	29	62.04
Mdumbi	22	66.52	96	78.45	36	59.67
Duiwenhoks	23	66.34	212	59.65	13	70.18
Mtata	24	66.33	96	78.45	37	59.36
Msikaba	25	66.20	68	82.20	47	57.00
Mbashe	26	65.93	108	77.38	38	59.34
Gourits	27	65.88	212	59.65	14	69.46
Qora	28	65.86	119	74.44	34	60.94
Mngazana	29	65.68	96	78.45	41	58.34
Olifants	30	65.26	247	38.05	4	80.91
Groot Berg	31	64.77	239	48.18	10	74.30
Great Fish	32	64.46	160	66.10	25	63.51
Mzintlava	33	64.23	88	80.59	55	54.83
Mgeni	34	64.12	20	91.50	112	48.38
Keurbooms	35	63.54	191	61.55	24	64.68
Mdlotane	36	63.49	5	92.03	121	47.09
Fafa	37	63.44	23	84.85	88	51.14
Nkodusweni	38	63.22	91	79.25	62	54.00

Goukou	39	63.18	212	59.65	23	65.22
Mnenu	40	63.00	96	78.45	59	54.12
Mdloti	41	62.85	5	92.03	129	46.07
Mgwalana	42	62.84	183	63.45	27	62.49
Bira	43	62.80	183	63.45	28	62.43
Mnyameni	44	62.76	68	82.20	78	51.59
Mntafufu	45	62.69	88	80.59	70	52.40
Mzamba	46	62.67	68	82.20	83	51.44
Mtamvuna	47	62.58	68	82.20	86	51.31
Mtati	48	62.41	183	63.45	30	61.81
Heuningnes	49	62.36	225	53.54	16	67.43
Mbotyi	50	61.92	83	81.39	93	50.72
Mkweni	51	61.58	83	81.39	99	50.20
Mhlali	52	61.57	5	92.03	145	44.07
Nhlabane	53	61.50	17	91.51	144	44.24
Sikombe	54	61.50	68	82.20	104	49.60
Kabeljous	55	61.48	191	61.55	33	61.44
Ntlonyane	56	61.22	116	74.45	66	53.61
Mtonga	57	61.06	96	78.45	89	51.06
Mkomazi	58	61.03	23	84.85	119	47.33
Mncwasa	59	61.02	109	74.98	69	53.00
Gqunube	60	60.99	142	66.12	43	58.04
Umgababa	61	60.69	23	84.85	125	46.80
Tyolomnqa	62	60.61	166	64.78	42	58.20
Sout (Oos)	63	60.42	191	61.55	35	59.77
Lwandile	64	60.38	96	78.45	101	49.99
Mpekweni	65	60.31	183	63.45	40	58.50
Gamtoos	66	60.09	191	61.55	39	59.26
Sinangwana	67	60.07	96	78.45	105	49.51
Shixini	68	60.02	119	74.44	75	51.74
Swartkops	69	60.00	137	67.94	52	55.43
Msimbazi	70	59.75	23	84.85	139	45.32
Mendu	71	59.73	119	74.44	87	51.28
Zinkwasi	72	59.72	5	92.03	165	41.15
Mahlongwana	73	59.58	23	84.85	141	45.05
Great Kei	74	59.55	107	77.64	108	49.15
Mfolozi	75	59.54	17	91.51	164	41.16
Boknes	76	59.51	137	67.94	56	54.67
Tugela	77	59.51	5	92.03	169	40.82
Zotsha	78	59.42	23	84.85	143	44.79
Mpako	79	59.39	109	74.98	95	50.43
Kobonqaba	80	59.34	125	73.91	90	50.96
Kasuka	81	59.18	161	65.81	53	55.37
Hluleka	82	59.17	96	78.45	114	48.09
Keiskamma	83	59.17	180	64.26	50	56.24
Quko	84	59.13	142	66.12	54	55.11
Krom (Oos)	85	58.78	191	61.55	45	57.19
Mngazi	86	58.77	96	78.45	118	47.46
Orange	87	58.65	248	30.32	9	74.94

Cebe	88	58.61	125	73.91	102	49.82
Riet	89	58.48	161	65.81	58	54.27
Palmiet	90	58.39	230	52.73	31	61.65
Lupatana	91	58.38	83	81.39	140	45.16
Kwelera	92	58.37	142	66.12	64	53.92
Mahlongwa	93	58.32	23	84.85	154	43.07
Mzimvubu	94	58.16	91	79.25	132	46.04
Qinira	95	58.15	142	66.12	67	53.56
Ngqwara	96	58.12	125	73.91	109	49.04
Bulungulu	97	58.07	109	74.98	113	48.34
Mvoti	98	58.04	5	92.03	178	38.50
Blinde	99	58.01	212	59.65	46	57.07
Noetsie	100	57.73	191	61.55	51	55.54
Sihlontweni	101	57.50	125	73.91	116	48.06
Mbhanyana	102	57.47	116	74.45	117	47.72
Kwanyana	103	57.30	68	82.20	156	42.99
Kleinemonnd (Oos)	104	57.22	136	68.47	92	50.75
Mtentwana	105	57.18	68	82.20	158	42.80
Lwandilana	106	57.14	96	78.45	142	44.89
Kwenxura	107	57.08	142	66.12	74	51.89
Bulolo	108	56.91	91	79.25	146	44.06
Cefane	109	56.83	142	66.12	81	51.49
Van Stadens	110	56.78	191	61.55	61	54.04
Mzimpunzi	111	56.76	88	80.59	155	43.07
Storms	112	56.76	191	61.55	63	54.00
Morgan	113	56.44	142	66.12	91	50.87
Nkanya	114	56.42	116	74.45	131	46.06
Mapuzi	115	56.37	109	74.98	137	45.67
Goda	116	56.37	166	64.78	79	51.53
Mpahlanyana	117	56.37	68	82.20	163	41.52
Ncera	118	56.36	166	64.78	80	51.52
Groot (Wes)	119	56.36	191	61.55	68	53.38
Gqunqe	120	56.36	125	73.91	127	46.27
Nenga	121	56.29	109	74.98	138	45.55
Mzimkulu	122	56.22	23	84.85	171	39.77
Gqutywa	123	56.12	183	63.45	73	51.90
Ncizele	124	56.10	125	73.91	134	45.87
Ratel	125	56.03	225	53.54	44	57.46
Kowie	126	56.03	161	65.81	96	50.40
Tongati	127	56.02	5	92.03	187	35.32
Gxara	128	55.99	125	73.91	136	45.68
Ntlupeni	129	55.65	91	79.25	161	42.09
Bulura	130	55.65	142	66.12	103	49.64
Matjies	131	55.62	191	61.55	71	52.21
Nyara	132	55.49	142	66.12	106	49.38
Klipdrifsfontein	133	55.42	225	53.54	49	56.50
Lottering	134	55.08	191	61.55	84	51.36
Klipdrif	135	55.05	191	61.55	85	51.31
Mtana	136	55.05	183	63.45	98	50.21

