Protocols Contributing to the Management of Estuaries in South Africa, with a Particular Emphasis on the Eastern Cape Province

Volume II

Report C

A Classification System for Eastern Cape Estuaries, with Management Guidelines for the Sustainable use of their Living Resources

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ABSTRACT

Increased levels of exploitation, illegal fishing activities and declining levels of estuary resource availability have highlighted the need for management to ensure long-term sustainable use of estuarine living resources. This report details the procedure that was followed to identify environmental, socio-economic and institutional issues that were affecting the sustainable use of living resources in estuaries. In order to address these issues, management guidelines for environmental (resource and ecosystem level), socio-economic and institutional issues, to be used by local managers on a variety of estuary categories based on mouth state and user dynamics, are proposed. A total of 10 resource, 8 ecosystem, 13 socio-economic and 18 institutional related guidelines were formulated. A Rapid Assessment Matrix (RAM) is proposed to identify priority estuaries within municipal regions based on a subjective assessment of certain key indicators. An Ecosystem Based Management (EBM) approach is suggested for the detailed assessment, through rating key environmental, social and institutional indicators, of the effective implementation of the proposed guidelines and the degree to which sustainable use has been achieved on a specific estuary.

1 INTRODUCTION

Despite years of scientific research and effort that has been invested in the management of aquatic living resources, sustainability is an ideal still to be realized in many instances (Knudsen and MacDonald, 2000). The primary reason for this failure is the ever increasing pressure on dwindling natural resources by a demanding human population. In addition to high levels of exploitation, methods of exploitation and resource allocation pose a clear threat to the ecological and socio-economic sustainable use of living resources (Pajak, 2000).

As a result of differing opinions on the robustness of the environment, and indeed the differences between individual species and ecosystems in this regard (Garcia and Staples, 2000b), opinions of what sustainable use is, vary. There are a few definitions which differ only semantically, but all contain the same basic message delivered by the Convention on Biological Diversity, which defines sustainable use as:

> *The use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations.*

Although this definition clearly incorporates a temporal aspect (e.g. long-term; future generations), it is vital to realize that components of biodiversity are also influenced by ecological, social and economic factors that differ on a spatial scale. This means that controls aimed at achieving sustainability will differ spatially while changing on a temporal scale as population dynamics change with time. There is no single hard and fast rule regarding sustainable use, but the principles of sustainable use developed by the World Conservation Union/Sustainable Use Specialist Group (IUCN/SSC) (Anon., 2000) can be applied to any situation and evaluated on a case-by-case (system specific) basis (Volume III, Project C, Supplementary Report 2).

A number of factors need to be taken into account when considering a resource for sustainable use (Anon., 2000; Garcia and Staples, 2000a), namely:

- Resources suitable for exploitation are limited by intrinsic features of both the species and its ecosystem, and include productivity, resilience and stability, all of which are influenced by extrinsic environmental variability.
- Effective management of resources requires positive incentives, negative sanctions and good governance, all of which need to be implemented on a hierarchical scale, the extent of which will be determined by each individual scenario. Participation of all stakeholders in this process is essential, and governance of renewable resources should be ecosystem-based and more holistic, requiring greater transparency, broader participation and systematic appraisal of management and managers.
- The cultural, ethical, ecological and economic values of the resource need to be ascertained. A positive spin needs to be placed on these values to create a favourable environment for investment by managers and users to reduce resource degradation, depletion and habitat conversion and promote conservation and sustainable use.

- It is likely that in the near future, demand for resources will increase while supply will decrease. Demand will fluctuate with political, social, economic and demographic factors, which need to be understood and anticipated to promote sustainability.

The functioning of estuaries and the biological aspects of many of their living resources are well documented in the literature. However, little is known about the dynamics and sustainability of resource utilization, user group dynamics (social and economic) and fisheries potential within these ecosystems. The paucity of data regarding estuarine resource utilization is highlighted when considering the data obtained from the detailed fisheries surveys performed during this project. For example, intensive roving creel surveys, conducted on the Kowie (Volume III, Project C, Supplementary Report 5), revealed that 28 fish species/groups were caught by recreational and subsistence users, and of these, 8 were actively targeted. As many as 20 bait types (invertebrate, vertebrate and artificial lures and flies) were used, 11 of which were collected from the Kowie system. These numbers for a single estuary differ markedly from those reported for the entire Eastern Cape region up till now (Pradervand, 1998; Cowley, 2000a).

The level of exploitation in some of the 143 functional estuaries in the Eastern Cape, specifically ones located near urban communities, is high because of easy, convenient and mostly safe access, even during adverse weather conditions. These high levels of exploitation pose a threat to species such as dusky kob and white steenbras, which are already over-exploited, and which utilise estuaries as nursery areas. In addition, juveniles of many species (e.g. Cape stumpnose, spotted grunter and white steenbras) are heavily targeted by both recreational and sham-recreational users, and will continue to be harvested unless law enforcement capacity is addressed. In addition, the recent banning of 4x4 vehicles on our beaches may result in an increase in fishing pressure on all our estuaries. Evidence of this is not yet forthcoming, but may be the result of a time lag while anglers convert from one form of exploitation (beach angling) to another.

Even on a national scale it would appear that few estuarine fisheries can be regarded as being sustainable at present levels (e.g. Kosi and Mtentu). If sustainable coastal development is to be achieved, partnerships and co-responsibility amongst key players such as government, local communities, parastatals and other statutory management bodies, civil society organizations and the research community need to be established (Anon. 1999). The requirements for sustainability in estuaries were clearly stated in a document prepared for the Department of Environmental Affairs and Tourism (DEAT) in the Eastern Cape (Cowley, 2000a) as follows:

> *The sustainable utilisation of Eastern Cape estuaries and their resources hinges on improved law enforcement, the development and implementation of a management system and dedicated research and monitoring efforts.*

2 RATIONALE

A wide variety of estuarine living resources are exploited by man for pleasure (recreational fishers), financial gain (commercial and recreational fishers and subsistence bait sellers) or as a primary food source (subsistence and traditional fishers). In recent years, increased levels of exploitation, illegal activities from all user groups and declining levels of resource availability,

have accentuated the need for management to ensure long-term sustainability. Until recently, estuarine resource management has arisen out of an information vacuum. Research on resource utilisation in the majority of South African estuaries is sparse, and existing information is fragmented, with minimal data on stock sizes and dynamics and socio-economic influences. This consequently allows for minimal management type applications. Many estuarine angling species such as the dusky kob and spotted grunter; and bait organisms such as bloodworm; and plant species such as mangroves (in certain systems) are presently over-exploited, and as such their management must be of the highest priority. Consequently, there is a desperate need to conduct quantitative ecological and socio-economic assessments of estuarine fisheries in order to develop and subsequently implement clear management protocols.

Estuarine resource utilisation is currently managed using a single species approach, with little consideration of the diversity of estuarine types and their ecological complexity and functioning. Furthermore, the forces of social and economic structuring that affect the various users, both fishers and bait collectors, are poorly understood, and institutional capacity is generally poor. These factors, in conjunction with the lack of historical data upon which to base a comparative infrastructure, have impeded the formulation of an overall estuarine specific management framework.

The Eastern Cape exhibits a limited capacity for effective coastal management, which is unfortunate for a region that has such a rich and diverse natural heritage. Protection of living resources is hampered in a region, which is dominated by rural communities, particularly those in the former Ciskei and Transkei regions. These communities are economically deprived, have a poor infrastructure and are limited in their capacity to manage their rich natural (and cultural) assets. Estuaries have the highest economic value of all ecosystems (Costanza et al., 1999) and are of fundamental importance to both the tourist and fishing industries, including commercial marine fisheries which utilize estuarine dependent species. Despite the many benefits that may be derived from these systems by people, development, habitat reclamation and high levels of exploitation have impacted negatively on their functioning. In effect, estuaries are a reflection of their surrounding environments, and their health is inexorably linked to factors such as the activities of humans, consumption per capita and prevailing technology (Grindley, 1974; Heydorn, 1986; Pajak, 2000). The multiple-use dynamic which characterizes estuaries, means that flexible management is required which is estuary or situation specific. In an article describing the threats to estuaries, Grindley (1974) suggested that the (then) Departments of Environment and Planning be completely separate to facilitate more effective parliamentary debate on related issues. More than a quarter of a century later the realization is that the only hope for effective management is to promote co-operation and an integrated coastal management strategy. Sustainable use of living resources in estuaries depends on a compromise between a suite of biological, social and economic factors. Integrated management plans involving public awareness; shared responsibility and empowerment; job creation; access equity; and partnerships between managers, users and enforcement agencies; will facilitate the ideal of sustainable use.

The Estuaries Management Research Sub-programme of the Eastern Cape Estuaries Management Programme (ECEMP) has been designed to acquire a better understanding of the issues confronting estuary managers, and to develop additional guidelines and tools to augment the

decision-making process as it pertains to estuary management. In order to realise these goals, the sub-programme identified a number of aims, each of which were to be achieved through directed research projects. This report details the project that was undertaken to achieve the following aim:

> *To develop guidelines for the appropriate authorities to ensure the sustainable use of estuarine living resources*

2.1 Project goal

To develop a set of guidelines to help manage to achieve the sustainable exploitation of living resources in Eastern Cape estuaries, which will be classified according to mouth state (open or temporarily open/closed) and user dynamics (no use, recreational and/or subsistence). These guidelines will be made available to managers who will be able to determine the best approach to sustainable use of the estuaries in their jurisdiction, and these guidelines will be based upon research incorporating the essential aspects defined in the principles of sustainability (Volume III, Project C, Supplementary Report 3)

2.2 Project objectives

2.2.1 To determine the current status of sustainable use in South African estuaries

This section of the project took the form of a literature review and comprised two aspects, namely:

1. A review paper on sustainable use, including a survey of sustainability of living resources in estuarine/marine environments (Volume III, Project C, Supplementary Report 2)
2. A review paper on the current knowledge and status of living resource exploitation in Eastern Cape estuaries (Volume III, Project C, Supplementary Report 3)

2.2.2 To assess the state of estuarine fisheries on selected Eastern Cape systems

This aspect of the study comprised several case studies on specific estuaries, namely:

1. Snapshot surveys of the biological, social and economic characteristics of the fisheries on the Gamtoos, Tyolomnqa, Cintsa, Cefane, Umngazana, Umngazi and Mzimvubu estuaries (Volume III, Project C, Supplementary Report 4), and
2. Detailed surveys of the biological, social and economic characteristics of the fisheries on the Kowie, Great Fish and East and West Kleinemonde (Volume III, Project C, Supplementary Report 5) estuaries.

2.2.3 To determine the economic importance of sustainable use

Detailed economic surveys were conducted on the Kowie, Great Fish and East and West Kleinemonde estuaries. Data gathered during the detailed fisheries surveys (see 2.2.2, above) were also used in the analysis. A report detailing the recreational angling and subsistence use activities and recommendations for their management from an economic perspective were presented in Volume III, Project C, Supplementary Report 6.

2.2.4 To determine the social and institutional forces which act on the exploitation of estuarine resources

Data pertinent to the social aspects influencing estuarine resource use were collected during the detailed and snapshot surveys (see Section 2.2.2, page C5) and economic survey (see Section 2.2.3, page C5), and are incorporated in the relevant reports referred to in sections 2.2.2 and 2.2.3 above. A survey of institutional capacity as it relates to estuarine fisheries and the protection of living resources was conducted and has been included as a section under the snapshot survey report (Volume III, Project C, Supplementary Report 4).

2.2.5 To classify Eastern Cape estuaries according to mouth state and user dynamics, and to develop management guidelines for sustainable resource utilisation in the various classes of estuary

This aspect of the study is covered in this report.

3 PROCEDURE FOR ACHIEVING SUSTAINABLE USE OF ESTUARY LIVING RESOURCES

3.1 Summary of approach to achieving sustainable use

The remainder of this report details the procedure that was used to categorise all functional estuaries in the Eastern Cape into different classes, and further details the guidelines that were formulated as the result of surveys, literature reviews and workshops and which are available for managers to use to ensure the sustainable use of the living resources found in the different classes of estuary. In addition, the approach managers would need to adopt to ensure the successful implementation of these management guidelines is presented. A summary of this procedure is presented in the flowchart below and provides a concise visual aid to managers and puts the process into context with regards to the proposed framework for effective co-operative governance of estuaries (Volume II, Report A). As stated in the proposed framework and illustrated below (see flowchart on page C8), estuarine management is a cyclic process comprising a sequence of steps, namely (i) vision, goals and objectives, (ii) management strategies, (iii) planning and operations (implementation), (iv) monitoring, (v) assessment and evaluation and (vi) revisiting the vision and objectives.

