



C.A.P.E. ESTUARIES PROGRAMME

Maximising the Economic Value of Estuaries

G.9

C.A.P.E. Estuarine Management Guideline



Version 1
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Our strategic vision for the estuaries in the Cape Floristic Region is:

*Our estuaries are beautiful, rich in plants
and animals, they attract visitors,
sustain our livelihoods and
uplift our spirits.*

C.A.P.E. Estuaries Guideline 9: Maximising the economic value of estuaries

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Photos: T. Bailey, B. Clark

Economic Value

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1. Introduction

The C.A.P.E. Regional Estuarine Management Programme was developed to ensure the conservation and sustainable utilisation of the estuarine biodiversity in the Cape Floral Region (CFR). The programme comprises three major components: a strategic workshop, development of a conservation plan, and the production of management plans for estuaries of the CFR.

The stakeholder workshop generated the following strategic vision for the estuaries of the CFR (van Niekerk & Taljaard 2006):

Our estuaries are beautiful, rich in plants and animals, they attract visitors, sustain our livelihoods and uplift our spirits.

Or more formally:

The estuaries of the CFR sustain our spiritual and economic well-being through their biophysical attributes and production of goods and services, which are made possible by the maintenance of their biodiversity and ecosystem functions (integrity).

The programme has generated a Conservation Plan (Turpie & Clark 2007) and will generate management plans for the estuaries of this region. The conservation plan identifies which estuaries should be given formal protection (for part or the whole system). For those that require partial protection (about 80% of estuaries) it is assumed that 50% of the biota will be protected. However, it is left up to the fine-scale planning incorporated into the management plans to design how that protection would best be achieved.

The development of management plans involves a phased approach. The first (2005 to 2009) will focus on the design and testing of the process delineated by the proposed National Estuarine Management Protocol in a number of pilot estuaries in the CFR. Phase II (2009 to 2014) will extend the Programme to include the more complex estuaries (from a management perspective) in the region. Phase III (2015 to 2020) will extend the Programme to all the remaining estuaries within the CFR.

As the initial part of the first phase in management plan development, a proposed generic framework for an estuarine management plan has been developed (Van Niekerk & Taljaard 2007). As an addendum to this generic framework, simple generic guidelines are also being developed for various aspects of estuary management that can be used in the development of the management plans. The set of guidelines will include the following components (Table 1).

Table 1. The full set of guidelines available for developing Estuary Management Plans

1	C.A.P.E. Estuaries: Regional Workshop Proceedings
2	C.A.P.E. Estuaries: Proposed Generic Framework for Estuarine Management Plans
3	C.A.P.E. Estuaries: The health status, conservation importance and economic value of Temperate South African estuaries and development of a regional conservation plan

C.A.P.E. ESTUARIES GUIDELINES	TITLE
1	Legislation pertaining to the management of environmental threats within estuaries
2	Sustainable Tourism in Estuaries of the Cape Floristic Region
3	Collection of Bait Organisms in Estuaries
4	Preliminary Zoning of the Human Use of C.A.P.E. Estuaries Based on Sensitivity Mapping and Carrying Capacity
5	Promoting Appropriate Water Quantity and Quality Management in Estuaries
6	Monitoring Programmes for Implementation in South African Estuaries
7	Sustainable Fishing in Estuaries
8	Generating Education and Awareness of Estuaries in the Cape Floristic Region
9	Maximising the Economic Value of Estuaries

1.1 Why is this guidance needed?

Turpie & Clark (2007) showed that estuaries yield a number of positive values that contribute to economic production. Yet our estuaries are being degraded and that value is being eroded. Indeed, for a majority of estuaries, increased protection would raise the value of estuaries over time, whereas lack of protection would have the opposite effect (Turpie & Clark 2007). While the conservation plan provides some guidance as to which configuration would maximise the overall value of estuaries, it merely assumes that those estuaries that are afforded some degree of protection are protected in such a way as to maximise the overall benefits. Of course, the protection could be carried out in a number of possible ways, some of which could even have detrimental effects on economic value. In addition to those estuaries that will be partly or fully protected, the remaining estuaries will need to be managed sustainably, necessitating the development of management plans for *all* estuaries.

While environmental management plans typically take stakeholder preferences into account, they are not usually explicitly concerned with economic value. However, it is becoming increasingly obvious that for such management plans to be successful they should align with broader economic and social policies. In other words, they need to make a positive contribution to the economy and to societal welfare.

To do this it will be necessary to understand the values associated with estuaries, how they are assessed and how to use that understanding to arrive at the solution that is most desirable from a societal standpoint, given the constraints such as required protection status. This way we can be more assured of the success of conservation measures. Using economics in this way is relatively novel and there is little precedent of any stage of this type of analysis. These guidelines provide an overview of the goods and services that estuaries provide, how and why they are valued, what we know about the value of temperate South African estuaries, and guidelines as to how to maximise the value of estuaries through management.

2. Estuary goods and services

2.1 Ecosystem goods and services

2.1.1 Defining goods, services and attributes

Estuaries, like other ecosystems, offer a range of **goods, services and attributes** that generate value and contribute to human welfare (Barbier 1994). The concept of ecosystem goods and services, popularised in the ecological-economics literature, stems from the perception of ecosystems as natural capital which contributes to economic production.

Goods, services and attributes may be defined as follows:

Goods are harvested resources, such as fish.

Services are processes that contribute to economic production or save costs, such as water purification.

Attributes relate to the structure and organisation of biodiversity, such as beauty, rarity or diversity, and generate less tangible values such as spiritual, educational, cultural and recreational value.

Goods, services and attributes are often referred to collectively as 'ecosystem services', or 'ecosystem goods and services'. However this often results in the value of ecosystem attributes being overlooked by those who are not aware of this.

2.1.2 Redefining ecosystem services: Millennium Ecosystem Assessment

More recently, the Millennium Ecosystem Assessment (2003) categorized the services obtained from ecosystems as follows:

Provisioning services such as food and water;

Regulating services such as flood and disease control;

Cultural services such as spiritual, recreational, and cultural benefits; and

Supporting services, such as nutrient cycling, that maintain the conditions for life on Earth.

The first three align well with the definitions of goods, services and attributes described above. The fourth, supporting services, has created some controversy as these fit firmly with in the biodiversity box in Figure 1, and inclusion of these 'services' in a valuation study can lead to double counting. It does, nevertheless, highlight the fact that the other services cannot be generated without these underlying processes.