Sandlundlu	137	55.02	68	82.20	173	39.40
Mpahlane	138	54.93	68	82.20	174	39.25
Nonoti	139	54.70	5	92.03	193	33.24
Myekane	140	54.60	83	81.39	176	39.20
Maalgate	141	54.58	212	59.65	76	51.67
Gwaing	142	54.58	212	59.65	77	51.67
Kaaimans	143	54.45	212	59.65	82	51.46
Damba	144	54.41	23	84.85	180	36.90
Intshambili	144	54.41	23	84.85	180	36.90
Tsitsikamma	146	54.36	191	61.55	97	50.22
Mpenjati	147	54.35	23	84.85	182	36.82
Mkozi	148	54.33	83	81.39	177	38.77
Groot (Oos)	149	54.32	191	61.55	100	50.16
Old Woman's	150	54.28	183	63.45	111	49.01
Kariega	151	54.06	135	71.93	148	43.79
Kleinemonnd (Wes)	152	53.98	161	65.81	120	47.18
Cintsa	153	53.87	142	66.12	123	46.84
Qolora	154	53.83	125	73.91	160	42.28
Elands	155	53.79	191	61.55	107	49.32
Lovu	156	53.61	23	84.85	186	35.66
Goukamma	157	53.60	191	61.55	110	49.03
Kiwane	158	53.45	166	64.78	122	46.93
Jujura	159	53.26	119	74.44	167	41.08
Mtendwe	160	53.16	142	66.12	135	45.71
Mzinto	161	53.13	23	84.85	189	34.89
Ngoma	162	53.12	119	74.44	168	40.86
Elandsbos	163	52.99	191	61.55	115	48.08
Ngqinisa	164	52.87	166	64.78	133	46.01
Mtentweni	165	52.75	23	84.85	191	34.30
Ku-amanzimuzama	166	52.61	109	74.98	172	39.75
Umhlangankulu	167	52.53	23	84.85	192	33.96
Bushmans	168	52.33	137	67.94	151	43.35
Krom (Wes)	169	52.12	239	48.18	57	54.38
Buffels (Oos)	170	52.06	232	48.99	65	53.83
Rietvlei/Diep	171	51.94	239	48.18	60	54.09
Maitland	172	51.80	191	61.55	128	46.21
Nahoon	173	51.76	142	66.12	149	43.51
Buffalo	174	51.66	142	66.12	150	43.35
Uilkraals	175	51.63	225	53.54	94	50.53
Siyaya	176	51.53	5	92.03	205	28.24
Groot Brak	177	51.51	212	59.65	124	46.83
Sezela	178	51.23	23	84.85	196	31.90
Klein Brak	179	51.23	212	59.65	126	46.38
Gxulu	180	51.10	166	64.78	152	43.23
Tongazi	181	50.99	68	82.20	194	33.04
Mtambane	182	50.88	91	79.25	190	34.57
Shwele-Shwele	183	50.86	166	64.78	157	42.86
Seteni	184	50.33	5	92.03	215	26.35
Mtwalume	185	50.32	23	84.85	198	30.47

Haga-Haga	186	50.25	142	66.12	166	41.13
Mcantsi	187	50.20	166	64.78	162	41.81
Mbizana	188	50.03	23	84.85	199	30.02
Mzumbe	189	50.01	23	84.85	200	29.98
Seekoei	190	49.89	191	61.55	153	43.20
Piesang	191	49.42	191	61.55	159	42.46
Mbokodweni	192	48.95	23	84.85	204	28.31
Lilyvale	193	48.92	166	64.78	170	39.80
Mhlabatshane	194	48.79	23	84.85	207	28.06
Manzimtoti	195	48.69	23	84.85	208	27.91
Mfazazana	196	47.44	23	84.85	217	25.93
Mlele	197	47.43	166	64.78	179	37.45
Sand	198	47.13	232	48.99	130	46.06
Kandandhlovu	199	47.09	68	82.20	212	26.91
Zolwane	200	46.87	68	82.20	213	26.56
Ngane	201	46.68	23	84.85	218	24.74
Bilanhlole	202	46.37	23	84.85	219	24.26
Rufane	203	46.23	161	65.81	188	34.97
Kwa-makosi	204	46.19	23	84.85	221	23.96
Boboyi	205	45.93	23	84.85	222	23.55
Mnamfu	206	45.88	23	84.85	223	23.48
Mhlungwa	207	45.57	23	84.85	224	22.98
Mhlangamkulu	208	45.52	23	84.85	225	22.91
Wildevoël vlei	209	45.48	239	48.18	147	43.93
Mpambanyoni	210	45.37	23	84.85	226	22.67
Mhlangeni	211	45.35	23	84.85	227	22.65
Bloukrans	212	45.29	191	61.55	185	35.95
Sipingo	213	45.27	23	84.85	228	22.52
Ngogwane	214	45.17	125	73.91	203	28.65
Hartenbos	215	45.01	212	59.65	183	36.60
Kaba	216	44.86	23	84.85	229	21.88
Mbango	217	44.77	23	84.85	230	21.73
Mvutshini	218	44.70	23	84.85	231	21.62
Vungu	219	44.70	23	84.85	232	21.62
Mvuzi	220	44.40	23	84.85	234	21.15
Cwili	221	44.29	142	66.12	197	31.74
Ngculura	222	43.53	183	63.45	195	32.08
Uvuzana	223	43.49	23	84.85	236	19.72
Cunge	224	42.89	142	66.12	202	29.55
Mzimayi	225	42.89	23	84.85	237	18.76
Rooiels	226	42.80	232	48.99	175	39.24
Little Manzimtoti	227	42.60	23	84.85	238	18.31
Hlozi	228	42.53	166	64.78	201	29.73
Koega	229	42.35	137	67.94	211	27.64
Mkumbane	230	42.27	23	84.85	239	17.79
Mdesingane	231	42.14	23	84.85	240	17.58
Koshwana	232	41.34	23	84.85	241	16.33
Hickmans	233	41.34	166	64.78	209	27.86
Kongweni	234	41.31	23	84.85	242	16.29

Steenbras	235	40.78	232	48.99	184	36.06
Ncqenga	236	38.95	166	64.78	220	24.10
Ku-Boboyi	237	38.75	68	82.20	244	13.78
Schuster	238	35.51	239	48.18	206	28.23
Eerste	239	35.48	232	48.99	210	27.72
Bokramspruit	240	34.40	239	48.18	214	26.48
Houtbaai	241	34.32	239	48.18	216	26.35
Hlaze	242	32.25	142	66.12	245	12.78
Sir Lowry's Pass	243	31.58	232	48.99	233	21.56
Lourens	244	31.11	232	48.99	235	20.84
Blind	245	31.10	142	66.12	246	10.97
Mvubukazi	246	30.53	166	64.78	247	10.84
Silwermyrn	247	26.37	239	48.18	243	13.83
Onrus	248	24.28	230	52.73	248	7.93

## APPENDIX C

Ranking hierarchy of 248 estuaries according to seven criteria incorporated into the FIR. Estuaries are listed in geographical order from the Orange River Estuary in the west to Kosi estuary in the east. Weighting scenario A was used to generate scores.