STRATEGIC VISION, GOALS AND OBJECTIVES

1. National and provincial/regional.
2. Local; site-specific for individual estuaries. Process will require detailed public participation process with IAP's, community involvement and conflict resolution. Ensure local vision is in line with National policy or framework.
3. Each estuary will have a vision for sustainable use, in addition each should also have a vision detailing biodiversity protection, monitoring and rehabilitation incorporated into an Estuary Management Plan (EMP).

MANAGEMENT STRATEGIES

1. Establish current state of estuary from literature and snapshot surveys.
2. Prioritise estuaries in each region using Rapid Assessment Matrix (RAM).
3. Establish the category (class) of priority estuaries and identify appropriate guidelines for sustainable use.

PLANNING & OPERATIONS

1. Establish a baseline-monitoring programme using appropriate indicators – these data will be used at a later stage during the evaluation phase.
2. Determine institutional capacity, cost and accessibility (by vehicle and boat) to identify which guidelines can effectively be implemented, enforced and monitored (based on manpower, funds and capital equipment), i.e which tools are best suited to each scenario.
3. Establish requirements to implement the Estuary Management Plan (EMP), namely cost, manpower, frequency of patrols etc, and compile an operations plan.

MONITORING

1. Baseline-monitoring – to establish a reference point for evaluation of progress towards achieving vision, i.e sustainability. Indicators to be used include Catch Per Unit Effort (CPUE), year-class (cohort) strength, user groups, catch (composition and quantity), motivation, effort, degree of compliance and levels of conflict between user groups.
2. Compliance monitoring – effective enforcement is required to ensure that guidelines are adhered to by all user groups. Target all users to avoid conflict between groups.

ASSESSMENT & EVALUATION

1. Analysis of data obtained from monitoring programme and reports to relevant departments.
2. Trends provide indication of success or failure of overall EMP.
3. Failure requires that strategic vision, objectives, management strategies, planning and operations need to be revisited.
4. Ecosystem Based management (EBM) approach to be adopted after 5 years – simple yet detailed assessment based on components (using indicators) of the three domains of sustainability, namely environment, socio-economic and institutional domains

3.2 The estuarine classification system[1]

The transitional and dynamic nature of estuaries, influenced by both the marine and terrestrial environments, means that estuarine function, importance and state are determined by a complex array of factors (Harrison et al., 2000). Historically, estuarine classification has been based upon a combination of tidal patterns, physiography, geomorphology, hydrography, salinity characteristics, sedimentation and ecosystem energetics (Whitfield, 1992).

Initially this project was going to utilize information on available levels of living resources, productivity, levels and dynamics of exploitation of living resources, location of the estuary (urban or rural), mouth state and institutional capacity to classify estuaries. Later, this approach was rejected for a number of reasons, namely:

1. Insufficient information exists for the majority of Eastern Cape estuaries
2. The majority of estuaries were regarded as being unique, and most systems would need to be classified on their own or in very small groups resulting in a large number of estuary classes
3. In order for the system to remain simple and accessible to on site managers (estuary conservation and enforcement officials), the number of estuary classes had to be reduced.

The alternative was to utilise broad categories to help reduce the number of estuary classes to acceptable levels. It was decided to use the criteria of mouth state as this was considered to be the main biophysical driving force influencing living resources in estuaries; and the criteria of user groups, as ultimately it is these people who need to be managed if sustainable use is to be achieved. The Marine Living Resources Act No 18 of 1998 (MLRA) recognizes three types of user namely: recreational, subsistence and licensed commercial. These categories, however, do not do justice to the dynamics of the various users within each group that were documented in the surveys (detailed and snapshot) during the course of this project. There are no licensed commercial operators on estuaries in the Eastern Cape. The subsistence and (particularly) recreational categories comprise diverse groups of users, each with its own motivation behind angling:

Subsistence

- Full time – continuous effort; utilizing resource as primary food source; full time bait collector/seller.
- Part time – collects/sells bait or uses resource as a food source when other work is not available.

Recreational

- Competition.
- Relaxation and adventure.

1 Amendments to Chapter 3 of the National Water Act (36 of 1998) will aim to classify the nation's estuaries and their catchments with respect to water reserves (environmental and human) and stakeholder requirements. Based on these classifications, the Department of Water Affairs and Forestry (DWAF) will require that managers fulfil certain obligations depending on the category of the estuaries within their jurisdiction.

- Food consumption – not as primary food source, but a preferred food source.
- Sham-recreationals (sham-amateurs) – pose as recreational anglers, but their motive for fishing is the thrill of catching as many fish as possible and financial gain through the selling of their catch. From a social perspective, this group thrives on the bragging rights and attention that appear to accompany this activity. Members belonging to this group will include a percentage of competition and trophy hunter anglers, and retired professionals who fish full-time.
- Trophy hunters – target only large specimens, mostly dusky kob, but will pursue other species when available, e.g. white steenbras, leervis, kingfish and skipjack.

There are 210 estuaries in the Eastern Cape region between the Bloukrans River near Plettenberg Bay to the Mtamvuna River near Port Edward in the north. A recent DEAT publication (Harrison et al., 2000) classified 80 of these as permanently open, 56 as temporarily open/closed, with the balance (74) being non-classified due to lack of data. Of the 210 estuaries in the region, 147 fall within a warm temperate biogeographical region and 63 in a sub tropical region (classification based on fish community composition; Harrison et al., 2000), with the boundary situated between the Mdumbi and Lwandilana estuaries along the former Transkei coast. According to Whitfield (2000), the list provided in Harrison et al., (2000) contains many small, non-functioning estuaries, and for the purposes of this study we have chosen to exclude these from any further analysis. An additional estuary (Klein Palmiet) was classed as temporarily open/closed by Cowley (2000b) and has been included. During a meeting of the Eastern Cape Estuaries Management Research sub-Programme in October 2001, a list of 136 estuaries was provided by the biodiversity protection project for consideration. Subsequent to this, an additional seven systems listed in Colloty (2000) were added, bringing the total number of functioning systems under consideration for this project to 143 (Table 1, page C13).

Mouth state for these systems was obtained from the literature (Harrison et al., 2000; Whitfield, 2000), consultation and interviews with on site users and managers and from field trip data. The two scenarios considered were permanently open and temporarily open/closed. The Mzimvubu, which is classed as a river mouth by Whitfield (2000) was grouped as a permanently open estuary for the purposes of this study (Table 1) namely:

Data on user dynamics were obtained from the literature (Volume III, Project C, Supplementary Report 3), from surveys conducted during this project (Volume III, Project C, Supplementary Reports 4 and 5), during a workshop[2] held in Port Alfred (18 - 19 March 2003), from a survey of the Wild Coast Cottage Owners Association and via consultation with regional and local authorities. All 143 functional estuaries in the Eastern Cape have been placed into one of nine classes based on a combination of the mouth state and the predominant form of exploitation (recreational or subsistence) taking place (Table 1), namely:

2 Workshop was aimed at addressing issues concerning sustainable use, guidelines to address these issues, the Rapid Assessment Matrix (see below) and the EBM approach to management (see below). The workshop was attended by other ECEMP project managers and representatives from various government institutions.

1. **Open** – **Recreational (OR**) - permanently open system whose living resources (fish and invert) are predominantly (>60%) targeted by recreational (shore and boat) anglers and bait collectors.
2. **Open - Subsistence (OS)** - permanently open system whose living resources (fish and invert) are predominantly (>60%) targeted by subsistence anglers and/or bait collectors.
3. **Open - Mixed User (OM)** - permanently open system whose living resources (fish and invert) are targeted by both subsistence and recreational users, with neither group predominating the overall effort. Systems where one group of anglers (e.g. recreational) predominate and the other group of bait collectors (e.g. subsistence) predominate are also classed as OM.
4. **Closed - Recreational (CR)** – temporarily open/closed system whose living resources (fish and invert) are predominantly (>60%) targeted by recreational (shore and boat) anglers and bait collectors.
5. **Closed - Subsistence (CS)** - temporarily open/closed system whose living resources (fish and invert) are predominantly (>60%) targeted by subsistence anglers and/or bait collectors.
6. **Closed – Mixed User (CM)** - temporarily open/closed system whose living resources (fish and invert) are targeted by both subsistence and recreational users, with neither group predominating the overall effort. Systems where one group of anglers (e.g. recreational) predominate and the other group of bait collectors (e.g. subsistence) predominate are also classed as OM.
7. **Closed - Unused (CU)** – temporarily open/closed system whose living resources are not exploited by any user group.
8. **Open - Unused (OU)** – permanently open system whose living resources are not exploited by any user group.
9. **Protected** – any estuary which enjoys total or a degree of protection from exploitation of its natural resources, e.g. those within the boundaries of the Tsitsikamma National Park.

Several estuaries have been classed as unknown, as no information was available in the literature or was forthcoming from managers or stakeholders. Others have been placed into a class based on an educated guess, but there is no indication of levels of use. Guidelines for the sustainable use of living resources in each of the nine classes of estuary have been formulated and are presented in Section 3.3 (page C11).

3.2.1 Confidence levels

Our assessment of the levels of use or presence of various user groups on each estuary (Table 1, page C13) was based on information available in the literature, anecdotal information, professional opinion and consultation, field surveys and subjective opinion. Due to the paucity of fisheries data on many Eastern Cape estuaries and the poor knowledge base for many systems (particularly in the former Transkei) a level of confidence has been applied to our classification of each estuary. These levels are defined as follows:

- Low (L) – limited anecdotal information and/or subjective assessment.
- Moderate (M) – anecdotal information, personal observations and subjective assessment.

- High (H) – published and in-house literature, professional assessment and consultation and detailed field surveys.

3.2.2 Levels of recreational and consumptive use

Estimates of levels of non-consumptive recreational use, e.g. canoeing, sailing, bird watching, power boating and infrastructure such as golf courses and bridges and consumptive use (removal of living organisms for use as bait or food) have been based largely on subjective assessment and are related to estuary size, i.e. relative numbers of anglers and levels of effort, not absolute values. Levels of consumptive use have not been related to productivity as for most systems, these values are not available. Estimates are simply high (H), medium (M), low (L) and zero, with high seasonal (HS) indicating that level of effort increases significantly only during peak holiday periods. High does not necessarily indicate that use is not sustainable, however, it could act as a precautionary indication for managers.

3.2.3 Illegal activities and/or poaching

This refers to large-scale organised activities involving commercial syndicates either directly exploiting resources or using local users as a conduit. Activities include gill netting, cast netting and trapping. Exploitation of living resources in estuaries that enjoy protected status also fall into this category (e.g. estuaries within the boundaries of the Tsitsikamma National Park). An additional group includes so-called sham-recreationals whose primary motivation may be recreation, but whose levels of effort are influenced by financial gain through selling of catch, which may comprise both undersize fish and numbers exceeding bag limits. This does not include recreational anglers who catch the odd undersized fish or who pump a few too many mudprawn.

3.3 Management guidelines for sustainable use

The 14 proximate threats to estuarine biodiversity, as identified by the biodiversity protection sub-programme are the result of the actions of eight ultimate threats, namely habitat alteration and loss, over-exploitation, changes in sedimentation, loss of system variability (through goal orientated management), recreational disturbance, change in biochemical characteristics (salinity, temperature, oxygen, sulphide, nutrients, turbidity and mouth dynamics), pollution (chemical, organic and solid waste) and alien invasives. During a workshop held in Port Alfred (March 2003), delegates were asked to identify the issues affecting sustainable use of estuaries. These issues were grouped under the three domains of sustainability, namely environmental (resource and ecosystem), socio-economic and institutional. These issues are presented below (see Section 3.3.2, page C16). Essentially, all the threats to biodiversity and issues relating to sustainable use need to be addressed if sustainability is to be ensured.