2.2 Goods and services provided by estuaries

The main types of ecosystem services that would be associated with aquatic ecosystems are listed in Table 2. Many of these are important services provided by estuaries.

Table 2. *Ecosystem goods, services and attributes of aquatic and water-dependent ecosystems, adapted from Costanza et al. (1997), and their importance in temperate South African estuaries*

	<i>Ecosystem Goods, Services & Attributes</i>	<i>Description</i>	<i>Importance in estuaries</i>
<i>Goods</i>	<i>Water</i>	<i>Provision of water for subsistence use</i>	<i>N/a</i>
	<i>Food, medicines</i>	<i>Production of fish and food plants; medicinal plants</i>	<i>High</i>
	<i>Raw materials</i>	<i>Production of craftwork materials, construction materials and fodder</i>	<i>Medium</i>
<i>Services</i>	<i>Gas regulation</i>	<i>Carbon sequestration, oxygen and ozone production,</i>	<i>Low</i>
	<i>Climate regulation</i>	<i>Urban heat amelioration, wind generation</i>	<i>Low</i>
	<i>Disturbance regulation</i>	<i>Flood control, drought recovery, refuges from pollution events</i>	<i>Negligible</i>
	<i>Water regulation</i>	<i>Provision of dry season flows for agricultural, industrial and household use [spatially and temporally]</i>	<i>N/a</i>
	<i>Erosion control and sediment retention</i>	<i>Prevention of soil loss by vegetation cover, and capture of soil in wetlands, added agricultural (crop and grazing) output in wetlands/floodplains</i>	<i>Low</i>
	<i>Waste treatment</i>	<i>Breaking down of waste, detoxifying pollution; dilution and transport of pollutants</i>	<i>Medium</i>
	<i>Ecological regulation</i>	<i>Regulation of malaria, bilharzia, liver fluke, black fly, invasive plants, etc.</i>	<i>N/a</i>
	<i>Refugia</i>	<i>Critical habitat for migratory fish and birds, important habitats for species</i>	<i>High</i>
	<i>Nursery areas</i>	<i>Critical breeding habitat, Nurseries for marine fish</i>	<i>High</i>
	<i>Export of materials and nutrients</i>	<i>Export of nutrients and sediments to marine ecosystems</i>	<i>High</i>
<i>Attributes</i>	<i>Genetic resources</i>	<i>Medicine, products for materials science, genes for resistance to plant pathogens and crop pests, ornamental species</i>	<i>Low</i>
	<i>Structure and composition of biological communities</i>	<i>Species diversity and habitats providing opportunities for recreational and cultural activities</i>	<i>High</i>

2.2.1 Goods

Temperate South African estuaries are particularly important for the provision of bait and fish resources which are used for recreational, subsistence and informal commercial purposes. Many estuaries also provide other raw materials such as grass for thatching, crafts and fencing, sedges for mats and crafts, reeds for mats, fences and building, timber and poles from riparian and mangrove forests, firewood, sand, pebbles, clay, and minerals. These goods are particularly important in urban and rural localities where surrounding populations are predominantly poor.

2.2.2 *Services*

While regulation functions such as carbon sequestration and climate regulation are important in ecosystems such as forests, these functions are probably not of significance in estuaries. Temperate estuaries also play little or no role in providing services such as flood attenuation, regulation of downstream flows and erosion control, since these systems are at the end of catchments and there is little in the way of downstream habitats that depend on them.

However, they tend to be far more important than other types of wetlands for services such as the provision of nursery habitats and refugia. Estuaries provide nursery areas to numerous fish species that recruit into inshore marine fisheries (Lamberth & Turpie 2003). They also provide a refugia to many coastal species, in the form of provision of sheltered habitat in an otherwise highly exposed coastline. In addition, they are well known for their function as a conduit in exporting nutrients and sediments to the marine zone, contributing to productivity there. Many estuaries are also important in the treatment of wastes, in particular providing this service to a number of urban centres that dispose of waste water into them.

2.2.3 *Attributes*

Ecosystems famously provide the genetic material that proves useful in the development of new pharmaceutical products, cultivars and crops. However, while there is some prospecting, there is little evidence that estuaries are important in this regard. Nevertheless, estuarine habitats and the species they contain provide very important opportunities for recreation, education and research in temperate South African estuaries, this being one of their most prominent set of services.

3. The economic valuation of estuaries

3.1 What is 'economic value'?

Economic value is a measure of societal welfare or wellbeing. Wellbeing is defined as a state of prosperity, health and happiness. Thus societal wellbeing is created through the generation of household income, employment, the contribution to household livelihoods (e.g. cash income, food, shelter), and the generation of utility or satisfaction.

Different measures of value are relevant to different decision-makers. Individuals and firms make decisions on the basis of their own financial and/or utility gains. Governments make decisions on the basis of overall welfare gains (contribution to national income and employment). At a more local level, municipalities may make decisions based on the generation of revenues, e.g. from property rates. It is important to understand value from both from an individual/firm perspective and a national perspective, since the former constitute the market forces of change, and the latter are required to make decisions that are in the overall interest of society.

A common indicator of societal wellbeing is income per capita. This is calculated by dividing a measure of national income – such as the Gross Domestic Product (GDP), by the total population. Thus it is highly relevant to estimate an estuary's contribution to GDP, and/or the way in which GDP would change given a change in estuary quality or size.

An estuary contributes to GDP through the expenditure generated by estuary-dependent activities. This expenditure contributes to the turnover in an industry. For example, expenditure by recreational anglers contributes to the turnover of businesses such as tackle-shops and hotels. Part of the turnover is spent on intermediate goods and services (e.g. on vegetables), the rest is direct value added to the national economy (i.e. ends up as income). The intermediate expenditure in turn contributes to the turnover of other businesses (e.g. greengrocers) in other sectors, some of which becomes value added. These contributions to value added together make up the indirect value added by estuaries. The total value added (contribution to GDP) is the sum of the direct and indirect value added. The relationship between these two reflects the multiplier effects of the direct value added. Note that the most difficult part is estimating the direct or indirect contribution of an estuary to different types of turnover, and how this turnover would change with a change in estuary quality.

Not all of the values generated by estuaries are traded in markets, however, and non-market values are not reflected in measures of GDP. For example, the consumption of estuary resources may make an important contribution to peoples' livelihoods without generating direct, tangible income. Similarly, the aesthetic benefits of a view, and the scientific and educational benefits associated with estuaries would not be directly measurable in national accounting systems. Values such as this are often best expressed in terms of peoples' Willingness to Pay, rather than actual turnover, the latter constituting proven Willingness to Pay.

