

CHARACTERISATION OF THE SOCIAL AND ECONOMIC VALUE OF THE USE AND ASSOCIATED CONSERVATION OF THE YELLOWFISHES IN THE VAAL RIVER.

Report to the
Water Research Commission

by

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Executive summary

Throughout history, human beings across the world have relied on freshwater ecosystems, particularly rivers, to provide the environmental goods and services that they need to sustain their societies. As such, these systems have been impacted on by humans for as long as human history exists, dating from early civilisations. Ecosystem services can be defined as the benefits that nature naturally provides to households, communities, and economies or those ecosystem services that simply offer some form of benefit to human beings. Aquatic ecosystems provide a range of ecosystem services including the supply of water, the assimilation and dilution of wastes, the supply of natural products like fish and plants, the sustainability of plants, animals and habitats that are important in biodiversity conservation, flood control, places for recreation and religious rituals and places where our need for beautiful places can be satisfied.

The Vaal River ecosystem is one of South Africa's most economically valuable aquatic ecosystems and is often referred to as "Africa's hardest working river". This is one of South Africa's most highly developed and regulated river systems that support roughly half of the economic activity of the country. The Vaal River not only provides water, it is also used to assimilate waste from Gauteng, this highly developed urban area which stands as South Africa's most important economic region. As a result of the services provided by the Vaal River ecosystem, this system is of considerable value to the economic and social sustainability of South Africa, and as such the management of this system forms a vital strategic component of the management of the country. Surprisingly, many of the ecosystem goods and services that are provided by the Vaal River have not been characterised and as such not considered in the management of this system.

Yellowfishes are amongst the most widely distributed and most easily related to of the indigenous fishes in South Africa. The yellowfishes of the Vaal River, the Orange-Vaal Largemouth yellowfish and the Orange-Vaal Smallmouth yellowfish are considered to be two of South Africa's most socially and economically important angling species as they are visually attractive, they grow to a large size and are considered to be excellent game fish. As a targeted angling species, the use and related conservation initiatives of the

yellowfish in the Vaal River, to facilitate this angling industry, have been poorly characterised and are infrequently considered in the establishment of management actions for this system.

This study aims to characterise the social and economic benefits and implications associated with the use of the Vaal River by yellowfish dependent angling activities and yellowfish related conservation initiatives.

The methods used to achieve the aim of the study include the use of valid economic and social assessment methodologies currently used by local and international ecosystem managers. The economic component of the study was carried out by making use of questionnaire based surveys and personal interviews. The social component of the study involved a comprehensive desktop review of the historical findings of studies addressing fish conservation and recreation and their social benefits. In addition the social component of the study was achieved by undertaking a field survey where various stakeholders of the use and or conservation of yellowfish in the Vaal River ecosystem were interviewed.

The study resulted in 91 questionnaires being comprehensively completed by anglers. An additional 23 equipment retail store representatives were interviewed, 17 accommodation sector representatives were interviewed and numerous interviews were carried out with professional guides, conservationists, specialist consultants and academic researchers as well as with various magazine editors, Vaal River ecosystem managers and municipality representatives.

Findings indicated that the majority of anglers on the Vaal River who target yellowfish from the Vaal River predominantly belong to the fly-fishing group of anglers who can further be divided into three categories of anglers including infrequent, frequent and dedicated anglers. These anglers (approximately 5000 in total) undertake between 2 and 32 fishing trips per season which can last between 1 and 3.5 days per trip. During these trips, between 216 and 732 km are covered which indicates that although some of the angling activities occur within or close to 100 km from where these anglers live, some anglers travel up to three times the distance in search of better angling waters. At fishing

venues anglers pay approximately R40 for entry and or rod fees to venue owners per angler and spend on average between R100 and R263 per day for subsistence. On occasion some anglers take additional family members on angling trips and spend between R10 and R100 on other activities. The fishing equipment that is used by anglers on the Vaal River is replaced every two to five seasons by the various anglers and costs between R850 and R5200. If anglers belong to angling clubs they spend between R70 and R170 per season to be a part of a club.

This study has revealed that the estimated value of the yellowfish dependant fishing industry on the Vaal River that actively targets yellowfish as just over R133 million per season. Of this total economic value the equipment sector is worth R14.6 million, the amount spent on travel is R41.4 million, accommodation costs total R75.5 million, other carried out while undertaking angling trips equal R2.2 million a season and membership fees paid by anglers to belong to clubs, etc. totals R500 thousand per season.

The social value of the use and associated conservation of yellowfish in the Vaal River occurs in the form of yellowfish acting as an indicator species where by communities benefit from the improvement of the overall health of the river ecosystem as an indirect result of the conservation of the yellowfish, yellowfish being an important source of protein to local communities, yellowfish have a recreational value in that they are an actively targeted angling species, yellowfish conservation promotes social cohesion, stewardship and community engagement and as such, yellowfish use and conservation has the potential to improve the quality of life of many South Africans.