Estuary	TOTAL IMPORTANCE SCORE		SPECIES RICHNESS SCORE		ENDEMIC RICHNESS SCORE		EXPLOITABLE RICHNESS SCORE		ESTUARINE TYPE SCORE		ESTUARINE CONDITION SCORE		ESTUARINE SIZE SCORE		ESTUARINE ISOLATION SCORE	
	Rank	Normalised score	Rank	Normalised score	Rank	Normalised score	Rank	Normalised score	Rank	Normalised score	Rank	Normalised score	Rank	Normalised score	Rank	Normalised score
Orange	87	58.65	248	16.47	248	47.62	248	11.32	238	50.00	154	50.00	10	62.55	1	100.00
Olifants	30	65.26	247	22.35	247	57.14	247	16.98	1	100.00	75	90.00	19	49.23	2	93.24
Groot Berg	31	64.77	239	28.24	183	71.43	239	24.53	1	100.00	154	50.00	12	60.40	3	85.16
Rietvlei/Diep	171	51.94	239	28.24	183	71.43	239	24.53	60	75.00	214	20.00	30	44.45	4	76.72
Houtbaai	241	34.32	239	28.24	183	71.43	239	24.53	60	75.00	214	20.00	211	3.33	25	51.51
Wildevoël vlei	209	45.48	239	28.24	183	71.43	239	24.53	60	75.00	154	50.00	70	32.97	92	30.08
Bokramspruit	240	34.40	239	28.24	183	71.43	239	24.53	60	75.00	214	20.00	171	15.53	111	27.02
Schuster	238	35.51	239	28.24	183	71.43	239	24.53	60	75.00	214	20.00	171	15.53	79	33.83
Krom (Wes)	169	52.12	239	28.24	183	71.43	239	24.53	60	75.00	1	100.00	171	15.53	20	55.65
Silwermyn	247	26.37	239	28.24	183	71.43	239	24.53	60	75.00	214	20.00	211	3.33	21	55.34
Sand	198	47.13	232	29.41	183	71.43	232	26.42	60	75.00	214	20.00	32	44.17	38	46.02
Eerste	239	35.48	232	29.41	183	71.43	232	26.42	60	75.00	214	20.00	197	8.45	38	46.02
Lourens	244	31.11	232	29.41	183	71.43	232	26.42	60	75.00	214	20.00	195	8.84	177	18.45
Sir Lowry's Pass	243	31.58	232	29.41	183	71.43	232	26.42	60	75.00	214	20.00	211	3.33	74	35.93
Steenbras	235	40.78	232	29.41	183	71.43	232	26.42	1	100.00	154	50.00	204	6.09	42	44.90
Rooiels	226	42.80	232	29.41	183	71.43	232	26.42	60	75.00	75	90.00	211	3.33	64	37.80
Buffels (Oos)	170	52.06	232	29.41	183	71.43	232	26.42	60	75.00	75	90.00	113	24.28	38	46.02
Palmiet	90	58.39	230	31.76	110	76.19	229	30.19	1	100.00	1	100.00	80	29.57	34	47.57
Bot/Kleinmond	13	69.69	224	32.94	53	80.95	229	30.19	1	100.00	75	90.00	6	69.50	54	41.01
Oonrus	248	24.28	230	31.76	110	76.19	229	30.19	60	75.00	214	20.00	211	3.33	47	43.70
Klein	9	72.88	224	32.94	110	76.19	224	32.08	1	100.00	75	90.00	2	74.50	22	54.70
Uilkraals	175	51.63	224	32.94	110	76.19	224	32.08	60	75.00	154	50.00	81	29.38	11	62.96
Ratel	125	56.03	224	32.94	110	76.19	224	32.08	60	75.00	75	90.00	124	22.22	8	64.28
Heuningnes	49	62.36	224	32.94	110	76.19	224	32.08	1	100.00	75	90.00	59	35.45	6	68.32
Klipdriffontein	133	55.42	224	32.94	110	76.19	224	32.08	60	75.00	1	100.00	171	15.53	9	63.91
Breë	19	68.43	212	36.47	18	85.71	212	33.96	1	100.00	75	90.00	13	57.09	33	48.53
Duiwenhoks	23	66.34	212	36.47	18	85.71	212	33.96	1	100.00	1	100.00	43	41.40	17	57.11
Goukou	39	63.18	212	36.47	18	85.71	212	33.96	1	100.00	75	90.00	50	37.32	19	55.95
Gourits	27	65.88	212	36.47	18	85.71	212	33.96	1	100.00	75	90.00	34	43.59	15	59.93
Bilinde	99	58.01	212	36.47	18	85.71	212	33.96	60	75.00	75	90.00	124	22.22	12	62.76