3.2 The concept of Total Economic Value

Environmental and resource economics typically uses a typology of values described in the Total Economic Value concept. The Total Economic Value of an ecosystem comprises Direct Use, Indirect, Option and Non-Use values. Their relation to goods and services is shown in Figure 1.

Economic Value

Direct use values may be generated through the consumptive or non-consumptive use of resources. In the case of South African estuaries, most, if not all, of this use is recreational, and includes both consumptive (fishing and bait collecting) and non-consumptive (e.g. boating, bird watching) activities.

Indirect use values are values generated by outputs from estuaries that form inputs into production by other sectors of the economy, or that contribute to net economic outputs elsewhere in the economy by saving on costs. These outputs are derived from ecosystem functioning such as water purification and nursery functions.

Non-use values include the value of having the option to use the resources (e.g. genetic) of estuaries in the future, and the value of knowing that their biodiversity is protected. Although far less tangible than the above values, non-use values are reflected in society's willingness to pay to conserve these resources, sometimes expressed in the form of donations.

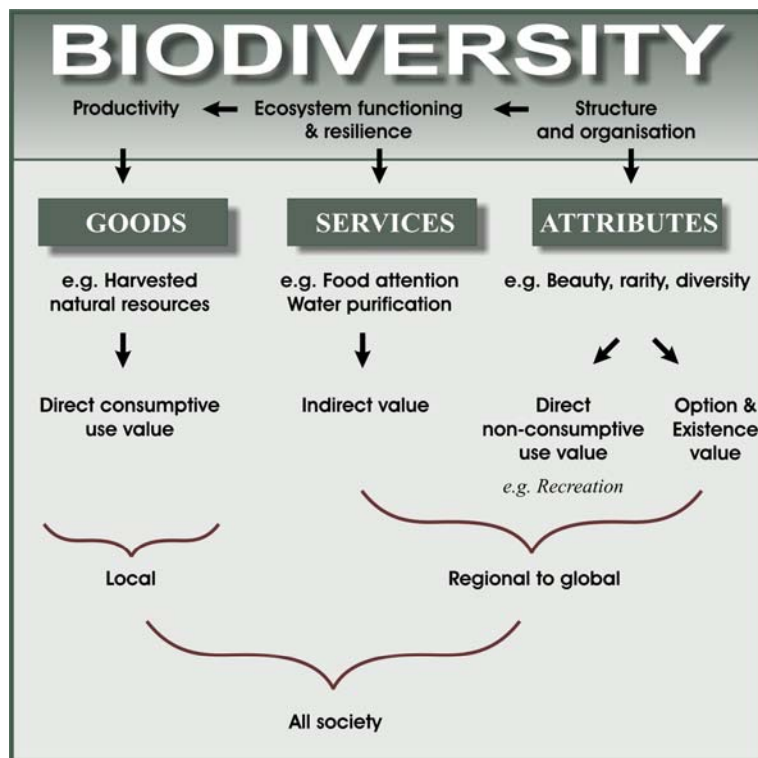


Figure 1. The relationships between biodiversity, the concept of ‘ecosystem goods and services’ and ‘total economic value’ typology of values (based on Turpie 2004a).

3.3 How are estuaries valued?

Economic valuation techniques can be divided into ‘market value’ approaches, ‘surrogate market’ or ‘revealed preference’ approaches and ‘simulated market’ or ‘stated preference’ approaches (Table 3). The more intangible the type of value, the fewer the methods available for use.

Table 3. Different types of valuation methods and the types of value they are typically used to measure

Methods	Consumptive use values	Non-consumptive use values	Indirect use values	Option & non-use values
Market value methods				
<i>Production function</i>	X	X	X	
<i>Replacement cost</i>			X	
Surrogate market / revealed preference methods				
<i>Travel cost method</i>		X		
<i>Hedonic pricing method</i>		X		
Simulated market / stated preference methods				
<i>Contingent valuation</i>	X	X		X
<i>Conjoint valuation</i>	X	X		X

3.3.1 Market value approaches

Market value approaches can be applied to measurement of direct or indirect use values. The production function approach is one which models the production of a good or service as a function of inputs such as environmental quality and labour, and then isolates the value added by the environmental component in question (e.g. Ellis & Fisher 1987, Barbier 1994). This can be used to estimate change in production when the quality or quantity of the environmental component is changed. The measurement of outputs requires quantitative surveys, prices can be taken directly from existing markets, shadow priced, or if non-existent, surrogate prices have to be used on the basis of related markets. Production costs also need to be estimated in a similar way. Other market value approaches include replacement cost methods, estimates of damage costs avoided and of defensive expenditure. The latter are applied to valuation of environmental services such as water purification, such as the replacement of a wetland with a water storage or purification facility.

3.3.2 Revealed preference approaches

Revealed preference methods include travel cost methods and hedonic pricing methods. The travel cost method is used for estimation of recreational use value, and involves the quantitative estimation of demand for visits to a site in relation to the price of a visit, using travel costs as a proxy for the site value (e.g. Clawson & Knetch 1966, Willis & Garrod 1991). The hedonic pricing method is used for estimation of the amount that an environmental amenity adds to property values in an area (Pearce & Turner 1990, Russell 2001). This method involves constructing a predictive model from existing property sales data, in which the environmental attribute is one of the explanatory variable for price of properties.

3.3.3 Stated preference approaches

Stated-preference methods, such as contingent valuation methods (e.g. Mitchell & Carson 1989) and conjoint valuation methods (Green & Rao 1971, Stevens *et al.* 2000), provide the only means of estimating option and non-use values, although they can be used to estimate most types of value. Both involve questionnaire surveys of the affected population. Conjoint valuation methods (CVM) elicit peoples' willingness to pay (WTP) for the benefit of an environmental asset or willingness to accept compensation (WTA) for its

loss. WTP and WTA are estimated by asking respondents to react to a hypothetical situation. The detailed method is usually unique to each specific situation or study. The method is very prone to biases, but if universally accepted standards are followed, these problems can be acceptably minimised (Arrow *et al.* 1993). Conjoint methods are more complex, and seek to ascertain the way in which different components of an amenity, such as species diversity or cleanliness, contribute to its value. The method borrows statistical techniques developed in the field of marketing.

3.3.4 *Benefits transfer*

In certain cases it may be possible to apply the results of other studies undertaken in similar areas, such as the transfer of international estimates to local open space areas. This is called benefits transfer (OECD 1994, Georgiou *et al.* 1997, Barbier *et al.* 1997), because the measured benefits are transferred to another site. This is usually not good enough to base important decisions upon.