The goods and services provided by estuaries are not infinite and rely on effective management to maintain a viable and functioning system, which in turn should ensure that social and economic benefits are secured for the long term. The degree to which estuaries are regarded as an asset by communities, depends on the extent to which they are reliant on its goods and services for quality of life and financial well being. The Municipal Systems Act No 32 of 2000 requires that municipalities formulate an Integrated Development Plan (IDP) that outlines their plans aimed at

the integrated development and management of their region. Estuaries where they occur should clearly form an integral part of these plans. However, despite the many communities and businesses that do rely on estuaries (some exclusively), local government has appeared to place a small amount of importance on their management and well being, even though local government is legally bound to do so[3]. The limited reference to estuaries within the IDPs of coastal municipalities such as Kouga, Ndlambe, Amatola and Buffalo City bears testament to this statement. Recently, the central office of the DEAET requested the regions' Marine Working Group to compile a technical inventory of coastal zone use (Brett and Cole, 2001). This report details the uses, conflicts and problems, and solutions in four different regions between the Kei and Tyolomnqa estuaries, namely hinterland, dunes, beach & sea and estuaries. This document is aimed at assisting with management issues on a local and regional scale and will be made available to Buffalo City and Amatola for comment and inclusion into an integrated Coastal Management Plan for the region.

The importance of having a structured management system for estuaries based on National legislation cannot be over-emphasised. Ultimately it is the elected government who has the responsibility of protecting assets to which all of its citizens have rights of access. However, within the framework of a National estuary management system there must be room for on site managers or law enforcement representatives to adjust and adapt to changing local conditions and scenarios. There must be a degree of flexibility within the framework that allows for guidelines that can be applied to estuaries that differ from each other in terms of user dynamics and biophysical characteristics.

We live in a world that is rapidly changing, both globally in terms of climate, sea levels and temperatures and in terms of numbers of humans and their activities and expectations. The management process should therefore be regarded as an iterative one, with a degree of flexibility if managers are expected to maintain a semblance of control in the face of these changes. Ultimately it is the actions and influences of humans that will need to be regulated by managers, and not the functions of the estuaries *per se*, if sustainable use is to be achieved.

3.3.1 Guidelines for sustainable use and the framework for co-operative governance

The framework for effective co-operative governance of South African estuaries developed during the ECEMP (Volume II, Report B) comprises a sequence of steps that include:

- The setting of a strategic vision (National and/or regional level), and the formulation of a local vision with site-specific objectives
- Setting strategic guidelines (goals and objectives) for achieving the National vision, and development of an Estuary Management Plan (EMP) at the local level
- Planning and operations (implementation) that include actions to be taken to reduce the impact of activities and developments on the goods and service of estuaries
- A monitoring programme incorporating both baseline and compliance monitoring

3 Part of the problem is that the legal framework is not specific enough with regards to estuaries (Alan Boyd, Marine and Coastal Management (MCM), Pers. Comm.).

- A feedback system based on assessment and evaluation of the management process and the extent to which the vision has been realised

The guidelines for sustainable use proposed in this document would be used primarily during the formulation of an EMP, but also for guiding the actions needed for the planning and implementation of activities and developments on estuaries. Ultimately, we perceive these guidelines to be tools used by managers to fulfil their objectives in order to achieve the goals and vision formulated for a particular estuary.

Table 1: The classification of functional Eastern Cape estuaries based on levels of non-consumptive and consumptive use and presence or absence of various user groups. Information was obtained from the literature, from fisheries surveys (Volume III, Project C, Supplementary Report 5), telephonic interviews and the Port Alfred workshop. Classification types, confidence levels and levels of use are explained in the text.

						SUBSISTENCE		RECREATIONAL			
ESTUARY	CONFIDENCE	CLASSIFICATION	NON-CONSUMPTIVE USE	CONSUMPTION - INVERTEBRATE	CONSUMPTION - FISH	FISH / BAIT	BAIT SELLER	SHORE	BOAT	BAIT	ILLEGAL / POACHING
Seekoei	M	CM	H	L	L	y	y	y	y	y	
Kleinemond Wes	H	CM	H	L	H	y	y	y	y	y	
Kleinemond Oos	H	CM	H	L	H	y	y	y	y	y	
Mpekweni	H	CM	H	H	H	y	y	y	y	y	
Mtati	H	CM	M	H	M	y	n	y	y	y	y (crab)
Mgwalana	H	CM	L	H	L	y	n	y	y	y	
Bira	H	CM	M	H	M	y	n	y	y	y	
Mtana	M	CM	L	H	L	y	y	y	n	y	
Qolora	M	CM	H	L	M	y	y	y	n	y	
Jujura	M	CM	L	L	L	y	n	y	n	y	
Ngadla	M	CM	L	L	L	y	n	y	n	y	
Mbotyi	H	CM	HS	L	L	y	y	y	y	y	
Tsitsikamma	H	CR	L	L	L	n	n	y	n	y	y (gillnet)
Kabeljous	M	CR	M	L	L	n	n	y		y	
Van Stadens	M	CR	H	L	L	n	n	y	n	y	
Maitland	M	CR	H	L	L	n	n	y	n	y	
Boknes	M	CR	H	L	M	n	n	y	n	y	
Kasuka	M	CR	H	L	M	n	n	y	y	y	
Riet	H	CR	H	L	M	n	n	y	n	y	
Klein Palmiet	H	CR	L	L	L	n	n	y	n	y	
Old woman's	H	CR	H	L	M	n	n	y	n	y	
Gqutywa	M	CR	L	H	L	n	n	y	n	y	
Blue Krans	M	CR	L	H	L	n	n	y	n	y	
Kiwane	M	CR	M	L	L	n	n	y	y	y	
Shelbers Stream	H	CR	L	L	L	n	n	y	n	y	
Lilyvale	H	CR	L	L	L	n	n	y	n	y	
Ross' Creek	H	CR	L	L	L	n	n	y	n	y	
Ncera	H	CR	H	L	L	y	y	y	y	y	y (crab/gillnet)
Mlele	H	CR	H	L	L	n	n	y	n	y	
Mcantsi	H	CR	L	L	L	n	n	y	n	y	

						SUBSISTENCE		RECREATIONAL			
ESTUARY	CONFIDENCE	CLASSIFICATION	NON-CONSUMPTIVE USE	CONSUMPTION - INVERTEBRATE	CONSUMPTION - FISH	FISH / BAIT	BAIT SELLER	SHORE	BOAT	BAIT	ILLEGAL / POACHING
Gxulu	H	CR	H	L	M	n	n	y	y	y	y (crab/gillnet)
Goda	H	CR	H	M	M	n	n	y	n	y	
Hlozi	M	CR	L	L	L	n	n	n	n	y	
Hickman's	M	CR	M	M	L	n	n	y	n	y	
Blind	H	CR	Zero	Zero	Zero	n	n	n	n	y	
Hlaze	H	CR	Zero	Zero	Zero	n	n	n	n	y	
Qinira	H	CR	H	M	L	n	n	y	y	y	y (crabs and prawn)
Cunge	M	CR	L	L	H	n	n	n	n	y	
Cintsa	H	CR	H	H	L	y	n	y	y	y	y (prawns and crabs)
Cefane	H	CR	H	M	M	y	n	y	y	y	y (prawns and crabs)
Kwenxura	M	CR	L	L	L	n	n	y	n	y	
Nyara	M	CR	L	M	L	n	n	y	n	y	
Haga-haga	M	CR	L	L	L	n	n	y	n	y	
Mtendwe	M	CR	L	L	L	n	n	n	n	y	
Quko	M	CR	L	L	M	n	n	y	n	y	
Morgan	H	CR	HS	M	L	n	n	y	y	y	
Ntlonyane	M	CR	L	L	L	n	n	y	n	n	
Tshani	H	CR	Zero	Zero	Zero	n	n	y	n	y	
Hluleka / Majusini	M	CR	L	L	L	n	n	y	n	y	
Mtamvuna	M	CR	H	L	M	y	y	y	y	y	
Ngqinisa	L	CS									
Gxara	M	CS	Zero	M	L	y	n	y	n	y	
Ngogwane	L	CS									
Ncizele	L	CS									
Cebe	M	CS	L	M	M	y	n	y	n	y	
Gqunqe	L	CS									
Zalu	L	CS									
Ngqwara	L	CS									
Sihlontlweni / Gcini	L	CS									
Ngoma/Kobule	L	CS									
Mendu	L	CS									
KuBhula / Mbhanyana	H	CS	L	L	M	y	y	y	n	y	
Kwasuku	L	CS									
Sundwana	L	CS									
Bulungula	M	CS	Zero	L	L	y	y	n	n	n	
Mncwasa	L	CS									
Lwandilana	L	CS									
Lwandile	H	CS	M	L	L	y	y	y	y	y	
Mtakatye	H	CS	M	L	M	y	y	y	y	y	
Mnenu	M	CS	L	L	L	y	n	n	n	n	
Mtonga	M	CS	L	L	L	y	n	n	n	n	
Mpande	M	CS	L	L	L	y	n	y	n	y	

						SUBSISTENCE		RECREATIONAL			
ESTUARY	CONFIDENCE	CLASSIFICATION	NON-CONSUMPTIVE USE	CONSUMPTION - INVERTEBRATE	CONSUMPTION - FISH	FISH / BAIT	BAIT SELLER	SHORE	BOAT	BAIT	ILLEGAL / POACHING
Sinangwana	H	CS	L	L	M	y	y	y	n	n	y (gillnet)
Gxwaleni	L	CS									
Bululo	L	CS									
Mtumbane	L	CS									
Butsha	L	CS									
Mgwegwe	L	CS									
Mgwetyana	L	CS									
Sikombe	L	CS									
Kwanyana	L	CS									
Mtolane	L	CS									
Mnyameni	L	CS									
Mpahlanyana	L	CS									
Mpahlane	L	CS									
Mzamba	L	CS	L	L	H	y	n	y	y	y	
Mtentwana	L	CS									
Klipdrif	H	CU	Zero	Zero	Zero	n	n	n	n	n	
Slang	H	CU	Zero	Zero	Zero	n	n	n	n	n	
Coega	H	CU	Zero	Zero	Zero	n	n	n	n	n	
Rufane	H	CU	Zero	Zero	Zero	n	n	n	n	n	
Ku-Mpenzu	H	CU	Zero	Zero	Zero	n	n	n	n	n	
Nkanya	M	CU	Zero	Zero	Zero	n	n	n	n	n	
Ku-amanzimuzama	H	CU	Zero	Zero	Zero	n	n	n	n	n	
Swartkops	H	OM	H	H	H	y	y	y	y	y	y
Kowie	H	OM	H	H	H	y	y	y	y	y	y (crab/gillnet)
Tyolomnqa	H	OM	HS	H	H	y	y	y	y	y	y (crab/gillnet)
Nqabara	H	OM	M	M	H	y	y	y	y	y	
Mbashe	H	OM	L	H	H	y	n	y	y	y	y(sham and crabs)
Mngazana	H	OM	H	H	H	y	y	y	y	y	y
Mngazi	H	OM	H	H	H	y	y	y	y	y	y
Mzimvubu	H	OM	H	L	H	y	y	y	y	y	y (sham)
Mtentu	H	OM	L	L	M	y	n	y	y	n	
Kromme	H	OR	H	L	H	y	y	y	y	y	y
Gamtoos	H	OR	H	L	H	y	n	y	y	y	y(gillnet and sham)
Sundays	H	OR	H	H	H	y	y	y	y	y	y
Bushmans	H	OR	H	M	H	y	y	y	y	y	y
Kariega	H	OR	H	M	H	y	y	y	y	y	y
Buffalo	H	OR	H		H	y	n	y	y	y	
Nahoon	H	OR	H	L	L	n	n	y	y	y	y (crabs)
Gqunube	H	OR	H	L	L	n	n	y	y	y	y (crabs)
Kwelera	H	OR	H	L	L	n	n	y	y	y	y (crabs)
Bulura	M	OR	H	L	L	n	n	y	y	y	y (prawns)
Great Kei	M	OR	H	L	H	y	y	y	y	y	y (sham and gillnet)