Hartenbos	215	45.01	212	36.47	18	85.71	212	33.96	60	75.00	214	20.00	97	26.59	44	44.31
Klein Brak	179	51.23	212	36.47	18	85.71	212	33.96	60	75.00	154	50.00	48	37.76	92	30.08
Groot Brak	177	51.51	212	36.47	18	85.71	212	33.96	60	75.00	154	50.00	60	35.22	71	36.89
Maalgate	141	54.58	212	36.47	18	85.71	212	33.96	60	75.00	75	90.00	107	25.12	74	35.93
Gwaling	142	54.58	212	36.47	18	85.71	212	33.96	60	75.00	75	90.00	124	22.22	52	41.72
Kaalmans	143	54.45	212	36.47	18	85.71	212	33.96	1	100.00	75	90.00	138	20.07	71	36.89
Wilderness	11	71.60	212	36.47	18	85.71	212	33.96	1	100.00	75	90.00	4	70.58	54	41.01
Swartvlei	10	71.64	190	38.82	8	90.48	189	39.62	1	100.00	75	90.00	11	62.22	31	48.99
Knysna	8	74.06	189	40.00	8	90.48	189	39.62	1	100.00	75	90.00	3	71.40	44	44.31
Goukamma	157	53.60	190	38.82	18	85.71	189	39.62	60	75.00	75	90.00	151	19.05	64	37.80
Noetsie	100	57.73	190	38.82	18	85.71	189	39.62	60	75.00	1	100.00	138	20.07	27	51.12
Plesang	191	49.42	190	38.82	18	85.71	189	39.62	60	75.00	154	50.00	133	20.65	31	48.99
Keurbooms	35	63.54	190	38.82	18	85.71	189	39.62	1	100.00	75	90.00	16	50.75	111	27.02
Matjies	131	55.62	190	38.82	18	85.71	189	39.62	60	75.00	1	100.00	124	22.22	79	33.83
Sout (Oos)	63	60.42	190	38.82	18	85.71	189	39.62	1	100.00	1	100.00	57	36.17	111	27.02
Groot (Wes)	119	56.36	190	38.82	18	85.71	189	39.62	60	75.00	75	90.00	74	32.11	101	28.62
Bloukrans	212	45.29	190	38.82	18	85.71	189	39.62	238	50.00	1	100.00	211	3.33	79	33.83
Lottering	134	55.08	190	38.82	18	85.71	189	39.62	238	50.00	1	100.00	94	27.34	101	28.62
Elandsbos	163	52.99	190	38.82	18	85.71	189	39.62	238	50.00	1	100.00	161	17.29	74	35.93
Storms	112	56.76	190	38.82	18	85.71	189	39.62	238	50.00	1	100.00	114	24.06	41	45.47
Elands	155	53.79	190	38.82	18	85.71	189	39.62	238	50.00	1	100.00	171	15.53	44	44.31
Groot (Oos)	149	54.32	190	38.82	18	85.71	189	39.62	238	50.00	1	100.00	171	15.53	34	47.57
Tsitsikamma	146	54.36	190	38.82	18	85.71	189	39.62	60	75.00	75	90.00	180	14.52	25	51.51
Klipdrif	135	55.05	190	38.82	18	85.71	189	39.62	60	75.00	75	90.00	171	15.53	23	53.71
Krom (Oos)	85	58.78	190	38.82	18	85.71	189	39.62	1	100.00	154	50.00	27	44.73	28	49.87
Seekoel	190	49.89	190	38.82	18	85.71	189	39.62	60	75.00	214	20.00	39	42.69	64	37.80
Kabeljous	55	61.48	190	38.82	18	85.71	189	39.62	60	75.00	75	90.00	40	41.98	56	40.26
Gamtoos	66	60.09	190	38.82	18	85.71	189	39.62	1	100.00	154	50.00	15	51.85	47	43.70
Van Stadens	110	56.78	190	38.82	18	85.71	189	39.62	60	75.00	75	90.00	92	27.57	56	40.26
Maitland	172	51.80	190	38.82	18	85.71	189	39.62	60	75.00	154	50.00	116	23.49	16	57.93
Swartkops	69	60.00	179	42.35	2	95.24	178	43.40	1	100.00	154	50.00	23	47.34	64	37.80
Koega	229	42.35	179	42.35	2	95.24	178	43.40	60	75.00	214	20.00	200	8.04	36	46.55
Sundays	12	70.92	179	42.35	2	95.24	178	43.40	1	100.00	75	90.00	21	48.05	10	63.35
Boknes	76	59.51	179	42.35	2	95.24	178	43.40	60	75.00	75	90.00	157	18.07	13	61.73
Bushmans	168	52.33	179	42.35	2	95.24	178	43.40	1	100.00	154	50.00	101	25.81	79	33.83
Kariega	151	54.06	167	45.88	1	100.00	177	45.28	1	100.00	154	50.00	75	31.95	137	23.28
Kasuka	81	59.18	179	42.35	8	90.48	178	43.40	60	75.00	1	100.00	98	26.39	64	37.80
Kowie	126	56.03	179	42.35	8	90.48	178	43.40	1	100.00	154	50.00	56	36.32	56	40.26
Rufane	203	46.23	179	42.35	8	90.48	178	43.40	60	75.00	154	50.00	171	15.53	92	30.08
Riet	89	58.48	179	42.35	8	90.48	178	43.40	60	75.00	75	90.00	63	34.64	111	27.02

Kleinmond (Wes)	152	53.98	179	42.35	8	90.48	178	43.40	60	75.00	75	90.00	86	28.52	208	11.64
Kleinmond (Oos)	104	57.22	178	43.53	2	95.24	178	43.40	60	75.00	75	90.00	90	27.79	111	27.02
Great Fish	32	64.46	167	45.86	18	85.71	168	49.06	1	100.00	75	90.00	22	47.66	101	28.62
Old Woman's	150	54.28	170	44.71	53	80.95	168	49.06	60	75.00	75	90.00	120	22.88	92	30.08
Mpekweni	65	60.31	170	44.71	53	80.95	168	49.06	60	75.00	75	90.00	45	40.05	84	32.67
Mlati	48	62.41	170	44.71	53	80.95	168	49.06	60	75.00	1	100.00	18	50.13	197	15.38
Mgwalanta	42	62.84	170	44.71	53	80.95	168	49.06	60	75.00	1	100.00	20	48.63	154	21.03
Bira	43	62.80	170	44.71	53	80.95	168	49.06	60	75.00	1	100.00	25	46.40	126	25.25
Gqutywa	123	56.12	170	44.71	53	80.95	168	49.06	60	75.00	1	100.00	61	35.13	235	6.81
Ngculura	222	43.53	170	44.71	53	80.95	168	49.06	60	75.00	75	90.00	211	3.33	137	23.28
Mtana	136	55.05	170	44.71	53	80.95	168	49.06	60	75.00	1	100.00	152	18.92	84	32.67
Keiskamma	83	59.17	167	45.88	53	80.95	153	50.94	1	100.00	154	50.00	14	54.31	111	27.02
Shwele-Shwele	183	50.86	153	47.06	53	80.95	153	50.94	60	75.00	75	90.00	166	16.71	177	18.45
Ngqinisa	164	52.87	153	47.06	53	80.95	153	50.94	60	75.00	1	100.00	129	21.26	208	11.64
Kiwane	158	53.45	153	47.06	53	80.95	153	50.94	60	75.00	1	100.00	131	21.16	197	15.38
Tyolomnqa	62	60.61	153	47.06	53	80.95	153	50.94	60	75.00	75	90.00	38	43.18	126	25.25
Lilyvale	193	48.92	153	47.06	53	80.95	153	50.94	60	75.00	75	90.00	205	5.67	101	28.62
Ncera	118	56.36	153	47.06	53	80.95	153	50.94	60	75.00	1	100.00	95	27.29	154	21.03
Miele	197	47.43	153	47.06	53	80.95	153	50.94	60	75.00	75	90.00	193	9.59	208	11.64
Mcanisi	187	50.20	153	47.06	53	80.95	153	50.94	60	75.00	75	90.00	183	13.38	154	21.03
Gxulu	180	51.10	153	47.06	53	80.95	153	50.94	60	75.00	154	50.00	68	33.14	111	27.02
Goda	116	56.37	153	47.06	53	80.95	153	50.94	60	75.00	1	100.00	106	25.19	126	25.25
Hlozi	228	42.53	153	47.06	53	80.95	153	50.94	60	75.00	75	90.00	211	3.33	177	18.45
Hickmans	233	41.34	153	47.06	53	80.95	153	50.94	60	75.00	154	50.00	187	10.92	208	11.64
Mvubukazi	246	30.53	153	47.06	53	80.95	153	50.94	60	75.00	154	50.00	211	3.33	208	11.64
Nqengga	236	38.95	153	47.06	53	80.95	153	50.94	60	75.00	75	90.00	211	3.33	137	23.28
Buffalo	174	51.66	135	49.41	53	80.95	135	52.83	1	100.00	214	20.00	31	44.22	111	27.02
Blind	245	31.10	135	49.41	53	80.95	135	52.83	60	75.00	214	20.00	211	3.33	197	15.38
Hlaze	242	32.25	135	49.41	53	80.95	135	52.83	60	75.00	214	20.00	211	3.33	208	11.64
Naphoon	173	51.76	135	49.41	53	80.95	135	52.83	1	100.00	154	50.00	51	37.22	208	11.64
Qinira	95	58.15	135	49.41	53	80.95	135	52.83	60	75.00	75	90.00	65	34.15	126	25.25
Gqunube	60	60.99	135	49.41	53	80.95	135	52.83	1	100.00	75	90.00	58	35.60	88	31.43
Kwelera	92	58.37	135	49.41	53	80.95	135	52.83	1	100.00	75	90.00	76	31.67	137	23.28
Bulura	130	55.65	135	49.41	53	80.95	135	52.83	60	75.00	75	90.00	85	28.62	154	21.03
Cunge	224	42.89	135	49.41	53	80.95	135	52.83	60	75.00	75	90.00	211	3.33	137	23.28
Cintsa	153	53.87	135	49.41	53	80.95	135	52.83	60	75.00	75	90.00	109	24.45	177	18.45
Cefane	109	56.83	135	49.41	53	80.95	135	52.83	60	75.00	1	100.00	78	30.05	197	15.38
Kwenxura	107	57.08	135	49.41	53	80.95	135	52.83	60	75.00	1	100.00	88	28.00	154	21.03
Nyara	132	55.49	135	49.41	53	80.95	135	52.83	60	75.00	1	100.00	146	19.32	101	28.62
Haga-Haga	186	50.25	135	49.41	53	80.95	135	52.83	60	75.00	1	100.00	211	3.33	92	30.08