3.4 *Why is valuation useful?*

3.4.1 *Justifying conservation*

Estuaries in South Africa are in a relatively good state of health, having benefited from the fact that most development has historically occurred inland. However, the situation has changed in recent decades, and threats such as habitat alteration, overexploitation, human disturbance, change in water quality and changes in habitat and mouth condition due to changes in freshwater inputs are increasingly becoming a problem for many of our estuaries (Turpie 2004b). Many of these problems can be traced to the recent escalation in coastal development, national increases in the demands for use and pollution of water, increased use and disturbance of catchment lands, and increased poverty among coastal communities (Turpie 2004b).

One of the reasons that estuaries are threatened is that the benefits of damaging activities are usually perceived to be greater than the benefits of conservation and sustainable use. Indeed, conservation is perceived by many to be costly, both in terms of management and the opportunity costs involved. Given these perceptions, and in some cases, realities, management and conservation planning will be toothless unless they take socio-economic realities into account. Turpie & Clark (2007) showed that while general perceptions may be true part of the time, there is a strong economic case for conservation and sustainable use in many instances, if the value of estuaries is taken into account.

Estuary valuation serves to **promote conservation** action by:

- highlighting the degree to which estuary goods and services contribute to human wellbeing and economic output
- showing that estuary degradation carries a cost, and
- bringing a more balanced perspective to planning and decision-making, by expressing conservation benefits in a currency compatible with conventional decision tools.

3.4.2 *Determining optimal levels of use*

Valuation can also help determine optimal levels of consumptive or non-consumptive use. In conjunction with ecological understanding, the valuation of natural resource use in estuaries can also be used to construct ecological-economic models with which to

analyse management alternatives. Ecological-economics modelling highlights the ecological linkages and is a potentially very powerful tool for informing stakeholders of the economic consequences of overexploitation, or of the benefits of preserving part of an estuary as a source area for a fishery.

3.4.3 *Determining optimal levels of development*

Valuation studies can examine the value of alternative levels of development and the marginal costs and benefits associated with changes in development.

3.4.4 *Designing financing systems*

Estuary conservation, and the groups who bear its costs, require funds. Valuation ascertains the magnitude and distribution of costs and benefits associated with conservation efforts, and also highlights conservation financing needs. It identifies the stakeholders that benefit freely or at low cost from estuaries, or who carry out activities which degrade estuaries without being penalised. These all present opportunities for capturing additional revenues which can be redistributed to those who bear the costs associated with estuary conservation.

Valuation studies elicit the public's willingness to pay for environmental goods and services, specifically to prevent or effect a change in their delivery. Much of this willingness to pay may be in the form of 'untapped' consumers' surplus. The understanding of demand for estuary goods and services provided by valuation studies can guide the design of revenue raising tools such as User Fees and Payments for Ecosystem Services.

3.4.5 *Designing incentive measures*

Valuation also helps to predict and understand why people engage in activities which are damaging to estuaries, and hence to develop measures that encourage people to engage in more sustainable activities (Emerton 2000). Valuation studies identify the stakeholders that benefit from and those that bear the costs of their conservation, and vice versa. This helps to identify measures that need to be implemented to achieve the optimal and sustainable use of estuaries.

It is increasingly being realised that wherever the optimal situation for society as a whole is dissimilar to the preferred behaviour of individuals, incentives are more effective in achieving the desired goals than regulatory measures alone. It is thus necessary to create incentives to promote conservation and/or reduce damaging behaviour. This entails making damaging behaviour less profitable or beneficial than sustainable practices, which in turn, requires a good understanding of the private costs and benefits of alternatives. Estuaries present an interesting challenge in this regard, since they are publicly owned, and incentive measures depend heavily on the allocation of clear property rights.

4. Estuary values and trade-offs

4.1 International perspective

Estuaries are rich and productive systems that produce a wide range of benefits to society. They derive their richness and productivity from nutrient and sediment inputs received from river and sea water, combined with the relatively sheltered aquatic habitat that they provide. Their characteristic biodiversity assemblages have arisen from the need for biota to cope with their salinity gradients and fluctuations. These characteristics mean that estuaries are among the most valuable types of ecosystems on earth, their global value amounting to some 12% of the total value of ecosystem services provided by the world's natural capital (Costanza *et al.* 1997). Some of the most pivotal international work on ecosystem valuation has been carried out on estuaries (e.g. Ruitenbeek 1992, 1994, Spaninks & van Beukering 1997).

Nevertheless, there is considerable variation in the characteristics of the 259 or so different estuaries in South Africa (Whitfield 2000, Turpie 2004c), and global average values per unit area such as those computed by Costanza *et al.* (1997) are not necessarily applicable at a regional level, nor are they useful at a site level.

4.2 The value of temperate South African estuaries

4.2.1 Estimates of economic value

Valuation studies have been carried out on a few South African estuaries in recent years. These include studies of selected types of value as well as studies which tackle Total Economic Value, and range from back-of-the-envelope to fairly comprehensive estimates.

Subsistence use values have been studied at the Mngazana (beyond the temperate zone) and Knysna estuaries. At Mngazana, the net present value of the mangroves to the local community (over 20 years) was estimated to be in the order of R3.4 million (R0.5 to R7.0 million; De Wet *et al.* 2005). A study at the Knysna estuary estimated that the estuary supports about 30 full-time and 200 part-time subsistence fishers, involved in bait collection (mud prawns *Upogebia africana* and bait worms *Marphysa* and *Gorgonorhynchus*), mud crab harvesting, and fishing (mainly for spotted grunter *Pomadasyd commersonii*, white steenbras *Lithognathus lithognathus*, and cape stumpnose *Rhabdosargus holubi*; Napier *et al.* 2005). The subsistence fishery is worth an estimated R0.7 – R1.1 million per annum, with full-time fishers earning at least R11-17 000 per annum from the estuary. Currently operating under recreational regulations, the fishery is poorly controlled and fails to reach its full potential. It was suggested that management of the fishery could be more effective if mud prawn collecting and sales were deregulated and the line fishery was co-managed with limited access, and value added by allowing sales of certain fish species.

The fishery and **nursery values** of South African estuaries were estimated by Lamberth and Turpie (2003). The study considered both direct use of fish within estuaries and the role of estuaries as a nursery area for inshore marine fisheries. Some 80 estuarine fish are utilised for subsistence, commercial and/or recreational purposes, these species varying in their degree of association with estuaries. Based on the types of association of different species with estuaries, about 21% of the value of inshore marine catches was attributed to estuaries. The total value of estuarine and estuary-dependent fisheries was estimated to

be just under R1 billion (1997 Rand), which works out to an average of R13 230 per ha for all South African estuaries.