						SUBSISTENCE		RECREATIONAL			
ESTUARY	CONFIDENCE	CLASSIFICATION	NON-CONSUMPTIVE USE	CONSUMPTION - INVERTEBRATE	CONSUMPTION - FISH	FISH / BAIT	BAIT SELLER	SHORE	BOAT	BAIT	ILLEGAL / POACHING
Kobonqaba	H	OR	HS	L	M	y	y	y	y	y	y (crab traps)
Nxaxo/Ngqusi	H	OR	H	H	H	y	n	y	y	y	
Qora	H	OR	H	L	H	y	y	y	y	y	
Xora	H	OR	HS	H	H	y	y	y	y	y	
Mpako	H	OR	HS	L	L	y	y	y	y	y	
Msikaba	H	OR	M	M	M	y	n	y	y	n	
Great Fish	H	OS	H	H	H	y	y	y	y	y	y (gillnet and sham)
Keiskamma	H	OS	H	H	H	y	y	y	y	y	y
Cwili	L	OS									
Shixini	H	OS	L	L	L	y	y	n	n	n	
Nenga	H	OS	L	L	M	y	n	n	n	n	
Mapuzi	H	OS	L	Zero	L	y	n	y	n	n	
Mtata	M	OS	L	H	H	y	n	y	y	y	y
Mdumbi	H	OS	L	L	M	y	y	y	y	y	y (gill net)
Mntafufu	H	OS	L	L	M	y	n	y	y	y	
Ku-Bomvu	H	OU	Zero	Zero	Zero	n	n	n	n	n	
Bloukrans	H	Protected	L	L	M	n	n	n	n	n	y
Lottering	H	Protected	L	L	M	n	n	n	n	n	y
Elandsbos	H	Protected	L	L	0	n	n	n	n	n	y
Storms	H	Protected	H	L	0	n	n	n	n	n	y
Elands	H	Protected	L	L	0	n	n	n	n	n	y
Groot (Oos)	H	Protected	L	L	0	n	n	n	n	n	y
Ntlupeni	L	Unknown									
Nkodusweni	L	Unknown									
Mzintlava	L	Unknown									
Mzimpunzi	L	Unknown									
Mkozi	L	Unknown									
Myekane	L	Unknown									
Lupatana	L	Unknown									
Mkweni	L	Unknown									

3.3.2 Issues influencing sustainable use

Issues affecting the sustainable use of estuarine living resources were identified during a workshop hosted by this project at the Port Alfred Ski-Boat Club in March 2003. Delegates were asked to group the issues under one of the three domains of sustainability. These are presented below:

(a) Environmental issues

- Lack of monitoring on most systems, i.e. no historical database to provide baseline assessments of fisheries, trends of fisheries statistics or long-term patterns of mouth closure.
- Existing data is biased towards a few large systems, resulting in knowledge gaps for the majority of estuaries.
- Existing knowledge does not include information on estuarine stock levels.

- Targeting of fish species whose stocks are seriously depleted.
- Over-exploitation.
- Netting and spearing of fish during breaching events.
- Poor compliance with fisheries regulations, e.g. exploitation of juvenile (undersize) fish and exceeding bag limits.
- Illegal and destructive bait collecting methods, e.g. spades and garden forks.
- Catchment (upstream) activities, including water abstraction and poor land-use.
- Sedimentation and siltation, resulting in changed mouth dynamics and habitat loss.
- Illegal activities such as seine and gillnetting.
- Multiple access points on larger systems make monitoring access and effort levels problematic.

(b) Socio-economic issues

- Recreational disturbance (non-consumptive use such as walking and boating).
- Poor utilisation of local or indigenous knowledge of estuary issues.
- Traditional practices and beliefs may contradict national legislation.
- Tribal authorities control community involvement in co-operative management schemes and influence local perceptions of estuaries and their use/importance.
- Lack of knowledge of users and their circumstances, leading to a poor understanding of their dependency on the resource, i.e. motivation for exploiting living resources.
- Management has tended to be autonomous in the past, and presently there is not sufficient user buy-in to management plans or schemes.
- Past inequalities must be addressed and equity in terms of access for subsistence and recreational users must be ensured.
- Tourism ventures that promote development on estuaries, e.g. jetties and resorts.
- Ribbon-type residential development encroaches on sensitive habitats, encourages construction of slipways and jetties and increases numbers of users on the estuary.
- Rapid urbanisation along the coast, leading to increased numbers of users on estuaries.
- Conflict between user groups due to resource-use overlap, lack of spatial separation and racial issues.
- Lack of education of users and managers (all levels) with regards to estuarine dynamics, ecosystem complexity and legislation pertaining to living resources.
- Users do not accept responsibility for their actions with regards to their contribution to decline of natural stocks.
- High levels of poverty due to overpopulation and unemployment lead to increased levels of effort towards utilising living resources as a food source.
- Demand for resources outweighs the supply.
- Issues are politicised, resulting in political solutions instead of solutions that are management orientated and geared toward sustainability.

(c) Institutional issues

- Lack of co-ordination and communication between institutions.
- Lack of co-ordination and communication between institutions and communities, i.e. co-operative management approach.

- National government does not comprehend the value of estuaries and thus allocation of human and financial resources (capacity) for their management, is poor.
- Capacity to monitor accumulative impacts is poor, as the tools for their assessment are lacking within institutions.
- Historical perception is that estuaries are playgrounds of the influential sector and hence not a government priority.
- In spite of being signatories of various conventions, government has a poor understanding of the concept of sustainability.
- Lack of enforcement of environmental law pertaining to development and waste disposal, resulting in habitat and resource destruction.
- Lack of awareness of estuarine importance and status of resources by local managers.
- Control is too centralised around national government and not sufficiently localised.
- Local requirements are not sufficiently catered for in national legislation.
- Management strategies for subsistence and recreational users are not always complementary, and are seen as favouring one or the other group in some cases.
- Corruption.
- Fines and penalties are not sufficiently harsh to act as a deterrent.

3.3.3 Guidelines for sustainable use

Management guidelines for the sustainable use of estuarine living resources were taken from suggestions in the literature, but mostly stemmed from the issues that were identified during the detailed and snapshot surveys during this study (Volume III, Project C, Supplementary Reports 4 and 5) and from the issues identified during the workshop held in Port Alfred (see Section 3.3.2 page C16). These guidelines are essentially actions that managers need to take to address these specific issues. The guidelines have been grouped into four broad categories that incorporate the main issues, namely those applicable at the resource level, the ecosystem level (together comprising the environment) and those pertaining to the socio-economic and institutional domains.

(a) Resource

1. Control access to bait collecting areas.
2. Rotate bait collection areas to be on an annual basis to allow for recovery.
3. Restrict collection of mud prawn, sand prawn, bloodworm, pencil bait and tapeworm only during daylight hours and using to only legal implements.
4. Control tropical fish collection.
5. Disallow capture of fish (irrespective of methods) during mouth breaching events in temporarily open/closed systems.
6. Disallow capture of linefish species (e.g. grunter) with cast nets, seine nets, gill nets and traps.
7. Reduce the number of fishing competitions.
8. Develop key indicators and implement effective monitoring programmes dedicated to individual species.
9. Undertake directed research aimed at stock status and sustainable yields.
10. Reduce bag limits on all threatened estuarine angling species.

(b) Ecosystem

1. Minimise impacts on associated sensitive habitats found adjacent to bait collection areas (e.g. salt marshes), by the construction of walkways.
2. Restrict number of boats and access according to carrying capacity of the estuary.
3. Establish sanctuary areas where threatened invertebrate and floral species occur.
4. Adopt holistic approach to estuarine management (i.e. incorporate issues related to the catchment and adjacent terrestrial and marine environments).
5. Identify potential Estuarine Protected Areas (EPA)[4] for the conservation of over-exploited linefish species (e.g. dusky kob and white steenbras). The area must include the mouth and adjacent marine environment.
6. Ensure that artificial breaching of estuary mouths (how and when) is done in accordance with guidelines and regulations in the Sea Shore Act No 21 of 1935 and the National Water Act No 36 of 1998 (NWA).
7. Protect sensitive and riparian habitats with reference to the use of vehicles, boat mooring sites and agricultural activities.
8. Assess and monitor accumulative impacts using tools such as Ecosystem Based Methods and Strategic Environmental Assessments.

(c) Socio-economic

1. Establish exclusive subsistence bait fisheries on selected systems.
2. Apply zonation, through consultation with all Interested and Affected Parties (IAPs), of estuaries for recreational and subsistence fishing activities and non-consumptive activities to reduce user conflict.
3. Prohibit power boating or impose engine size restrictions.
4. Restrict recreational activities such as skiing and powerboating to certain times of the day to avoid user group conflict.
5. Promote estuarine awareness and instil a feeling of social responsibility towards estuaries through advertising & marketing and education of managers, user groups and the general public.
6. Promote co-operative management through community involvement.
7. Use of funds raised from estuary activities, to be used for estuary management in the same region.
8. Identify and mitigate against impacts resulting from industrial and mining activities, and urban development.
9. Promote alternatives to consumptive exploitation. For example, catch and release fisheries and eco-tourism or alternative livelihood options such as mariculture ventures and job creation for subsistence users.
10. Reduce fishing effort by controlled access or increased access costs.
11. Prioritise and increase funding for research and enforcement.
12. Recognise and involve tribal authorities and indigenous social structures.
13. Address the cause (e.g. poverty) and not the symptom (over-exploitation) in EMPs.

4 Currently no specific provision for EPAs in the MLRA and they would need to be proclaimed under the new Protected Areas Bill when it comes into effect.

(d) Institutional

1. Identify and quantify (monitor) consumptive resources, their value, and the present levels of exploitation in all systems.
2. Enforce, through compliance monitoring, existing legislation under the MLRA, e.g. permits, catch restrictions, use of cast nets etc. Penalties need to be severe and convictions need to be secured.
3. Prevent illegal syndicates from using local communities to poach estuarine resources, in particular linefish, swimming prawns and mud crabs.
4. Eliminate illegal activities (e.g. gill netting, crab trapping and netting of swimming prawns).
5. Promote communication and co-operation between local, provincial and national authorities.
6. Generate database on historic and current biophysical and socio-economic characteristics to facilitate monitoring programme.
7. Control pollution and waste emissions including sewage, detergents, agricultural runoff, urban runoff, industrial waste, solid waste and fossil fuels.
8. Control erosion and runoff associated with infrastructure development (roads, residential and industrial).
9. Enforce existing legislation under the NWA, e.g. water abstraction and catchment management.
10. Control harvesting of mangroves.
11. Enforce legislation pertaining to activities that impact on estuary ecosystems and their functioning (e.g. National Environmental Management Act No 107 of 1998 (NEMA), Environmental Conservation Act No 73 of 1989, Agricultural Resources Act No 43 of 1983, etc.).
12. Empower and encourage local authorities (managers) to enforce National legislation (e.g. MLRA) as well as municipal by-laws.
13. Return custodianship of estuaries (from MCM) to local authorities and forums to manage within a national framework.
14. Incorporate findings and recommendations arising from research programmes into management plans.
15. Police user groups equally and consistently between and within the different groups.
16. Establish a lead agent Non Governmental Organisation (NGO) to market estuaries and sell their value to government and the general public.
17. Address estuaries specifically in all forms of legislation (e.g. Coastal Bill, NWA and MLRA), and do not include under an all encompassing banner such as ‘coastal zone’.
18. Improve capacity through employment of competent staff and the concentration of effort in priority areas or estuaries.

3.4 Applying the guidelines to different classes of estuary

The categories of guidelines detailed above have been allocated to the nine estuary classes described in Section 3.2 (see page C8). Many of these guidelines are applicable to more than one class of estuary, and some may be applied to all in order to achieve sustainable use (Table 2, page

C23). Despite all efforts to obtain information on as many estuaries as possible, no information was forthcoming for the following systems, namely Ntlupeni, Nkodusweni, Mzintlava, Mzimpunzi, Mkozi, Myekane, Lupatana and Mkweni, and they remain unclassified (see Table 1 page C13).

The objective of Table 2(page C23), in conjunction with the list of guidelines, is to provide on site managers with a concise, easy to follow document providing them with the available management options for the estuaries within their jurisdiction. It is important to note that due to the unique nature of each estuary and the user groups, not all guidelines allocated to a class of estuary will be applicable to each system in that class. The following procedure may be followed to identify the relevant guidelines applicable to each situation:

- Access relevant scientific literature on systems that have been studied.
- Gain information via public meetings and local knowledge of managers, user groups, traditional leaders, and businesses.
- Conduct a preliminary snapshot survey (extent will depend on funding and personnel capacity), incorporating information about weekdays, weekends and holidays to determine user patterns (including illegal activities) and dynamics.
- Commission detailed studies (if sufficient funds are available) aimed at describing and advising on the issues relevant to resource exploitation.
- Monitor essential indicators to determine progress or success of the EMP, and to allow for changes in the EMP depending on circumstances (extent of monitoring programme will depend on funding and personnel capacity).