Mtendwe	160	53.16	135	49.41	53	80.95	135	52.83	60	75.00	1	100.00	181	13.85	126	25.25
Quko	84	59.13	135	49.41	53	80.95	135	52.83	60	75.00	1	100.00	68	33.14	137	23.28
Morgan	113	56.44	135	49.41	53	80.95	135	52.83	60	75.00	75	90.00	84	28.91	126	25.25
Cwilli	221	44.29	135	49.41	53	80.95	135	52.83	60	75.00	75	90.00	211	3.33	177	18.45
Great Kei	74	59.55	134	63.53	18	85.71	118	73.58	1	100.00	154	50.00	17	50.61	235	6.81
Gxara	128	55.99	124	64.71	110	76.19	118	73.58	60	75.00	75	90.00	104	25.61	208	11.64
Ngogwane	214	45.17	124	64.71	110	76.19	118	73.58	60	75.00	154	50.00	179	14.87	235	6.81
Qolora	154	53.83	124	64.71	110	76.19	118	73.58	60	75.00	1	100.00	146	19.32	245	1.00
Ncizele	124	56.10	124	64.71	110	76.19	118	73.58	60	75.00	1	100.00	168	16.28	154	21.03
Kobonqaba	80	59.34	124	64.71	110	76.19	118	73.58	1	100.00	75	90.00	118	23.23	101	28.62
Nxaxo	14	69.60	124	64.71	110	76.19	118	73.58	1	100.00	1	100.00	24	46.55	78	34.91
Cebe	88	58.61	124	64.71	110	76.19	118	73.58	60	75.00	1	100.00	144	19.45	92	30.08
Gqunqe	120	56.36	124	64.71	110	76.19	118	73.58	60	75.00	1	100.00	141	19.89	197	15.38
Ngqwara	96	58.12	124	64.71	110	76.19	118	73.58	60	75.00	1	100.00	122	22.45	154	21.03
Sihlontweni	101	57.50	124	64.71	110	76.19	118	73.58	60	75.00	1	100.00	137	20.54	154	21.03
Gora	28	65.86	118	65.88	110	76.19	118	73.58	1	100.00	1	100.00	44	40.32	137	23.28
Jujura	159	53.26	118	65.88	110	76.19	118	73.58	60	75.00	75	90.00	186	11.95	154	21.03
Shixini	68	60.02	118	65.88	110	76.19	118	73.58	1	100.00	75	90.00	117	23.34	88	31.43
Nqabara	18	68.93	118	65.88	110	76.19	118	73.58	1	100.00	1	100.00	36	43.38	74	35.93
Ngoma	162	53.12	118	65.88	110	76.19	118	73.58	60	75.00	1	100.00	211	3.33	92	30.08
Mendu	71	59.73	118	65.88	110	76.19	118	73.58	60	75.00	1	100.00	103	25.69	137	23.28
Mbashe	26	65.93	107	70.59	110	76.19	107	79.25	1	100.00	75	90.00	37	43.34	154	21.03
Mbhanyana	102	57.47	115	69.41	183	71.43	108	77.36	60	75.00	1	100.00	154	18.75	137	23.28
Nitonyane	56	61.22	115	69.41	183	71.43	108	77.36	60	75.00	1	100.00	73	32.65	177	18.45
Nkanya	114	56.42	115	69.41	183	71.43	108	77.36	60	75.00	1	100.00	143	19.47	197	15.38
Xora	21	66.76	107	70.59	183	71.43	108	77.36	1	100.00	1	100.00	35	43.58	154	21.03
Bulungulu	97	58.07	107	70.59	183	71.43	108	77.36	60	75.00	1	100.00	132	21.10	154	21.03
Ku-amanzimuzama	166	52.61	107	70.59	183	71.43	108	77.36	60	75.00	1	100.00	211	3.33	137	23.28
Mncwasa	59	61.02	107	70.59	183	71.43	108	77.36	60	75.00	1	100.00	100	26.37	101	28.62
Mpako	79	59.39	107	70.59	183	71.43	108	77.36	60	75.00	1	100.00	145	19.34	84	32.67
Nenga	121	56.29	107	70.59	183	71.43	108	77.36	60	75.00	75	90.00	185	16.87	101	28.62
Mapuzi	115	56.37	107	70.59	183	71.43	108	77.36	60	75.00	1	100.00	135	20.60	208	11.64
Mtata	24	66.33	96	76.47	183	71.43	96	83.02	1	100.00	75	90.00	28	44.68	177	18.45
Mdumbi	22	66.52	96	76.47	183	71.43	96	83.02	1	100.00	1	100.00	55	36.86	126	25.25
Lwandlana	106	57.14	96	76.47	183	71.43	96	83.02	60	75.00	1	100.00	150	19.07	208	11.64
Lwandile	64	60.38	96	76.47	183	71.43	96	83.02	60	75.00	1	100.00	111	24.30	154	21.03
Miakatye	20	68.40	96	76.47	183	71.43	96	83.02	1	100.00	1	100.00	41	41.75	111	27.02
Hluleka	82	59.17	96	76.47	183	71.43	96	83.02	60	75.00	1	100.00	135	20.60	154	21.03
Mhenu	40	63.00	96	76.47	183	71.43	96	83.02	60	75.00	1	100.00	52	37.04	208	11.64
Mtonga	57	61.06	96	76.47	183	71.43	96	83.02	60	75.00	1	100.00	98	26.39	154	21.03