Recreation and tourism values have also been estimated for several South African estuaries. These range from the Sandvlei estuary within the suburbs of Cape Town to the Knysna estuary, which has a major resort town which has grown around the estuary. The Sandvlei estuary is mainly used by locals and had an estimated recreational value of some R700 000 per annum (Turpie & Joubert 2001). Knysna and its estuary attract large numbers of visitors. The estuary contributes about 60% of the enjoyment of Knysna. An estimated R1.4 – R2 billion of property value was attributed to views of the estuary, representing the value of the view to Knysna residents. In addition, the total value added by tourism-related expenditure attributed to the estuary was estimated to be about R1 billion per year (Turpie & Joubert 2005).

The **non-use value** has been estimated for South African estuaries as a whole, as well as for several individual systems. In a study by Turpie & Savy (2005), some 71% of survey respondents in the Western Cape claimed to be willing to contribute towards the conservation of South African biodiversity in general. Western Cape residents had a value of R19 million for South African estuaries, which extrapolated to all South Africans, suggests a total non-use value for South African estuaries of some R93 million per annum. Turpie & Clark (2007) obtained a similar value in a second study of this nature. Turpie & Savy also specifically investigated the existence value of the Knysna estuary. There was a low level of knowledge on estuaries, but two thirds of respondents had at least heard of the Knysna estuary or “Knysna Lagoon”. Based on the proportion of their WTP for conservation that they would allocate to Knysna estuary itself, the total non-use value of the estuary to the Western Cape population was estimated as R2.7 million. Extrapolated to all South Africans, the non-use value of the Knysna estuary was estimated to be some R9.7 million per annum. Respondents’ willingness to pay was positively correlated with their stated level of interest in conservation and with their income. When queried as to their motivation for contributing to estuary conservation, respondents rated biodiversity conservation and the more selfish motives, such as knowing that one’s own children would be able to benefit, as being more important than reasons such as others being able to make a living from estuaries.

Based on these and other studies, Turpie & Clark (2007) have subsequently produced rough estimates of the subsistence use value, tourism and recreational value, nursery value and existence value of each of South Africa’s temperate estuaries. The total value of temperate estuaries was estimated to be in the order of R3.2 billion per annum.

Table 4. Estimated total economic value of temperate South African estuaries (Turpie & Clark 2007).

<i>Type of value</i>	<i>Current value (R millions per annum)</i>
<i>Subsistence use value</i>	<i>10</i>
<i>Recreation value</i>	<i>2 402</i>
<i>Nursery value</i>	<i>773</i>
<i>Existence</i>	<i>43</i>
<i>Total estuary value (R millions)</i>	<i>3 229</i>

4.2.2 The cost of degradation

Few studies have attempted to put a value on degradation. In Knysna, the majority of respondents in a valuation study were against growth of the town that would result in negative impacts on the estuary. Foreign and South African visitors claimed they would

spend an average of 24% and 32% less time in Knysna, respectively if the estuary's condition were significantly degraded, resulting in a hypothetical loss of R260 million per annum. Eighty percent of respondents wanted better estuary management, and 60% were willing to pay to maintain the estuary's current conservation status. Overall willingness to pay was estimated to be R34 million per annum (Turpie & Joubert 2005).

Using benefit transfer (results of similar studies), travel cost, and contingent valuation methods, Nahman *et al.* (2005) roughly estimated the total economic value of the Kongweni Estuary in Margate, KwaZulu-Natal, to be at least R285 million. The estuary is threatened with declining water quality which could affect tourism, resulting in an estimated loss of between R58 million and R129 million per annum, and thus having a significant impact on the local economy.

Turpie & Clark (2007) estimated the potential cost of degradation of all temperate South African estuaries, using simple assumptions derived together with several estuarine ecologists about the way in which different values would change over time in the absence of adequate conservation measures. It was very roughly estimated that the overall value of estuaries would decrease by some R413 million per annum, or 13% of their total value. On the other hand, implementation of a conservation plan which involves partial protection in some 80% of estuaries results in an increase in overall value relative to present value of R346 million, or 11%. The real value of protection is potentially the difference between the value under no protection and the value under protection, i.e. a 24% difference!

4.2.3 The value of rehabilitation

A case study of the property value of the Silvermine estuary, Clovelly, Cape Town, showed that there is considerable benefit in restoring degraded systems (Van Zyl and Leiman 2005). The change in property value after restoration was used as a proxy for the aesthetic and recreational benefits derived. In addition, there was a minor flood attenuation benefit that was estimated in terms of preventative expenditures and damage costs avoided. A cost benefit analysis indicated a significantly positive net present value (NPV) and a benefit cost ratio of 4.58:1. The valuation study did not include the ecological benefits associated with increased ecosystem health. The Silvermine project demonstrates the significant benefits of maintaining aesthetically pleasing, healthy green open space areas within an urban setting.

4.2.4 Estimating the potential for conservation finance

A study carried out by Turpie & Joubert (2001) at the Sandvlei estuary in Cape Town sought to elicit the users' willingness to pay an entrance fee to contribute towards maintenance, conservation and crime prevention at that site. A demand curve derived using the travel cost method indicated that the revenue maximising fee would be R5, but this would reduce the numbers of visitors by 60%. Visitors' stated Willingness to Pay yielded a similar result. This study demonstrates the trade-off between attempting to maximise revenues and maximising societal welfare, in that revenue maximisation in this case would preclude use of the area for a large proportion of visitors.

4.3 Understanding the trade-offs between different values

Understanding trade-offs is an important part of conservation and management planning (Faith & Walker 2002). If the value of an estuary is to be increased or maximised, then it is

necessary to understand the potential impacts of different management decisions on value. This, in turn, will provide an understanding of the trade-offs involved, and will facilitate optimal decision-making in the development of a management plan.

Decisions need to be made at the regional scale, regarding the overall level of development among all estuaries, and at the estuary level regarding the level of development and different types of activities within a system. Decisions as to which estuaries or areas to conserve involve trading off biodiversity values against the opportunity costs of conservation. These opportunity costs are the benefits of the best alternative use of the land or water required for conservation.