3.5 Prioritising estuaries for management of sustainable use

There are 15 municipalities located along the Eastern Cape coastline. With the exception of the Sunday's River Valley Municipality, all have a number of estuaries within their boundaries. Realistically it is not possible to manage all these systems effectively, and even fewer will receive the attention necessary to ensure some degree of sustainable utilization. Prior to any venture by local managers, it is imperative that the current state of sustainability of estuaries within each region is determined. To this end it is necessary for estuaries within each municipal district to be prioritised in terms of the degree of management effort that is to be afforded to each one. A Rapid Assessment Matrix (RAM) has been developed for this purpose (see Section 3.5.1, below).

3.5.1 The Rapid Assessment Matrix (RAM)

A detailed assessment of sustainability is a lengthy process, and one that is better suited to a later phase of an EMP, e.g. five years into the plan. At this initial stage, priority can be assigned using a Rapid Assessment Matrix utilizing mostly subjective assessments of key environmental, social and institutional indicators that will provide an indication of the current situation on each system (Table 3, page C26). The rating system and assessment guides for each category are described below:

(a) Recreational disturbance

Determined by number of boat licenses issued, from personal observations and knowledge and from communication with users and general public.

0 – no recreational use of the system; 1 – limited use, mostly weekends and holidays; 2 – moderate use, with peaks over weekends and during holiday seasons; 3 – high levels of use throughout the year.

(b) Consumptive use

Subjective visual assessment during patrols, local knowledge and interaction with users.
0 – no consumptive use of resources; 1 – limited use of resources, mostly on weekends and holidays; 2 – moderate levels of exploitation, but intensive on weekends and holidays; 3 – intensive exploitation throughout the year.

(c) User conflict

Visual observations, phone calls from public, complaints to other authorities (e.g. police) and reports or letters in the media.
0 – no conflict; 1 – low; 2 – moderate; 3 – high.

(d) Population density

This is assessed relative to estuary size, and includes all potential users living near the system and not just residents along the banks. Influx of seasonal holiday makers is also taken into consideration. Visual assessment and census results can be used.
0 – isolated system, with no settlements or residents in the vicinity; 1 – low density, small-scale residential and rural communities close to estuary; 2 – moderate density, holiday resorts and residential areas close to the estuary banks and the mouth region; 3 – high density, includes industrial, commercial and residential areas along the entire lower reaches and along the banks.

(e) Illegal activities

Make use of local knowledge, reports from the general public, fines issued and reports made to other authorities (e.g. police).
0 – no illegal activities; 1 – unorganised, generally individuals catching undersize fish or exceeding bag limits, includes spearing and netting of fish during breaching events; 2 – groups of local residents using nets and traps on a regular basis; 3 – large scale, organized syndicates operating commercial netting or trap fisheries.

(f) Enforcement patrols

0 – none; 1 – monthly; 2 – weekly; 3 – daily.

(g) Conservation value

Although the conservation value category is based on the importance rating by Turpie et. al. (2002), the overall prioritisation differs from their proposal in that it is not a measure of conservation importance in terms of biodiversity, but an indication of importance with respect to utilization of living resources. For example, the East Kleinemonde estuary would rank highest in terms of biodiversity conservation because of the estuarine pipefish (*Syngnathus watermeyeri*), but it is relatively unimportant from a sustainable exploitation perspective and hence ranks low in the RAM.

0 – estuaries rated between 181 and 250; 1 – estuaries rated between 121 and 180; 2 – estuaries rated between 61 and 120; 3 – estuaries rated between 1 and 60.

(h) Water abstraction

Determined from % mean annual runoff entering estuary, number of water user licenses issued and from local knowledge and communication with farmers and officials (e.g. DWAF). Assessment will be subjective when considering degree of abstraction and relative size of estuary.
0 – estuary is non-regulated; 1 – few farm dams, no major water schemes or weirs; 2 – moderately regulated, no major water schemes but many weirs and farm dams; 3 – highly regulated, farm dams, major impoundments and irrigation schemes all potentially leading to altered mouth dynamics.

(i) Shallow water habitats

Comparison with historical data or local knowledge, and use of current trends in development.
0 – all shallow water habitats intact, pristine; 1 – limited impacts due to few jetties and slipways, with occasional encroachment by residential development; 2 – moderate loss of habitat due to encroaching residential development and associated infrastructure such as jetties and slipways; 3 – significant loss of habitat due to marinas, land reclamation (residential, commercial, agricultural and industrial), canalisation of lower reaches, jetties, slipways, pollution and trampling.

Table 2: The different categories of management guidelines that may be applied to the nine classes of functional estuaries in the Eastern Cape.

				GUIDELINES			
ESTUARY CLASS				RESOURCE	ECOSYSTEM	SOCIO-ECONOMIC	INSTITUTIONAL
CLOSED - SUBSISTENCE							
Ngqinisa	Mendu	Mnenu	Sikombe	1, 3, 5, 6, 8, 9, 10	3, 4, 5, 6, 7, 8	3, 5, 6, 7, 8, 9, 10, 11, 12, 13	1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 14, 15, 16, 17, 18
Gxara	KuBhula/Mbhanyana	Mtonga	Kwanyana				
Ngogwane	Kwasuku	Mpande	Mtolane				
Ncizele	Sundwana	Sinangwana	Mnyameni				
Cebe	Bulungula	Gxwaleni	Mpahlanyana				
Gqunqe	Mncwasa	Bulolo	Mpahlane				
Zalu	Lwandilana	Mtumbane	Mzamba				
Ngqwara	Lwandile	Butsha	Mtentwana				
Sihlontlweni/Gcini	Mtakatye	Mgwegwe					
Ngoma/Kobule	Hluleka/Majusini	Mgwetyana					
CLOSED - RECREATIONAL							
Tsitsikamma	Old woman's	Goda	Nyara	1, 3, 5, 6, 8, 9, 10	2, 3, 4, 5, 6, 7, 8	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13	1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 14, 15, 16, 17, 18
Klipdrif	Blue Krans	Hlozi	Haga-haga				
Slang	Kiwane	Hickman's	Mtendwe				
Kabeljous	Shelbers Stream	Blind	Quko				
Van Stadens	Lilyvale	Hlaze	Morgan				
Maitland	Ross' Creek	Qinira	Ntlonyane				
Boknes	Ncera	Cunge	Tshani				
Kasuka	Mlele	Cintsa	Mtamvuna				
Riet	Mcantsi	Cefane	Gqutywa				
Klein Palmiet	Gxulu	Kwenxura					
CLOSED - MIXED USER							
Seekoei	Mpekweni	Bira	Jujura	1, 3, 5, 6, 8, 9, 10	2, 3, 4, 5, 6, 7, 8	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13	1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 14, 15, 16, 17, 18
West Kleinemonde	Mtati	Mtana	Ngadla				
East Kleinemonde	Mgwalana	Qolora	Mbotyi				

CLOSED - UNUSED							
Klipdrif	Rufane	Ku-amanzimuzama	Nkanya		6, 7	8	6, 7, 8, 16, 17
Slang	Ku-Mpenzu	Coega					
OPEN - RECREATIONAL							
Kromme	Bulura	Great Kei	Mpako	1, 2, 3, 4, 6, 7, 8, 9, 10	1, 2, 3, 4, 5, 7, 8	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 14, 15, 16, 17, 18
Gamtoos	Buffalo	Kobonqaba	Msikaba				
Sundays	Nahoon	Nxaxo/Ngqusi					
Bushmans	Gqunube	Qora					
Kariega	Kwelera	Xora					
OPEN - SUBSISTENCE							
Great Fish	Nqabara	Mapuzi	Mntafufu	1, 2, 3, 4, 6, 7, 8, 9, 10	1, 2, 3, 4, 5, 7, 8	3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 14, 15, 16, 17, 18
Keiskamma	Shixini	Mtata					
Cwili	Nenga	Mdumbi					
OPEN - MIXED USER							
Swartkops	Tyolomnqa	Mngazi	Mtentu	1, 2, 3, 4, 6, 7, 8, 9, 10	1, 2, 3, 4, 5, 7, 8	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 14, 15, 16, 17, 18
Kowie	Mngazana	Mzimvubu	Mbashe				
PROTECTED							
Bloukrans	Elandsbos	Elands			5, 7	5, 6, 8, 11, 12	2, 3, 4, 6, 7, 8, 9, 10, 11, 15, 16, 17, 18
Lottering	Storms	Groot (Oos)					
OPEN - UNUSED							
Ku-Bomvu					7	8	6, 7, 8, 16, 17

3.5.2 The weighting system and application of the RAM

Delegates at a workshop in Port Alfred (18 and 19 March 2003) were asked to rate the top three categories in order of importance. Using the results from this exercise, a weighting system was devised to provide a more realistic assessment of priority. A rating of 3 by the delegates indicated a category that was most significant, with a score of 1 indicating a category was rated third in order of importance. Ratings for each category were totalled and a weighting system that saw accumulative scores (<5, 5 to 10, 11 to 15, 16 to 20 and 20+) multiplied by one, two, three, four and five respectively was devised. Consumptive use was considered to be the most important indicator by far with an accumulative score of 25, followed by shallow water habitats (8), population density (7), illegal activities and conservation value (6), water abstraction (5), enforcement patrols (3), user conflict (2) and recreational disturbance (0).

The estuary that ranks the highest according to the RAM should receive the majority of the attention, with the lowest ranking estuary being accorded little or no effort. Managers can use information from the literature on the few systems for which it is available, but for the most part they will need to make subjective assessments based on local experience and knowledge with input from local stakeholders.

The example presented in Table 3 (page C26) prioritises the estuaries within the Ndlambe municipal boundaries, and shows that the Kowie ranks the highest followed by the Kariega and Bushmans estuaries and then the Great Fish. All these systems are medium to large permanently open estuaries, with the smaller types and those that are temporarily open/closed ranking much lower.

The RAM is a useful tool to use at the outset to identify areas where maximum institutional effort should be concentrated. Following this procedure, however, does not guarantee the successful implementation of an EMP will be ensured. Co-operation with, and buy-in by, municipal departments responsible for financing such operations is essential. Funding must be procured for the long-term implementation of an EMP, and must allow for a comprehensive enforcement and monitoring programme.

Once an EMP has been formulated and has been operational for approximately five years, the more comprehensive EBM approach may be applied in those regions that have the capacity to administer it. Data gathered from monitoring programmes implemented after EMPs are put into practice can be used to adopt an ecosystem-based management approach (Pajak, 2000) to assess sustainability.

3.6 Assessment of sustainability through an Ecosystem-Based Management (EBM) approach

Ecosystem-based management or EBM is an ecologically and socially comprehensive approach to achieving sustainable use of living resources (Pajak, 2000). This simple, yet comprehensive approach considers the three domains of environment, society and institutions that are required to achieve sustainability. The EBM approach uses indicators to monitor progress, assess the status quo and communicate information. These indicators should both simplify information to facilitate communication and quantify information to reveal its significance. Indicators fall into one of three categories, namely:

- **State** – measure current conditions
- **Pressure** – measure factors believed to be causing current conditions
- **Response** – measure what managers or society are doing to improve the situation.

In order to monitor indicators and manage towards sustainability, an operational framework incorporating the components necessary for maintaining the integrity of ecosystems, society and their institutions is required. Pajak (2000) identifies 13 components that constitute a framework that will allow for a process to select and adopt a set of sustainability indicators that will aid in planning, management and evaluation. The framework is summarized in Figure 1 (page C27), and is designed to be both robust enough to apply to global issues while being detailed and flexible enough to address issues of local concern. To this end the framework establishes a simple, yet comprehensive conceptual model that aims to help managers and decision makers evaluate a small set of components known to help sustain ecosystems and society.

Table 3: Rapid Assessment Matrix for the 11 functional estuaries located within the Ndlambe municipal boundaries. The rating and weighted rating system is described in the text.