Sinangwana	67	60.07	96	76.47	183	71.43	96	83.02	60	75.00	1	100.00	163	16.97	79	33.83
Mgazana	29	65.68	96	76.47	183	71.43	96	83.02	1	100.00	75	90.00	54	36.87	92	30.08
Mngazi	86	58.77	96	76.47	183	71.43	96	83.02	60	75.00	75	90.00	110	24.38	154	21.03
Bulo	108	56.91	91	77.65	183	71.43	91	84.91	60	75.00	75	90.00	160	17.76	154	21.03
Mtambane	182	50.88	91	77.65	183	71.43	91	84.91	60	75.00	154	50.00	167	16.29	111	27.02
Mzimvubu	94	58.16	91	77.65	183	71.43	91	84.91	238	50.00	154	50.00	29	44.66	137	23.28
Ntlupeni	129	55.65	91	77.65	183	71.43	91	84.91	60	75.00	1	100.00	182	13.62	208	11.64
Nkodusweni	38	63.22	91	77.65	183	71.43	91	84.91	60	75.00	1	100.00	79	30.01	126	25.25
Mintafufu	45	62.69	88	80.00	183	71.43	88	86.79	1	100.00	1	100.00	142	19.64	88	31.43
Mzintlava	33	64.23	88	80.00	183	71.43	88	86.79	1	100.00	1	100.00	102	25.76	101	28.62
Mzimpunzi	111	56.76	88	80.00	183	71.43	88	86.79	60	75.00	1	100.00	188	10.83	154	21.03
Mbotyi	50	61.92	83	81.18	183	71.43	83	88.68	60	75.00	75	90.00	67	33.55	197	15.38
Mkozi	148	54.33	83	81.18	183	71.43	83	88.68	60	75.00	1	100.00	202	7.16	208	11.64
Myekane	140	54.60	83	81.18	183	71.43	83	88.68	60	75.00	1	100.00	211	3.33	126	25.25
Lupatana	91	58.38	83	81.18	183	71.43	83	88.68	60	75.00	1	100.00	192	9.69	88	31.43
Mkwani	51	61.58	83	81.18	183	71.43	83	88.68	60	75.00	1	100.00	170	15.89	61	38.66
Msikaba	25	66.20	68	82.35	183	71.43	23	90.57	1	100.00	1	100.00	119	23.09	49	42.41
Mtentu	17	69.10	68	82.35	183	71.43	23	90.57	1	100.00	1	100.00	64	34.30	64	37.80
Sikombe	54	61.50	68	82.35	183	71.43	23	90.57	60	75.00	1	100.00	128	21.43	126	25.25
Kwanyana	103	57.30	68	82.35	183	71.43	23	90.57	60	75.00	1	100.00	159	17.79	235	6.81
Mnyameni	44	62.76	68	82.35	183	71.43	23	90.57	60	75.00	1	100.00	93	27.41	154	21.03
Mpahlanzana	117	56.37	68	82.35	183	71.43	23	90.57	60	75.00	1	100.00	189	10.64	197	15.38
Mpahlane	138	54.93	68	82.35	183	71.43	23	90.57	60	75.00	1	100.00	191	10.51	235	6.81
Mzamba	46	62.67	68	82.35	183	71.43	23	90.57	1	100.00	75	90.00	62	35.07	235	6.81
Mtentwana	105	57.18	68	82.35	183	71.43	23	90.57	60	75.00	75	90.00	123	22.42	235	6.81
Miamvuna	47	62.58	68	82.35	183	71.43	23	90.57	60	75.00	1	100.00	53	36.89	245	1.00
Zolwane	200	46.87	68	82.35	183	71.43	23	90.57	60	75.00	75	90.00	211	3.33	208	11.64
Sandlondlu	137	55.02	68	82.35	183	71.43	23	90.57	60	75.00	75	90.00	183	13.38	208	11.64
Ku-Boboyi	237	38.75	68	82.35	183	71.43	23	90.57	60	75.00	214	20.00	211	3.33	235	6.81
Tongazi	181	50.99	68	82.35	183	71.43	23	90.57	60	75.00	75	90.00	211	3.33	177	18.45
Kandandhlovu	199	47.09	68	82.35	183	71.43	23	90.57	60	75.00	154	50.00	205	5.67	177	18.45
Mperjati	147	54.35	23	83.53	110	76.19	23	90.57	60	75.00	154	50.00	115	23.66	154	21.03
Umhlangankulu	167	52.53	23	83.53	110	76.19	23	90.57	60	75.00	154	50.00	163	16.97	137	23.28
Kaba	216	44.86	23	83.53	110	76.19	23	90.57	60	75.00	214	20.00	197	8.45	137	23.28
Mbizana	188	50.03	23	83.53	110	76.19	23	90.57	60	75.00	214	20.00	111	24.30	137	23.28
Mvutshini	218	44.70	23	83.53	110	76.19	23	90.57	60	75.00	154	50.00	211	3.33	208	11.64
Bilanhlo	202	46.37	23	83.53	110	76.19	23	90.57	60	75.00	154	50.00	194	9.22	245	1.00
Uvuzana	223	43.49	23	83.53	110	76.19	23	90.57	60	75.00	154	50.00	211	3.33	208	11.64
Kongweni	234	41.31	23	83.53	110	76.19	23	90.57	60	75.00	214	20.00	210	3.38	208	11.64
Vungu	219	44.70	23	83.53	110	76.19	23	90.57	60	75.00	154	50.00	211	3.33	235	6.81