These decisions apply to the level of conservation beyond that which is required under international agreements, in other words, the amount required to meet biodiversity targets. Turpie & Clark (2007) showed that it is economically beneficial to conserve more than the number of estuaries required to meet conservation targets. Within estuaries, trade-offs need to be made in management decisions such as where to locate conservation zones in an estuary.

Estuary values are derived from use of their habitats and resources (direct use values), from services such as nursery functions that yield value elsewhere (indirect values) and from the values derived from the existence of certain features of biodiversity (non-use values). All of these values are dependent on the functional health of the ecosystem. Nevertheless, ecosystems that are exploited (generating direct use value) will have altered ecosystem functioning that affects their indirect and non-use values, even in cases where exploitation is sustainable (can be maintained into perpetuity). For example, a system in which recreational fishing levels are high may not deliver fewer fish to inshore marine fisheries than one in which recreational fishing does not occur. Thus there is essentially a trade-off between direct use values and other types of value (Figure 2), even where direct use is managed to be sustainable.

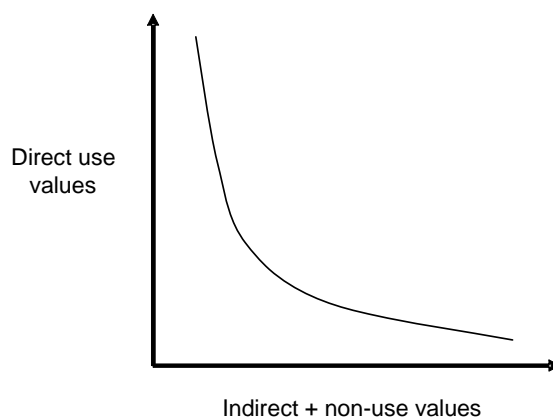


Figure 2. Hypothetical trade-off relationship between direct use values and other types of value generated by estuaries. Source: Turpie *et al.* (2006).

Thus it is easy to picture how changing levels of development will affect the overall value of an estuary (Turpie *et al.* 2006; Figure). With no development, an estuary would be expected to have little or no direct use value (e.g. perhaps a little derived by passing

hikers), and the undisturbed estuary would have high indirect and non-use value, owing to its high level of biodiversity and healthy functioning. Sensitive development around the estuary might add significant value in terms of direct uses such as ecotourism, while having negligible impact on biodiversity and ecosystem functioning. Thus overall values would be raised. As development around an estuary progresses to a resort town, direct use value increases, but the valued attributes and ecosystem services are likely to become somewhat impacted. Thus the total value of ecosystem goods and services may initially be enhanced by increased use, but would decrease again beyond some level. The point at which value is maximised would depend on the nature and relatively magnitude of the two curves described in Figure 3.

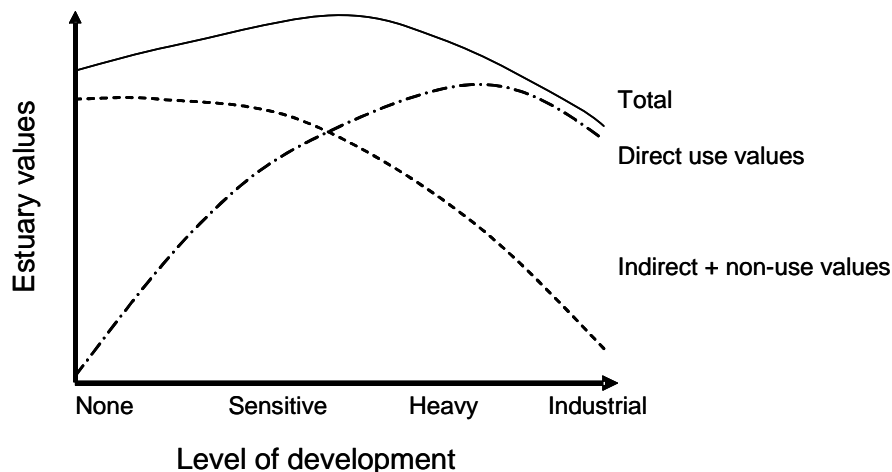


Figure 3. *Hypothetical relationship between the level of estuary development and the magnitude of direct versus indirect and non-use values. Note that the shape of the total value curve is dependent on the relative scales of the other two curves, but is likely to be roughly hyperbolic. Note that the development scale could be logarithmic. Source: Turpie et al. 2006.*

In general, the values associated with conservation of estuaries would be the indirect and non-use values, plus the additional direct use value that would be secured by ensuring that use levels are sustainable. The latter would accrue mainly in the future.

The opportunity cost of estuary conservation depends on the level of protection applied to estuaries. This would include any use that is restricted in the present in order to secure a flow of value in the future, i.e. a cost that is borne mainly in the present. In some cases, complete protection may be required, in which case the opportunity costs would extend to any type of use. In other cases, conservation goals may be achievable with certain types of development that are deemed compatible. Thus the values of conservation might be maintained while there are also some developmental benefits. Whichever the case, the opportunity cost of conservation would be the benefits that would be obtained by the most valuable alternative use.

Undeniably, property development is simultaneously of significant economic value and also one of the biggest threats to estuarine fauna and flora in terms of habitat loss, exploitation, disturbance and pollution. Properties adjacent to any type of wetland tend to be more expensive (Boyer & Polasky 2004), which means that the opportunity costs of

protecting estuaries in urban areas are likely to be high. This creates a significant challenge for conservation planners and decision makers (Turpie *et al.* 2006).

5. Maximising the economic value of estuaries

5.1 Introduction

This section expands upon the basic guidelines laid out in Turpie *et al.* (2006), based on the above description of trade-offs and current understanding of how certain types of management affect value. While there has been relatively little research on these issues, common sense can provide some simple guidelines as to the sorts of planning and management decisions that are likely to maximise the economic value of estuaries.

5.2 Aligning the vision to economic importance

No estuary can maximise all types of value, but the potential value of an estuary can be maximised. Either some types of values should be prioritised in certain systems, or an estuary could be managed to provide lower levels of value for a wider range of values. Incompatible activities should ideally be promoted in different estuaries, and it may be easier to earmark different estuaries as being managed primarily for different types of value. Thus it is necessary to understand which values are important in the estuary in question, and which should be emphasised or enhanced by management, using the following steps.

5.2.1 Identify values and their regional importance

The values generated by the estuary in question should be evaluated in terms of their importance on a regional scale, using a broad scale analysis such as that by Turpie & Clark (2007). The importance of the estuary for each type of value should be established in terms of its rank, for example, whether it fits into the top 20% of bottom 20% of estuaries for that type of value.