	UNWEIGHTED RATINGS								
ESTUARY	RECREATIONAL DISTURBANCE	CONSUMPTIVE USE	USER CONFLICT	POPULATION DENSITY	ILLEGAL ACTIVITIES	ENFORCEMENT PATROLS	CONSERVATION VALUE	WATER ABSTRACTION	SHALLOW WATER HABITATS
Boknes	1	1	0	2	0	0	2	2	1
Bushmans	2	3	2	3	1	1	3	3	1
Kariega	2	3	2	3	1	1	3	3	1
Kasouga	1	1	2	1	0	0	2	2	1
Kowie	3	3	3	3	2	2	3	3	3
Rufanes	0	0	0	0	0	0	1	3	1
Riet	1	1	0	1	0	0	2	1	1
West Kleinemonde	1	2	1	2	0	0	3	1	1
East Kleinemonde	1	2	2	2	0	0	3	1	1
Klein Palmiet	0	0	0	0	0	0	1	3	1
Great Fish	2	3	3	1	1	1	3	3	2

	WEIGHTED RATINGS										
ESTUARY	RECREATIONAL DISTURBANCE	CONSUMPTIVE USE	USER CONFLICT	POPULATION DENSITY	ILLEGAL ACTIVITIES	ENFORCEMENT PATROLS	CONSERVATION VALUE	WATER ABSTRACTION	SHALLOW WATER HABITATS	TOTAL	RANK
Boknes	1	5	0	4	0	0	4	4	2	20	7
Bushmans	2	15	2	6	2	1	6	6	2	42	2
Kariega	2	15	2	6	2	1	6	6	2	42	2
Kasouga	1	5	2	2	0	0	4	4	2	20	7
Kowie	3	15	3	6	4	2	6	6	6	51	1
Rufanes	0	0	0	0	0	0	2	6	2	10	10
Riet	1	5	0	2	0	0	4	2	2	16	9
West Kleinemonde	1	10	1	4	0	0	6	2	2	26	6
East Kleinemonde	1	10	2	4	0	0	6	2	2	27	5
Klein Palmiet	0	0	0	0	0	0	2	6	2	10	10
Great Fish	2	15	3	2	2	1	6	6	4	41	4

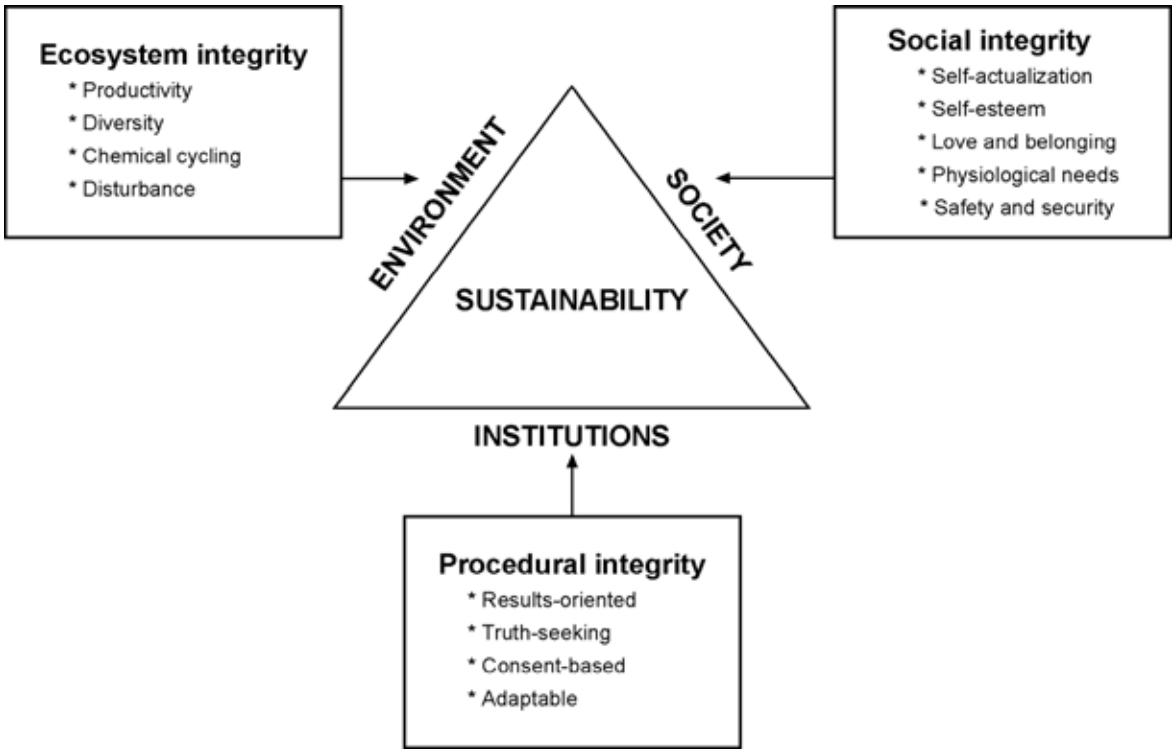

Figure 1: The conceptual framework for sustainability comprising the three domains of environment, society and institution and their respective components, which all ensure the integrity of each domain.

These components are ranked under each of the indicator categories and assigned values (scores) of ascending desirability, with pressure and response indicators often applying to more than one of the sustainability components. These values assigned to the components are presented in the form of a modified amoeba plot (Figure 2, page C28) and provide a simple yet comprehensive snapshot of sustainability.

Complete sustainability is achieved when all components have achieved maximum values (i.e. 3 or 100 %), and the amoeba plot provides an indication of which components, and thus indicators, are not sustainable at that time. The rapid identification of limiting components within each domain will help managers prioritise issues of concern and direct their actions towards the factors that are most responsible for retarding the sustainability vision for a particular system (Pajak, 2000). Table 4 (page C30) provides a listing of the indicators applicable to the categories within each domain. The category of physiological needs within the socio-economic domain has been excluded, as it does not appear to be applicable to the sustainable use of estuary living resources. Each estuary will provide the manager with a different scenario, and as such a different set or combination of indicators will be used in each case. This method can be applied to most estuaries after a period of approximately five years of monitoring and data gathering, and it is recommended that this approach be incorporated as a long-term evaluation method in all EMPs where capacity (education and funding) to do so is sufficient.

The amoeba plot presented in Figure 2 (page C28) shows an example of an estuarine recreational fishery that was assessed to be 63 % sustainable. The majority of limiting components requiring

the most attention were found within the environment; and institutional/procedural domains where overall measures of 58 and 50% were recorded respectively. The aim of managers would therefore be to address these limitations through the formulation and implementation of an EMP, with the objective of being able to score all components with the maximum of 100 %, which would indicate sustainable development had been achieved. The end result would be an amoeba plot resembling a perfectly symmetrical circle.

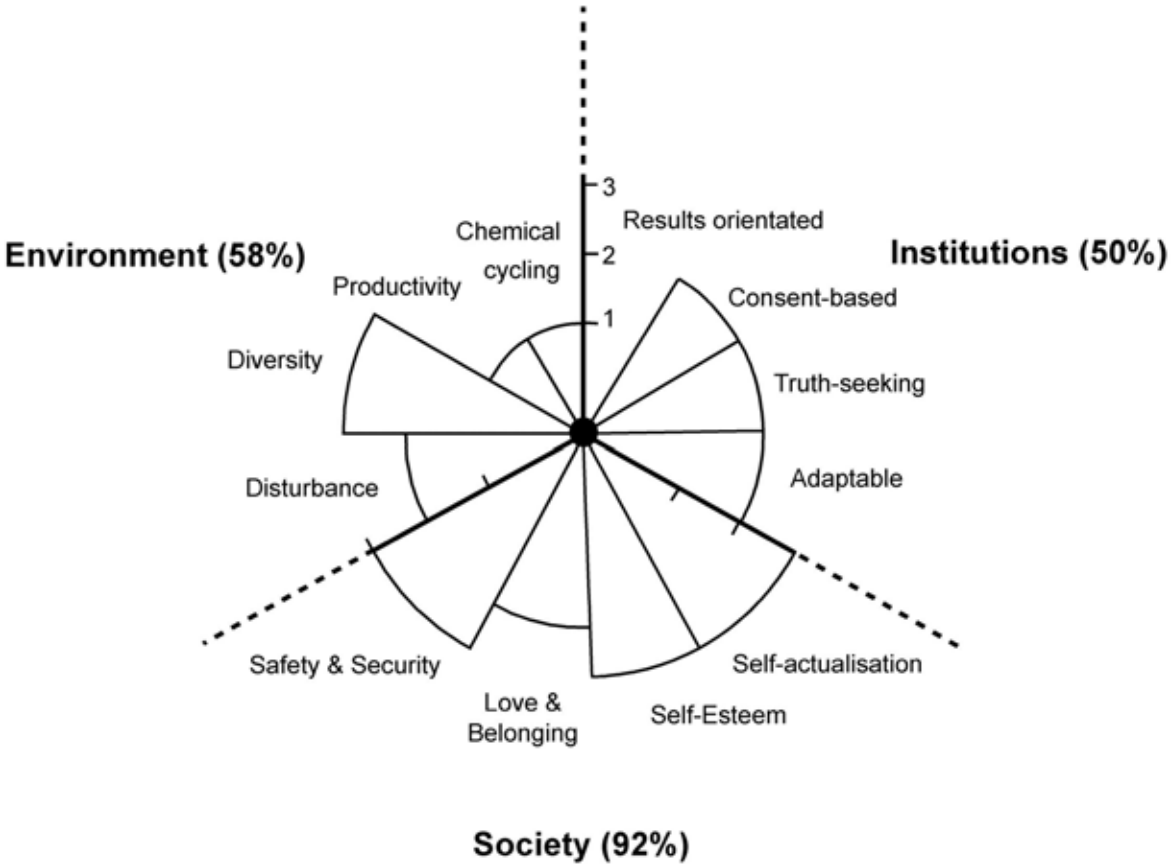

Figure 2: Amoeba plot of the three domains of sustainability and their components for a hypothetical recreational fishery on an Eastern Cape estuary.

4 ASSESSMENT

The guidelines presented in this document should be available for local mangers to use as a means to an end. Each estuary is different, even those with the same classification, and the way in which these guidelines are used will differ slightly depending on site conditions at any given time. Considerations for the implementation of these guidelines are provided in Appendix A (page C35) and describe the benefits and limitations in more detail. Managers and stakeholder representatives need to have a clear vision of what they want for a particular estuary, and then follow procedures with regards to formulating goals, objectives, implementing plans of action and monitoring their progress. The guidelines presented here should be used as a foundation towards formulating a management action plan that would see the objectives, goals and ultimately the vision achieved. Measures of success would need to be ascertained via a monitoring programme, which is an activity all stakeholders could conceivably be involved in. As part of the capacity building process,

municipalities should appoint a full time estuary management officer, whose sole purpose is the implementation and enforcement of an estuary management plan. An estuary officer's job description would vary between municipal regions, being dependent on the approach chosen to achieve the vision and goals of a particular plan.

It is apparent that the management of estuary living resources is a complex undertaking, with a multitude of issues that need to be addressed and management actions that need to be taken. In addition, the EBM approach to assessing sustainability requires dedication, an understanding of environmental, social and institutional dynamics and competence in applying the relevant aspects to specific estuaries or scenarios. The effective management of an estuary or assessment of the level of sustainability essentially hinges on two aspects, namely capacity (monitoring, enforcement, knowledge and education, apathy, perceptions) and money (funding and budget allocation). In the end it is about realizing, promoting and preserving the economic importance of estuaries and the goods and services they provide. It is encouraging that a few programmes such as this one and the forthcoming national linefish survey are well funded endeavours aimed at addressing estuarine issues. However, there is still the need to improve capacity and funding, both locally and nationally, to ensure that estuaries are protected as important national natural assets.

The process of managing an estuary and maintaining it in a healthy state should be a permanent undertaking, guided by a detailed management plan. Law enforcement officers and conservation officials whose time is almost exclusively dedicated to estuary patrols need to be appointed. Unless there is an almost continuous presence to act as deterrent when necessary or to facilitate community compliance, the guidelines proposed in this document cannot be effectively implemented and the situation regarding the management of stakeholders and estuarine living resources will remain as they are now: woefully inadequate.