Mhlangeni	211	45.35	23	83.53	110	76.19	23	90.57	60	75.00	214	20.00	185	12.36	177	18.45
Zotsha	78	59.42	23	83.53	110	76.19	23	90.57	60	75.00	75	90.00	148	19.19	154	21.03
Boboyi	205	45.93	23	83.53	110	76.19	23	90.57	60	75.00	154	50.00	211	3.33	208	11.64
Mbango	217	44.77	23	83.53	110	76.19	23	90.57	60	75.00	154	50.00	211	3.33	208	11.64
Mzimkulu	122	56.22	23	83.53	110	76.19	23	90.57	1	100.00	214	20.00	42	41.53	177	18.45
Mtentweni	165	52.75	23	83.53	110	76.19	23	90.57	60	75.00	154	50.00	140	20.05	177	18.45
Mhlangamkulu	208	45.52	23	83.53	110	76.19	23	90.57	60	75.00	154	50.00	211	3.33	197	15.38
Damba	144	54.41	23	83.53	110	76.19	23	90.57	60	75.00	75	90.00	207	5.12	177	18.45
Koshwana	232	41.34	23	83.53	110	76.19	23	90.57	60	75.00	214	20.00	211	3.33	197	15.38
Intshambili	144	54.41	23	83.53	110	76.19	23	90.57	60	75.00	75	90.00	207	5.12	177	18.45
Mzombe	189	50.01	23	83.53	110	76.19	23	90.57	60	75.00	154	50.00	201	7.91	177	18.45
Mhlabatshane	194	48.79	23	83.53	110	76.19	23	90.57	60	75.00	154	50.00	201	7.91	177	18.45
Mhlungwa	207	45.57	23	83.53	110	76.19	23	90.57	60	75.00	214	20.00	190	10.60	137	23.28
Mfazazana	196	47.44	23	83.53	110	76.19	23	90.57	60	75.00	154	50.00	202	7.16	208	11.64
Kwa-makosi	204	46.19	23	83.53	110	76.19	23	90.57	60	75.00	154	50.00	196	8.65	245	1.00
Mnamfu	206	45.88	23	83.53	110	76.19	23	90.57	60	75.00	154	50.00	211	3.33	208	11.64
Mtwalume	185	50.32	23	83.53	110	76.19	23	90.57	60	75.00	214	20.00	77	30.99	208	11.64
Mvuzi	220	44.40	23	83.53	110	76.19	23	90.57	60	75.00	154	50.00	211	3.33	208	11.64
Fafa	37	63.44	23	83.53	110	76.19	23	90.57	60	75.00	75	90.00	71	32.83	177	18.45
Mdesingane	231	42.14	23	83.53	110	76.19	23	90.57	60	75.00	154	50.00	211	3.33	208	11.64
Sezela	178	51.23	23	83.53	110	76.19	23	90.57	60	75.00	154	50.00	130	21.21	235	6.81
Mkumbane	230	42.27	23	83.53	110	76.19	23	90.57	60	75.00	154	50.00	211	3.33	154	21.03
Mzinto	161	53.13	23	83.53	110	76.19	23	90.57	60	75.00	154	50.00	153	18.78	137	23.28
Mzimayi	225	42.89	23	83.53	110	76.19	23	90.57	60	75.00	214	20.00	211	3.33	92	30.08
Mpambanyoni	210	45.37	23	83.53	110	76.19	23	90.57	60	75.00	214	20.00	199	8.12	111	27.02
Mahlongwa	93	58.32	23	83.53	110	76.19	23	90.57	60	75.00	75	90.00	162	17.13	177	18.45
Mahlongwana	73	59.58	23	83.53	110	76.19	23	90.57	60	75.00	75	90.00	155	18.56	137	23.28
Mkomazi	58	61.03	23	83.53	110	76.19	23	90.57	1	100.00	154	50.00	46	39.96	154	21.03
Ngane	201	46.68	23	83.53	110	76.19	23	90.57	60	75.00	154	50.00	211	3.33	197	15.38
Ungababa	61	60.69	23	83.53	110	76.19	23	90.57	60	75.00	75	90.00	90	27.79	208	11.64
Msimbazi	70	59.75	23	83.53	110	76.19	23	90.57	60	75.00	75	90.00	108	24.90	208	11.64
Lovu	156	53.61	23	83.53	110	76.19	23	90.57	60	75.00	154	50.00	121	22.69	177	18.45
Little Manzimtoti	227	42.60	23	83.53	110	76.19	23	90.57	60	75.00	214	20.00	209	3.91	177	18.45
Manzimtoti	195	48.69	23	83.53	110	76.19	23	90.57	60	75.00	214	20.00	156	18.31	111	27.02
Mbokodweni	192	48.95	23	83.53	110	76.19	23	90.57	60	75.00	214	20.00	149	19.11	111	27.02
Sipingo	213	45.27	23	83.53	110	76.19	23	90.57	1	100.00	214	20.00	211	3.33	61	38.66
Durban Bay	5	75.70	22	90.59	53	80.95	9	96.23	1	100.00	154	50.00	7	67.41	49	42.41
Mgeni	34	64.12	21	91.76	53	80.95	9	96.23	60	75.00	154	50.00	49	37.36	61	38.66
Mhlanga	15	69.49	9	92.94	53	80.95	9	96.23	60	75.00	75	90.00	71	32.83	60	39.48
Mdloti	41	62.85	9	92.94	53	80.95	9	96.23	60	75.00	154	50.00	66	33.75	71	36.89

Tongati	127	56.02	9	92.94	53	80.95	9	96.23	60	75.00	214	20.00	105	25.40	52	41.72
Mhlali	52	61.57	9	92.94	53	80.95	9	96.23	60	75.00	154	50.00	81	29.38	64	37.80
Seteni	184	50.33	9	92.94	53	80.95	9	96.23	60	75.00	154	50.00	211	3.33	126	25.25
Mvoti	98	58.04	9	92.94	53	80.95	9	96.23	238	50.00	154	50.00	87	28.11	111	27.02
Mdlotane	36	63.49	9	92.94	53	80.95	9	96.23	60	75.00	75	90.00	158	17.84	84	32.67
Nonoti	139	54.70	9	92.94	53	80.95	9	96.23	60	75.00	214	20.00	89	27.90	101	28.62
Zinkwasi	72	59.72	9	92.94	53	80.95	9	96.23	60	75.00	154	50.00	83	29.09	111	27.02
Tugela	77	59.51	9	92.94	53	80.95	9	96.23	238	50.00	214	20.00	47	38.68	42	44.90
Matigulu/Nyoni	3	76.89	9	92.94	53	80.95	9	96.23	1	100.00	75	90.00	26	46.37	29	49.44
Siyaya	176	51.53	9	92.94	53	80.95	9	96.23	60	75.00	154	50.00	211	3.33	56	40.26
Mlalazi	4	76.43	7	94.12	53	80.95	7	98.11	1	100.00	75	90.00	33	44.04	29	49.44
Mhlatuze	7	74.82	7	94.12	110	76.19	7	98.11	1	100.00	154	50.00	9	62.93	36	46.55
Richard's Bay	6	75.66	4	95.29	110	76.19	1	100.00	1	100.00	154	50.00	8	66.67	49	42.41
Nhlabane	53	61.50	4	95.29	110	76.19	1	100.00	1	100.00	154	50.00	169	15.91	17	57.11
Mfolozi	75	59.54	4	95.29	110	76.19	1	100.00	238	50.00	154	50.00	133	20.65	24	52.28
St Lucia	1	100.00	1	100.00	8	90.48	1	100.00	1	100.00	75	90.00	1	100.00	7	66.02
Mgobezeleni	16	69.37	3	98.82	8	90.48	1	100.00	1	100.00	75	90.00	211	3.33	5	74.29
Kosi	2	89.46	1	100.00	8	90.48	1	100.00	1	100.00	75	90.00	5	70.26	14	60.85

## APPENDIX D

Ranking of 248 estuaries within each of three biogeographical regions along the South African coast. Biogeographical regions after Whitfield (2000) and Maree *et al.* (2000).