The values should be ranked in terms of their regional importance ranking as well as their relative absolute value. This will help to identify where management emphasis might best be placed.

5.2.2 Understand compatibility and trade-offs

Based on an understanding of the above, plus additional research if required, it should be possible to identify the main types of value associated with an estuary, such as in the following list:

- Industrial value – waste water disposal, harbour
- Tourism/recreational value - fishing
- Tourism/recreational value -non-consumptive use
- Tourism/recreational value - village/town appeal
- Tourism/recreational value -- wilderness appeal
- Subsistence use
- Nursery function
- Existence value – biodiversity conservation

These different sources of value vary in their compatibility with one another (Table 5). This needs to be taken into consideration in deciding which values to promote or avoid within an estuary or within zones within an estuary. For some activities, the level of conflict may be reduced by certain management actions (some examples are provided in Table 5).

Table 5. Compatibility between main sources of value.

	<i>Recreational fishing</i>	<i>Non-consumptive recreation</i>	<i>Subsistence use</i>	<i>Nursery function</i>	<i>Village appeal</i>	<i>Wilderness appeal</i>	<i>Biodiversity conservation</i>
<i>Non-consumptive recreation</i>	Medium. Better separated						
<i>Subsistence use</i>	Medium, may require conflict management	Low					
<i>Nursery function</i>	Medium. Requires restriction on fishing	High	Medium. Requires restriction on fishing				
<i>Village appeal</i>	High	High	Medium, enhance by management	Medium, enhanced by restricted use			
<i>Wilderness appeal</i>	Low; requires restrictions on type of fishing, e.g. non-motorised	High, enhanced by restrictions	Medium, or high if very small scale	High	Low, enhanced by sensitive development		
<i>Biodiversity conservation</i>	Low: existence value requires sanctuary	Medium; restrict disturbance	Low	High	Medium, enhanced by education	High	
<i>Industrial use</i>	Low	Low	Low	Low	Low	Low	Low

For some estuaries the uses are diverse and the issues are complex. In such cases, especially where large values are at stake, it might be worthwhile conducting a proper assessment of value and trade-offs. Such valuation studies should aim to determine people’s preferences, and how they would be affected by a change in the supply of goods and services provided by the estuary in question. Valuation studies should identify the most productive, sustainable and equitable management options and inform management decision processes. An important aspect of this process is to assess how the benefits and costs of alternative management options are distributed among different stakeholder groups. Ultimately, the analysis should be able to describe the trade-offs involved in choosing different management alternatives. The analysis should be sufficiently sophisticated to be able to determine the best mix of uses, and not only all-or-nothing alternatives.

The types of management questions addressed in a valuation study would include questions concerning the zonation of the estuary for different types of use, and the optimal level of exploitation of the estuary.

Key questions would include:

- If an estuary is to be developed, how should development be sited around the estuary

in order to maximise its value minus the impacts on other users.

- How much of an estuary should be open or closed to activities such as motorboating or fishing?
- How much utilisation of bait and fish resources should be permitted?

Valuation studies should try to ascertain the attributes that contribute to the value of property, and the recreational opportunities that determine the demand for utilisation of the estuary. The last question will require understanding the value obtained from conserving resources versus the value obtained from their utilisation.

5.2.3 *Agree on a broad vision of the type of development on the estuary*

Given the above considerations, estuaries should be classified at a regional scale into main types, such as the following:

Wilderness estuaries

These are estuaries in which development is very limited, subsistence use might be promoted, and non-consumptive recreation is very important. Examples include most Transkei estuaries, but also include others such the Olifants. Emphasis should be placed on maintaining wilderness appeal. While wilderness estuaries are highly compatible with conservation, many estuaries falling into this category are small and contain relatively low biodiversity.

Partially developed estuaries

These estuaries are characterised by small resort villages, and tend to attract recreational fishers as well as non-consumptive users. They are often ideal for the development of conservancies. Examples include Breede, Gamtoos, Duiwenhoks, Bushmans and East Kleinemonde. These estuaries can support a range of activities, are very compatible with conservation and are often suitable for emphasis on one or two types of activities or value, which can be beneficial. This type of estuary should dominate.

Developed estuaries

These estuaries are characterised by substantial development relative to the size of the estuary. The emphasis is often on aesthetic value in a developed sense, and intense recreational use. These estuaries are often also important for subsistence use because of the poorer communities that exist around the town. These estuaries support a range of activities but they are usually complex to manage, due to the level of pressure on space and resources. Examples include Berg, Knysna, Swartkops, Kromme, Sand and Klein. If the estuary is already highly developed, emphasis might be on reducing conflict, e.g. through zonation, or encouraging certain types of activities more than others.

Industrial estuaries

These are estuaries which are used primarily for industry such as harbours, for waste water treatment or outflow. This would include canalised estuaries.

The first three types are able to support an estuarine protected area (= no-take sanctuary zone), but the fourth cannot.

5.2.4 *Develop a more detailed vision for the estuary*

The above categorisation is very broad, and serves to ensure that there is adequate representation of less developed estuaries. This should inform which of the following guidelines below are most applicable.

Recognising the broad vision, it will be necessary to embark on the development of a more detailed vision for the estuary which defines the relative importance of different types of value. Again, the table of compatible values will be useful here.

Once the basic vision is in place, there are a number of ways in which the priority values can be enhanced.

5.3 *Enhancing tourism & recreational value*

Several measures can be taken to improve the tourism and recreational value of an estuary through improving aesthetics (appropriate to the type of development envisaged), management of recreational activities, and encouragement of tourism business.

5.3.1 *Strictly limit development on wilderness estuaries*

This may be an obvious point, but if not explicitly built into a management plan, the level of development can gradually increase because any single EIA does not register significant impacts.

5.3.2 *Develop one side only*

Where estuaries are developed, property values are usually enhanced if one side of the estuary remains undeveloped, preferably as a nature reserve. This is a highly successful model that exists in many South African estuaries, and can successfully combine development and conservation needs. Houses that face a nature reserve are likely to have a higher property value than houses that face other properties. The emphasis is on quality rather than quantity.

5.3.3 *Appropriate development*

Many temperate South African estuaries derive most of their use value as resort areas, and thus the value of these systems relies largely on their aesthetic appeal. Mixed development often detracts from this appeal, and hence reduces economic value. An extreme example would be mixing industry with residential development (e.g. Swartkops estuary). A less extreme example includes mixing housing of different quality, such as at the Berg River estuary. While not feasible on a large scale, the restricted style of development around the Kromme estuary provides an example of how a certain type of uniformity can elevate values to a high level. Note, though that limited traditional housing is unlikely to detract from the value of a resort development in a wilderness type setting.