Table 4: The three domains of sustainability, environment, social and institutional, the categories associated with each and the indicators (state, pressure and response) used to determine the level of sustainability.

SUSTAINABILITY		INDICATOR TYPE		
DOMAIN	COMPONENT	STATE	PRESSURE (APPLICABLE TO 1 OR MORE STATE INDICATORS)	RESPONSE (APPLICABLE TO 1 OR MORE STATE/RESPONSE INDICATORS)
ENVIRONMENT	DIVERSITY	Threatened endemic species	♦ Effort	♦ Estuarine Protected Areas
		Total number of species	♦ Targeting threatened species	♦ Spatial zonation
		Undersize fish in catch	♦ Habitat destruction (particularly in lower reaches)	♦ Law enforcement
		Target species in catch	♦ Land-use	♦ Estuary Management Plan
		Habitat diversity	♦ Water reserve	♦ Integrated Development Plan
		Alien invasives	♦ Water demand	♦ Management based research programme
	PRODUCTIVITY	Stock status	♦ Quality control (pollution and water)	♦ Monitoring programme
		Catch per unit effort (CPUE)	♦ Compliance	♦ Initiatives to address unemployment
		Recovery period (prawn beds)	♦ Available scientific data	♦ Buffer zones or POS
		Recruitment	♦ Town planning	♦ Communication and cooperation with government agencies, e.g. DWAF
		Nursery habitats	♦ Demand for development	
		Mouth state	♦ Monitoring capacity	♦ Institutional capacity
		Freshwater abstraction	♦ Population density	♦ Control over land-use patterns adjacent to estuary
	NUTRIENT CYCLING	Water quality index	♦ Immigration to coastal areas	
		Clean water days	♦ Unemployment	
		Pollutants	♦ Manipulation of waterways	
		Contamination	♦ Sedimentation	
		River-Estuarine Interface (REI) dynamics		
		Control measures		
	DISTURBANCE	Development		
		Habitat loss and alteration		
		Exploitation		
		Recreational activities		
		Illegal activities		
		Dredging activities		
		Pollution		
		Freshwater abstraction		

Table 4 continued

SUSTAINABILITY		INDICATOR TYPE		
DOMAIN	COMPONENT	STATE	PRESSURE (APPLICABLE TO 1 OR MORE STATE INDICATORS)	RESPONSE (APPLICABLE TO 1 OR MORE STATE/RESPONSE INDICATORS)
SOCIETY	SELF-ACTUALISATION	Unemployment	♦ Population density	♦ Unemployment initiatives
		Community involvement	♦ Unemployment	♦ Poverty alleviation initiatives
		Participation/contribution to co-operative management	♦ Desire to be involved (apathy) ♦ Altruism and concern/tolerance for fellow users	♦ Education and awareness initiatives ♦ Co-operative management Incentives
		Motivation for exploitation	♦ Greed	♦ Feeding schemes
		Alternative livelihoods	♦ Hunger	♦ Law enforcement
		Willingness to accept a degree of responsibility	♦ Recreation ♦ Education and literacy	♦ Crime prevention ♦ Initiatives to promote tolerance
	SELF-ESTEEM	Job-security	♦ Social hierarchy	♦ Public relations
		Financial independence	♦ Broken homes	♦ Media coverage/exposure
		Education and literacy	♦ Demographics of angling clubs or forums	♦ Initiatives to promote tolerance
		Social standing	♦ Unstable/unpredictable work environment	
	LOVE AND BELONGING	Functional families	♦ Law enforcement / crime prevention	
		Integration and acceptance in community	♦ Racial tension	
		Interaction amongst users, e.g. angling clubs and forums, and involvement in management		
		Conflict		
	SAFETY AND SECURITY	Income		
		Financially independent		
		Crime, e.g. theft of equipment and harassment		

Table 4 continued

SUSTAINABILITY		INDICATOR TYPE		
DOMAIN	COMPONENT	STATE	PRESSURE (APPLICABLE TO 1 OR MORE STATE INDICATORS)	RESPONSE (APPLICABLE TO 1 OR MORE STATE/RESPONSE INDICATORS)
INSTITUTION	RESULTS-ORIENTED	Enforcement	♦ Data available for monitoring	♦ Demographically representative forums established
		Co-ordination with appropriate departments and authorities	♦ Capacity to monitor	♦ Increased capacity to monitor
			♦ Capacity to enforce	♦ Increased capacity to enforce
		Legal framework and requirement for an EMP	♦ Funding and budget allocation	♦ Estuary marketing campaign
			♦ Awareness of estuaries by all tiers of government	♦ Awareness programmes to educate government
		Development of an EMP	♦ Apathy of stakeholders	♦ Funding for directed research, biological monitoring and compliance monitoring
		Monitoring programmes	♦ Available NGO and funding for marketing	
		Incorporation of EMP into IDP	♦ Perception of authorities by stakeholders	♦ Institutions held accountable for management actions
		Marketing of estuaries	♦ Knowledge of legislation	♦ Public awareness programme regarding estuaries, legislation and its relevance
		Implementation of evaluation programme	♦ Employment practices	
			♦ Employee competence	
	TRUTH-SEEKING AND CONSENT-BASED	Stakeholder and user buy-in and participation	♦ Communication of legislation and its relevance	
			♦ Reaction to change	
		Approach to management	♦ Capacity to communicate with stakeholders	
		Knowledge of legislation	♦ Capacity of authorities to understand estuaries	
		Research support	♦ Accountability by government agencies	
		Support from local council	♦ Negative incentives to encourage compliance	
	ADAPTABLE	Education level		
		Education capabilities		
		Funding and budget allocation		
		Ability to respond to proposed changes		

5 REFERENCES

Anonymous, 1999. Draft White Paper for Sustainable Coastal Development in South Africa. Submitted by the Policy Committee to the Minister of Environmental Affairs and Tourism. March 1999.

Anonymous, 2000. Sustainable use within an ecosystem approach. Information Paper for the Subsidiary Body for Scientific, Technical and Technological Advice to the Convention on Biological Diversity. Prepared by the IUCN – Sustainable Use Initiative.

Breen, C.M. and McKenzie, M. (eds). 2001. Managing estuaries in South Africa: An introduction. Institute of Natural Resources, Pietermaritzburg.

Brett, G. and K. Cole. (eds). 2001. Technical inventory of coastal zone use 2001. Kei River to Tyolomnqa River. Internal Report, Marine Working Group, East London.

Colloty, B.M., 2000. The botanical importance rating of the estuaries in the former Ciskei/Transkei. PhD Thesis, UPE.

Colloty, B.M., Adams, J.B. and Bate, G.C., 2001. The Botanical Importance Rating of the estuaries in former Ciskei/Transkei. WRC Report no TT 160/01.

Costanza, R., et al., 1999. The value of the world's ecosystem services and Natural Capital. Nature. 387: 253-260.

Cowley, P.D., 2000a. Base line study of the utilisation of living marine resources in the Eastern Cape Province. Prepared for the Department of Economic Affairs and Tourism, Eastern Cape Province.

Cowley, P.D., 2000b. Utilisation of living marine resources in the estuaries between Port Elizabeth and East London, Eastern Cape Province. JLB Smith Institute of Ichthyology, Unpublished Report.

Forbes, V.R., 1998. Recreational and resource utilisation of Eastern Cape estuaries and development towards a management strategy. MSc Thesis, UPE.

Garcia, S.M. and Staples, D., 2000a. Sustainability indicators in marine capture fisheries: introduction to the special issue. Marine and Freshwater Research 51: 381-384.

Garcia, S.M. and Staples, D., 2000b. Sustainability reference systems and indicators for responsible marine capture fisheries: a review of concepts and elements for a set of guidelines. Marine and Freshwater Research 51: 385-426.

Grindley, J.R., 1974. Estuaries. An endangered habitat. African Wildlife 28(1): 23-26.

Harrison, T.D., Cooper, J.A.G. and Ramm, A.E.L., 2000. State of South African Estuaries. Geomorphology, Ichthyofauna, Water Quality and Aesthetics. DEAT, State of the Environment Series. Report No. 2.

Heydorn, A.E.F., (ed). 1986. An assessment of the state of the estuaries of the Cape and Natal 1985/86. South African National Scientific Programmes. Report No. 130.

Knudsen, E. and MacDonald, D., 2000. Sustainable fisheries: Are we up to the challenge? Fisheries 25(12): pp4 & 43.

Martin, A.P., 1999. Sustainable utilization of bait organisms. Swartkops estuary, Port Elizabeth. Unpublished Report to the Swartkops River Utilization Task Group.

Pajak, P., 2000. Sustainability, ecosystem management, and indicators: Thinking globally and acting locally in the 21st century. Fisheries 25(12): 16-30.

Pradervand, P., 1998. An assessment of recreational angling in Eastern Cape estuaries. MSc Thesis, UPE.

Turpie, J.K., Adams, J.B., Joubert, A., Harrison, T.D., Colloty, B.M., Maree, R.C., Whitfield, A.K., Wooldridge, T.H., Lamberth, S.J. Taljaard, S. and. van Niekerk, L., 2002. Assessment of the conservation priority status of South African estuaries for use in management and water allocation. Water SA 28(2): 191-206.

Whitfield, A.K., 1992. A characterization of Southern African estuarine systems. South African Journal of Aquatic Science 18(1/2): 89-103.

Whitfield, A.K., 2000. Available scientific information on individual South African estuarine systems. Water Research Commission, Report No. 577/3/00.

Whitfield, A.K., Paterson, A.W., Bok, A.H. and. Kok, H.M., 1994. A comparison of the ichthyofaunas in two permanently open eastern Cape estuaries. South African Journal of Zoology 19: 175-185.

APPENDIX A: CONSIDERATIONS FOR THE IMPLEMENTATION OF GUIDELINES FOR SUSTAINABLE USE OF ESTUARINE LIVING RESOURCES

1.1 General

1. Estuaries within each classification will differ with regards to specific user patterns, social and institutional characteristics and biophysical aspects. Managers must therefore treat each system on an individual basis when selecting guidelines from Table 1 (page C13).
2. Activities that need to be considered by municipal authorities or managers when determining a vision, goals and objectives for any system include:

- Identifying all IAPs through public advertising
- Meeting and consulting with IAPs to ensure buy-in with respect to any management orientated venture
- Conflict resolution between user groups and amongst institutional departments
- Ensure that the vision is compatible both with National policy (e.g. MLRA) and with the National Framework for co-operative governance
- Consultation with DWAF with regards to catchment management agencies and water allocation (natural reserve) to ensure compatibility with the vision.

1.2 Resource

1. Controlled access to bait areas while also restricting collecting activities to daylight hours facilitates enforcement and monitoring of offtake and effort. Illegal implements such as forks and spades, used to dig up organisms such as tapeworm, destroy the mudbank habitat and should be prohibited.
2. Rotation of bait collecting areas will allow for replacement of harvested organisms and the recovery of the substrate due to trampling. A minimum period of 6 months is proposed, but annual rotation would be preferable. Closed bait areas should be selected from the most productive sites on each system and not located in areas used for other recreational activities such as skiing.
3. The market for tropical fish is a lucrative one, and potential for over-harvesting exists. Permits are required and need to be enforced.
4. Fish trapped in closed systems require a breaching event to gain access to the sea, whether for reasons of feeding, migration or reproduction. When breaching occurs, fish tend to congregate in the shallow mouth region and become channelled at the point of exit. Unscrupulous users participate in wholesale slaughter, and this needs to be stopped. Breaching events are predictable if rainfall activity can be monitored so implementing this guideline should not be problematic.
5. Regular patrols will be required to monitor fishing activities and ensure that only legal methods are used to catch linefish. Certain species such as spotted grunter are susceptible to cast nets and all species are ensnared by gill nets – this provides a realistic threat to sustainability.
6. Competitive angling promotes higher levels of effort within a confined space and encourages the killing of as many fish as possible in a short period. This activity also

places increased strain on bait organisms, and should be stopped or at least severely limited.

7. Surveys need to be conducted on all systems to assess the status of fisheries and the health of the living resources. Managers can conduct these surveys after consultation with researchers; or municipalities can fund this type of research.
8. Mouth breaching events allow fish to migrate to sea to spawn and allow new recruits to enter the system. These fish are vulnerable to being caught, particularly with nets and spears, and as such this activity should be prevented. Local knowledge should allow managers to prevent fishing for a day prior to the event when fish start to congregate near the mouth and for three days after the event.