COOL TEMPERATE			WARM TEMPERATE			SUBTROPICAL		
Estuary	Rank	Normalised Score	Estuary	Rank	Normalised Score	Estuary	Rank	Normalised Score
Olifants	1	100.00	Knysna	1	100.00	St Lucia	1	100.00
Groot Berg	2	99.24	Klein	2	98.40	Kosi	2	89.46
Orange	3	89.87	Swartvlei	3	96.73	Matigulu/Nyoni	3	76.89
Krom (Wes)	4	79.85	Wilderness	4	96.67	Mlalazi	4	76.43
Rietvlei/Diep	5	79.58	Sundays	5	95.75	Durban Bay	5	75.70
Wildevoël vlei	6	69.69	Bot/Kleinmond	6	94.09	Richard's Bay	6	75.66
Schuster	7	54.41	Nxaxo	7	93.97	Mhlatuze	7	74.82
Bokramspruit	8	52.71	Nqabara	8	93.06	Mhlanga	8	69.49
Houtbaai	9	52.58	Breë	9	92.39	Mgobezeleni	9	69.37
			Duiwenhoks	10	89.56	Mtentu	10	69.10
			Gourits	11	88.95	Mtakatye	11	68.40
			Qora	12	88.93	Xora	12	66.76
			Great Fish	13	87.03	Mdumbi	13	66.52
			Keurbooms	14	85.79	Mtata	14	66.33
			Goukou	15	85.31	Msikaba	15	66.20
			Mgwalana	16	84.85	Mbashe	16	65.93
			Bira	17	84.79	Mngazana	17	65.68
			Mtati	18	84.26	Mzintlava	18	64.23
			Heuningnes	19	84.20	Mgeni	19	64.12
			Kabeljous	20	83.01	Mdlotane	20	63.49
			Gqunube	21	82.34	Fafa	21	63.44
			Tyolomnqa	22	81.83	Nkodusweni	22	63.22
			Sout (Oos)	23	81.57	Mnenu	23	63.00
			Mpekweni	24	81.42	Mdloti	24	62.85
			Gamtoos	25	81.14	Mnyameni	25	62.76
			Shixini	26	81.04	Mntafufu	26	62.69
			Swartkops	27	81.01	Mzamba	27	62.67
			Mendu	28	80.65	Mtamvuna	28	62.58
			Great Kei	29	80.40	Mbotyi	29	61.92
			Boknes	30	80.35	Mkwani	30	61.58
			Kobonqaba	31	80.12	Mhlali	31	61.57
			Kasuka	32	79.91	Nhlabane	32	61.50
			Keiskamma	33	79.89	Sikombe	33	61.50
			Quko	34	79.83	Ntlongyane	34	61.22
			Krom (Oos)	35	79.36	Mtonga	35	61.06
			Cebe	36	79.14	Mkomazi	36	61.03
			Riet	37	78.96	Mncwasa	37	61.02
			Palmiet	38	78.84	Umgababa	38	60.69
			Kwelera	39	78.81	Lwandile	39	60.38
			Qinira	40	78.51	Sinangwana	40	60.07

	WARM TEMPERATE			SUBTROPICAL		
	Estuary	Rank	Normalised Score	Estuary	Rank	Normalised Score
	Ngqwara	41	78.47	Msimbazi	41	59.75
	Blinde	42	78.33	Zinkwasi	42	59.72
	Noetsie	43	77.95	Mahlongwana	43	59.58
	Sihlontlweni	44	77.63	Mfolozi	44	59.54
	Kleinemonnd (Oos)	45	77.25	Tugela	45	59.51
	Kwenxura	46	77.07	Zotsha	46	59.42
	Cefane	47	76.73	Mpako	47	59.39
	Van Stadens	48	76.66	Hluleka	48	59.17
	Storms	49	76.63	Mngazi	49	58.77
	Morgan	50	76.20	Lupatana	50	58.38
	Goda	51	76.11	Mahlongwa	51	58.32
	Ncera	52	76.10	Mzimvubu	52	58.16
	Groot (Wes)	53	76.10	Bulungulu	53	58.07
	Gqunqe	54	76.10	Mvoti	54	58.04
	Gqutywa	55	75.77	Mbhanyana	55	57.47
	Ncizele	56	75.75	Kwanyana	56	57.30
	Ratel	57	75.65	Mtentwana	57	57.18
	Kowie	58	75.64	Lwandilana	58	57.14
	Gxara	59	75.59	Bulolo	59	56.91
	Bulura	60	75.14	Mzimpunzi	60	56.76
	Matjies	61	75.09	Nkanya	61	56.42
	Nyara	62	74.92	Mapuzi	62	56.37
	Klipdriffontein	63	74.83	Mpahlanyana	63	56.37
	Lottering	64	74.37	Nenga	64	56.29
	Klipdrif	65	74.32	Mzimkulu	65	56.22
	Mtana	66	74.32	Tongati	66	56.02
	Maalgate	67	73.70	Ntlupeni	67	55.65
	Gwaing	68	73.70	Sandlundlu	68	55.02
	Kaaimans	69	73.52	Mpahlane	69	54.93
	Tsitsikamma	70	73.39	Nonoti	70	54.70
	Groot (Oos)	71	73.34	Myekane	71	54.60
	Old Woman's	72	73.29	Damba	72	54.41
	Kariega	72	72.99	Intshambili	73	54.41
	Kleinemonnd (Wes)	74	72.88	Mpenjati	74	54.35
	Cintsa	75	72.74	Mkozi	75	54.33
	Qolora	76	72.68	Lovu	75	53.61
	Elands	77	72.62	Mzinto	77	53.13
	Goukamma	78	72.37	Mtentweni	78	52.75
	Kiwane	79	72.16	Ku-amanzimuzama	79	52.61
	Jujura	80	71.90	Umhlangankulu	80	52.53
	Mtendwe	81	71.77	Siyaya	81	51.53
	Ngoma	82	71.72	Sezela	82	51.23
	Elandsbos	83	71.55	Tongazi	83	50.99
	Ngqinisa	84	71.38	Mtambane	84	50.88
	Bushmans	85	70.65	Seteni	85	50.33

	WARM TEMPERATE			SUBTROPICAL		
	Estuary	Rank	Normalised Score	Estuary	Rank	Normalised Score
	Buffels (Oos)	86	70.29	Mtwalume	86	50.32
	Maitland	87	69.95	Mbizana	87	50.03
	Nahoon	88	69.89	Mzumbe	88	50.01
	Buffalo	89	69.75	Mbokodweni	89	48.95
	Uilkraals	90	69.70	Mhlabatshane	90	48.79
	Groot Brak	91	69.55	Manzimtoti	91	48.69
	Klein Brak	92	69.17	Mfazazana	92	47.44
	Gxulu	93	68.99	Kandandhlovu	93	47.09
	Shwele-Shwele	94	68.67	Zolwane	94	46.87
	Haga-Haga	95	67.85	Ngane	95	46.68
	Mcantsi	96	67.77	Bilanhlo	96	46.37
	Seekoei	97	67.37	Kwa-makosi	97	46.19
	Piesang	98	66.73	Boboyi	98	45.93
	Lilyvale	99	66.05	Mnamfu	99	45.88
	Mlele	100	64.03	Mhlungwa	99	45.57
	Sand	101	63.64	Mhlangamkulu	101	45.52
	Rufane	102	62.41	Mpambanyoni	102	45.37
	Bloukrans	103	61.16	Mhlangeni	102	45.35
	Ngogwane	104	60.99	Sipingo	102	45.27
	Hartenbos	105	60.77	Kaba	102	44.86
	Cwili	106	59.80	Mbango	102	44.77
	Ngculura	107	58.77	Mvutshini	107	44.70
	Cunge	108	57.91	Vungu	108	44.70
	Rooiels	109	57.79	Mvuzi	109	44.40
	Hlozi	110	57.42	Uvuzana	110	43.49
	Koega	111	57.18	Mzimayi	111	42.89
	Hickmans	112	55.81	Little Manzimtoti	112	42.60
	Steenbras	113	55.06	Mkumbane	113	42.27
	Ncqenga	114	52.59	Mdesingane	114	42.14
	Eerste	115	47.91	Koshwana	115	41.34
	Hlaze	116	43.54	Kongweni	116	41.31
	Sir Lowry's Pass	117	42.63	Ku-Boboyi	117	38.75
	Lourens	118	42.01			
	Blind	119	41.99			
	Mvubukazi	120	41.22			
	Silwermyn	121	35.61			
	Onrus	122	32.79			