5.3.4 *Zonation of recreational activities*

Whether or not an estuary contains a protected sanctuary area (or no-take zone) recreational use of some estuaries can be enhanced by the zonation of the estuary for different types of activities that would be better enjoyed in separate zones. Since the recreational value of estuaries is derived from multiple consumptive and non-consumptive uses which are often incompatible, zonation can prevent one type of user's utility from impacting on another's.

A zoned sanctuary area will provides the opportunity to achieve some conservation goals while not prohibiting consumptive use altogether. Furthermore, it can potentially enhance the value of recreational fishing by providing a source area.

Deciding on zonation should be guided by the value rankings and by a finer scale examination of recreational activities on the estuary. Note that zonation may be more appropriate in some estuaries than others, depending on the vision and activities. Care should also be taken not to over-regulate recreational users, as this can stifle their enjoyment.

5.3.5 *Ensuring sustainability of consumptive activities*

Management measures should be put in place that limit consumptive use by recreational fishers to within sustainable limits, and that takes cognisance of the carrying capacity of the estuary for other recreational activities. This is probably best achieved through zonation, since this is a far easier way of limiting consumptive use than through bag or effort limits. This will help to ensure that these values are sustained in the long term.

5.3.6 *Provision of recreational facilities*

Recreational value can be enhanced if facilities are provided that support targeted activities. This would include facilities such as access, parking, slipways and security.

5.3.7 *Provision of interpretive signage*

Interpretive signage, rather than purely regulatory type of signage, raises the value of the user experience in that it helps people understand the need for protection or zonation, and the reason for regulations. It also helps people enjoy the area more if some interesting aspects of the estuary's biodiversity are explained.

5.3.8 *Encouragement of tourism business*

In certain types of estuaries, tourism value can be enhanced by encouragement of tourism business. Depending on the situation (the market and the potential service providers), this can take the form of commercial or simple community-based tourism, and or high end or budget tourism, and can include a large range of services such as accommodation, interpretive tours or canoe hire. Any of these types of business, whichever are desirable within the estuary vision, can be attracted through different types of incentives, not necessarily financial incentives. There has also been much work recently on what makes private and community-based tourism initiatives work (e.g. Devlin 1999, Ntshona & Lahiff 2003).

5.4 *Enhancing subsistence/small-scale commercial value*

Many estuaries are surrounded by poor communities, particularly in the larger urban centres and in the former homeland areas of Transkei and Ciskei.

In rural areas, communities have traditionally made use of estuary resources for food and raw materials for subsistence purposes. These resources make a significant contribution to their livelihoods and this value needs to be sustained as far as possible.

Where demand exists, for example in developed estuaries or those with hotels, poor communities often live in the surrounding areas or townships. Estuaries provide an opportunity for income generation to these people, through collection and sale of bait and seafood.

Subsistence and limited commercial rights are allocated at a national level and should be respected and accommodated in the estuary management plan.

5.4.1 Co-management

Benefits derived from these fisheries can be maximised and risks of overexploitation minimised through a co-management approach. This requires consultation between national government and the estuary management body regarding all aspects of management issues discussed below. The primary consideration should be sustainability, but allocation issues and maximising resource rents are also key.

5.4.2 Zonation

Zonation may be appropriate to reduce conflict with other users and potentially to conserve source stocks. Giving the community an opportunity to participate in the establishment of the zones will facilitate compliance. The allocation of fishing turfs to rights holders may also encourage sustainable use.

5.4.3 Rights allocation

Although carried out at a national level, through co-management, the management plan should have input into the number of users that can be allocated rights. In the case of small-scale commercial users it is important to minimise the number of users in order to provide meaningful ownership and encourage stewardship of resources. This will also encourage self-policing. Resources managed in this way are likely to generate more rents, and hence have greater economic value.

5.4.4 Limiting catches

The value of small scale fisheries can be enhanced by establishing rules that are easy to follow and manage. Limiting access is likely to work better than limiting catches (e.g. Bag limits) in reducing the probability of overexploitation.

5.4.5 Trade

Allowing the sale of r-selected species such as mud prawns may increase incomes, since more of the public will be willing to buy. If sales are allowed, then selling points could be established to make business more viable but should not be used as a control mechanism, since this could also restrict access to markets.

5.5 Enhancing nursery value

5.5.1 Designate a sanctuary area

Nursery value is estimated to be one of the most important values of estuaries, and is potentially greatly affected by the way in which an estuary is managed. This value is being undermined in many estuaries by overexploitation and alteration in mouth dynamics. Turpie & Clark (2007) estimated that conserving half of an estuary's fish stocks can significantly enhance the future nursery value of an estuary. This played a major role in the recommendation that sanctuary areas are established in 80% of estuaries.

A sanctuary area means that a proportion of the estuarine area should be completely protected from consumptive use and excessive recreational disturbance.

The management plan will need to define the boundaries of the sanctuary zone such that it protects at least 50% of the estuarine fishery stocks. If nursery value is to be further enhanced, then this proportion can be increased.

A sanctuary area will also provide opportunities for recreation, wilderness experience, spiritual enrichment and research. It is also likely to improve fishing in other parts of the estuary. The value of a sanctuary area can be further enhanced if it is sited adjacent to a terrestrial nature reserve.

5.5.2 Control consumptive use of resources

If the emphasis is on managing an estuary for its nursery value, then there should be extra emphasis on the management of fisheries, keeping harvests at sustainable levels, and below maximum sustainable levels if nursery value is to be enhanced.

5.5.3 Maintain mouth functioning

Nursery value is also dependent on an open mouth during certain times of year. If the mouth dynamics have been altered by anthropomorphic changes such as water abstraction, then it might be necessary to manipulate the mouth condition artificially in order to enhance an estuary's nursery value.

5.6 Enhancing non-use value

5.6.1 Education and awareness

Non-use value, or existence value, is highly contingent on people's knowledge and awareness. Thus the more that the broader public appreciates South Africa's estuarine natural heritage, the biodiversity contained therein, the threats, and conservation efforts, the more those conservation efforts will yield existence value, and hence raise the public's Willingness to Pay for estuary conservation. Conservation efforts, in particular, should be publicised.

5.6.2 Interpretive signage

Interpretive signage in conservation areas explaining aspects of biodiversity will go a long way towards enhancing users' awareness and the value they hold for the estuary.

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