1.3 Ecosystem

1. Walkways constructed over sensitive habitats adjacent to bait collecting areas will reduce the level of impact by trampling. Adjacent habitats such as saltmarshes generally are not utilized for living resources but are degraded by activities associated with exploitation. Living resources that use these habitats for feeding or protection are then harmed resulting in a cascade effect. The setback line needs to be reviewed – this will not only protect marginal habitats but also will decrease the frequency of artificial breaching events. The amount of public open space between developments and the waters edge needs to be increased so that sensitive habitats are not trampled by passing members of the public.
2. The number of boats on an estuary should be limited according to the carrying capacity of that system. A method for determining this can be found in Forbes (1998). Limiting the number of boats will not only reduce effort, but also will reduce impacts due to noise and wakes. This action would be more effective on systems with limited access points, as monitoring multiple points is logistically unfeasible.
3. Sanctuary areas for threatened sedentary species (e.g. bloodworm, proboscis worm and mangroves) should be identified and monitored. These sanctuaries should be located in areas that are not used for other recreational activities such as fishing, skiing and power boating, all of which may disturb the species concerned.
4. In order to adopt a holistic approach to management, and to ensure that their vision conforms to national legislation and a national framework, managers will need to consult with representatives from organizations such as DWAF, MCM, agricultural forums, town planners, Dept. Minerals and Energy, etc.
5. Estuarine Protected Areas need to be proclaimed under the Protected Areas Bill when it is promulgated. Linefish species will not benefit from the partial closure of a system, as they are mostly transient and move throughout the estuary, thus suitable candidate systems need to be identified for total closure. Research orientated towards this goal may be done by managers, but due to the time involved and scope of work is better suited to research organizations. Funding may come from national government if the resource being protected is of national significance, but local organizations or municipalities may fund endeavours aimed at protecting resources with local significance.

6. Guidelines under national Acts that govern activities on estuaries such as mouth breaching need to be adhered to. This may be achieved through consultation with relevant authorities and/or organizations (e.g. MCM and Centre for Scientific and Industrial Research (CSIR)) and education programmes. In addition, to the Sea Shore Act and NWA, breaching may be required (or forbidden) under certain interpretations of sections of the MLRA.
7. Riparian habitats tend to be sensitive and should be protected from human activities such as trampling and farming and impacts associated with vehicles and boat mooring sites. A safety or exclusion zone around these habitats needs to be established to prevent or limit access, e.g. no farming activities within 10 m of the estuary and no mooring on saltmarshes or productive mudbanks used as bait collecting sites.

1.4 Socio-economic

1. Subsistence bait fisheries may be established on selected systems using the following guidelines (see also Martin, 1999);

- Collectors should sell to an outlet, i.e. licensed bait kiosk, which then sells on to the public. No direct sale between collectors and anglers should be allowed. This will facilitate monitoring and minimize waste.
- Fishery must be controlled through prevention of illegal collection methods as specified in the MLRA.
- No informal selling by unlicensed subsistence users to recreational anglers (prosecute both parties).
- Enforce daily quotas, both for collectors in terms of their permit conditions and anglers in terms of the MLRA.
- Limit collecting effort by controlling the number of permit holders.

2. User conflict needs to be reduced or avoided by introducing zones within an estuary for specific user groups. Effective zonation can only be achieved through a public participation process where the requirements and rights of all individuals are taken into consideration. Zonation can either be spatial (separate fishing and skiing zones or separate recreational and subsistence fishing zones) or temporal (skiing and power boating only allowed at certain times). Multiple access points can serve to reduce encounters and conflict between user groups, however, this would make enforcement and monitoring more problematic. This decision would ultimately depend on available manpower and capacity.
3. Power boats used for recreation and fishing are responsible for a small proportion of overall damage due to wave action (bank erosion), noise pollution and fuel/oil spills. Local by-laws can restrict engine size (horsepower), have go-slow or wake free zones or ban powered craft altogether. Many municipalities have built-in costs for boat licenses that vary according to horsepower – this money should be used to fund management costs.
4. Education of managers, users and the general public as to the importance of estuaries, not only on a local scale but regional and national is essential to instil a sense of ownership and pride. At the moment, transfer of knowledge to grass roots level is the most problematic aspect. Education of the young generation through school programmes

will reap benefits in the long-term. By placing a value or degree of importance to an estuary, interest in its well-being from stakeholders can be ensured.

5. Once the local and national value of estuarine resources are brought to the attention of government, they may recognize the value in managing those resources. This approach will realistically be limited to larger, high profile estuaries, and careful marketing will be required to avoid unscrupulous politicians and developers from realizing the potential from a commercial viewpoint.
6. Community involvement in estuarine management is vital. Any vision for a system must arise from a transparent process and encompass the needs and dreams of all IAPs to ensure their buy-in and ultimately their cooperation with managers in trying to achieve that vision. The level of interest and dependence by IAPs on the resource needs to be determined at the beginning of the process. Community involvement in the form of trusts or forums needs to be representative of community and user demographics, and these structures need to have the support of all IAPs. Communities can be made to accept partial responsibility for the success of an EMP by being involved in monitoring programmes. In addition, appropriate incentive measures that can be used to encourage community participation and user compliance need to be highlighted. Community members can also be used during peak holiday season to assist authorities whose capacity at those times is severely limited.
7. Funds generated from activities such as boat licenses and fines must be used for estuarine directed management or education activities in the region where those funds were generated. Funds that are deposited in regional or national schemes seldom find their way back to areas (rural in particular) where they are needed most. Although there is merit in a portion of the funds being directed toward National programmes (e.g. linefish survey), the majority should remain to help implement local management plans.
8. Strict adherence to and compliance with environmental regulations are needed to reduce impacts associated with human activities such as mining, industry, agriculture and urban development. A rigorous routine of patrols and presence on the estuary, as well as an intricate knowledge of the requirements of the relevant Acts will facilitate this process.
9. Reduction of effort will help to achieve sustainability. Apart from reducing access, the most effective way of achieving this would be to offer alternatives to consumptive use, i.e. people can still use the estuary but for activities such as eco-tourism and catch & release fisheries (e.g. Mtentu) or commercial ventures such as mariculture. Job creation (within the eco-tourism industry or on mariculture farms) for subsistence users will significantly reduce effort on some systems.
10. Controlled access sites will facilitate monitoring and allow for strict control of levels of effort based on the carrying capacity of a particular estuary. Increased cost of access may alleviate effort slightly, but it will also serve to generate funds for management based activities.
11. Although funding can be procured at the local level in some of the larger municipalities, most would rely on national government.
12. In certain rural areas, tribal authorities are still held in high regard by local communities. Their influence should not be underestimated and should be used whenever appropriate. Traditional beliefs and perceptions are firmly part of community history and law in rural

areas and are difficult to change. There must, however, be compromise when indigenous customs and tribal law conflict with legislation and the sustainable use of natural resources.

13. A similar situation exists within the group of elite, rich white anglers who do not believe that their activities have ever or will ever significantly impact on the resource. They need to be aware of accumulative impacts and the contribution they make towards this. Only when their perceptions are changed, will they accept an integrated approach to estuary management and accept responsibility for their actions.
14. Permit holders are disillusioned - they do not see the money they paid for the permits being used for anything useful. Positive steps need to be taken by authorities to initiate projects that either involve permit holders or appear to benefit them directly.

1.5 Institutional

1. Monitoring levels of effort and catch of both fish and bait organisms is a vital part of the monitoring and evaluation process by which the level of sustainability can be assessed. Effective monitoring can be done at a single point on small systems, but will require considerably more effort on larger systems with multiple access points. Community participation should be encouraged wherever practically possible. Managers on larger systems will need to undertake roving surveys, preferably with the aid of a boat. These patrols can be combined with enforcement activities with regards the MLRA. The minimum requirements for a monitoring programme should include data on CPUE, user groups, number of users (consumptive use), effort, target organisms, catch composition, levels of bait utilization, motivation for using resource, degree of compliance (e.g. catch restrictions, permits and illegal activities) and level of conflict between user groups. Historical data should be accessed and incorporated into the monitoring programme wherever possible. Catch restrictions that need to be enforced include minimum legal size, daily bag limit, closed season and areas closed to fishing and/or bait collecting.
2. Communities from several systems in the Eastern Cape (e.g. Umngazana and Tyolomnqa) are used by syndicates to catch linefish, prawns and mudcrabs using a variety of illegal methods. The catch is bought at low prices and sold at a huge profit by the syndicate operators. These activities, together with those of sham-recreationals seriously retard efforts at attaining sustainability and need to be stopped. A concerted effort on behalf of law enforcement will be required to stem this tide as the syndicates appear to be well organized with considerable financial backing, and sham-recreationals have become masters at avoiding authorities.
3. Communication and co-operation between municipal departments and different tiers and departments of government will facilitate effective governance and ultimately empower managers to effectively conserve the resource and manage the users. An awareness of the activities of DWAF with regards to catchment management and the natural reserve would be highly beneficial to local managers. A communication network needs to be established, with strategically placed officials in the right posts.
4. Pollution of estuaries from a variety of sources including agriculture, mariculture, industry and urban development can be prevented through compliance monitoring with

regards to environmental legislation. A strong visual presence of authorities on estuaries also acts as a deterrent to offenders.

5. Co-operation with developers and town planners can pre-empt bad planning that leads to erosion and runoff due to bad roads and poor rehabilitation practices.
6. Mangroves are utilised on most estuaries where they are found, but only significantly on the Umngazana. Steps need to be taken to reduce the impact on this resource both through conventional law enforcement and by providing alternative materials for building.
7. Legislation aimed at protecting estuarine living resources is not being enforced due to poor capacity, i.e. the vision government has proposed is not being achieved. Managers need to familiarize themselves with sections of Acts that pertain to estuaries and their habitats and resources. They also need to be familiar with their obligations (legally) with regards to enforcing the relevant legislation. This knowledge will provide them with the tools necessary to recognize situations where environmental regulations are being ignored or exceeded, and allows for accountability to be established.
8. Acts such as the MLRA need to be sold to the anglers as something that is beneficial to them and is ultimately in place to help them. If we succeed in this, if the anglers perceive they have a vested interest, they will become the drivers behind helping authorities implement the Act. Presently, users feel threatened by the process of permits and detailed legislation and many are not familiar with the most basic regulations. Efforts must be made to communicate with anglers to allay fears and inform them of regulations.
9. Municipalities and regional institutions need to lobby national government on behalf of local managers for custodianship of estuaries and for their natural resources to be returned to local authorities and management forums. Local managers appear to be in favour of this proposal provided it is an adequately funded mandate, i.e. funding for performing enforcement and managerial tasks needs to originate via national government or motivated local incentives, e.g. local business and funds from boat license and permits (bait and angling). Although some local managers are MCM appointed, they carry out this activity on a part-time basis and realistically do not have the time or capacity to effectively enforce the MLRA amongst others. By giving them the responsibility and including it in their day-to-day job description, monitoring and enforcement will be more effective. At the very least, all local managers should be MCM appointed – this applies to both municipal and regional (DEAET) representatives. In addition, co-operation between tiers of government should include appointing all local managers as DEAET representatives for purposes of monitoring and enforcing aspects of the Sea Shore Act as it pertains to estuaries.
10. Communication and co-operation between researchers and managers should facilitate the effective transfer and implementation of information relevant to management issues.
11. Public perceptions of favouritism, resulting from corruption and perceived racism, by enforcement officials towards a specific user group can destroy trust between institutions and communities and result in conflict situations. This is to be avoided at all costs. Enforcement must also be in line with legislation relevant to the resource and not according to politically motivated agendas.

12. The value of estuaries to communities needs to be communicated to government, which also needs to be made aware that all members of a community, not just the influential, stand to benefit from the goods and services provided by estuaries.
13. Increased capacity is not achieved merely by employing more workers. People on the ground need to be educated and aware of their responsibilities towards the community and the estuary, i.e. course work aimed specifically at estuaries and their management. Educated and motivated employees will increase the capacity of an institution to function effectively. Capacity can be enhanced by seasonal concentration of effort at popular holiday destinations, which are otherwise quiet during the year.