Although the use and conservation of yellowfish in the Vaal River has proven social and economic values, a threat to these benefits exist in that currently, insufficient management actions have been implemented in the study area, limited resources have been made available to ecosystem managers and conservationists. Participants of this survey feel that it is not the absence of laws/policies required to protect the environment that is lacking but rather that the enforcement and implementation of these policies/laws is lacking. The social benefits of conservation initiatives can potentially promote the enforcement of these policies/laws particularly by lobbying at grassroots and national level to increase awareness and encourage public participation in conservation

initiatives. Successful conservation of the Vaal River and the yellowfish can only be accomplished through partnerships between civil society and public institutions.

Finally, the yellowfish dependant angling practices in the Vaal River continues to be a growing sport in South Africa and it presents numerous social and economic benefits, not only to the yellowfish angling community, but to society as a whole.

Following the outcomes of this study, recommendations are made to establish an integrated use and associated conservation plan for the yellowfish in the Vaal River and assess risk posed to the continued survival of yellowfish individuals by the so-called ecologically friendly practice of catch-and-release of yellowfish. Further recommendations suggest the need to consider the social and economic value of the use and conservation of yellowfish in the Vaal River when the ecological goods and services of the Vaal River are allocated for use through the aquatic ecological reserve determination process and carry out similar assessments on other yellowfish and indigenous species and ecosystems in South Africa. Finally, one more recommendation is made to continue to research the social and economic use of yellowfish in the Vaal River.

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1 Introduction

Throughout history, human beings across the world have relied on freshwater ecosystems, particularly rivers, to provide the environmental goods and services that they need to sustain their societies (Nilsson *et al.*, 2007). As such, these systems have been impacted on by humans for as long as human history exists, dating from early civilisations (Nilsson *et al.*, 2007). The excessive use of ecosystem services by humans, affects the structure and function of systems on a local, regional and potentially global scale in that increasing societal and economical pressures cause the excessive extraction, transportation and transformation of natural resources (Ohl *et al.*, 2007). This in turn changes the landscape, influences biodiversity and redefines the ecological state of the ecosystems and the rate of delivery of ecological goods and services (Ohl *et al.*, 2007). Unfortunately, societies have often considered rivers and their resources to be inexhaustible which has resulted in human centred attitudes towards water and the extraction and use of river resources (Ohl *et al.*, 2007). Within South Africa, similar attitudes have resulted in the deterioration of many river ecosystems which have brought about environmental and social impacts, such as pollution, catchments degradation and poor water quality for human or animal consumption (Nel *et al.*, 2004; Dudgeon, 2005). Today over 80% of our river ecosystems are considered to be threatened, primarily due to the over utilisation of the goods and services of these systems (Nel *et al.*, 2004).

Ecosystem services can be defined as the benefits that the natural environment provides to households, communities, and economies or those ecosystem services that simply offer some form of benefit to human beings (Van Wilgen *et al.*, 1996; Boyd and Banzhaf, 2007). Aquatic ecosystems provide a range of ecosystem services including the supply of water, the assimilation and dilution of wastes, the supply of natural products like fish and plants, the sustainability of plants, animals and habitats that are important in biodiversity conservation, flood control, places for recreation and religious rituals and areas where our need for beautiful places can be satisfied (Palmer *et al.*, 2002). Unfortunately, the benefits of these aquatic ecosystem services have over the years been poorly defined and consequently poorly valued, resulting in them being accorded low priority (Dudgeon, 2005).

In developing countries where ecosystem management is focused on short term economic growth and social development, the importance of conserving aquatic ecosystems is negated (Van Wilgen *et al.*, 1998). This is often, due to pressures from growing human populations and increased industrialisation of these developing countries (Dudgeon, 2005). Human needs have taken precedent over the environment, forcing governments to place more emphasis on economic development above all else (Dudgeon, 2005). The result is that the social and economic value of these aquatic ecosystems is poorly represented in official statistics and may not be seen as, or considered of, high priority or value. Aquatic ecosystems are therefore likely to suffer as activities perceived to have more economic or social priorities like: agriculture, hydroelectric power or mining, are given preference (Nilsson *et al.*, 2007). Consequently, only after the long-term economic and social sustainability of aquatic ecosystem resources are threatened, do ecosystem managers consider the establishment of sustainable balances between ecosystem resource use and protection (Turpie and Joubert, 2001; NWA, 1998).

Conservationists though, have been advocating that the conservation of freshwater aquatic ecosystems have numerous economic and social benefits (Dudgeon, 2005). Their most persuasive tool to ensure intervention is to establish the economic and social value of ecosystem services (Alyward and Barbier, 1992; Van Wilgen *et al.*, 1998; Le Quesne & McNally, 2005). With these values available to ecosystem managers, a shift in the management approach of ecosystems towards, or at least in consideration of, conservation and sustainability is possible (Duraiappah, 2006). The field of environmental and biodiversity valuation is growing internationally due to the consideration that ecosystem management decisions, that have been made in the past, are suboptimal as a lack of consideration for the costs and benefits of the decisions occurred (Turpie & Joubert, 2001). Environmental economics provides policy makers with frameworks, in monetary values, which illustrate the potential trade-offs between conserving and converting ecosystems (Duraiappah, 2006), justifying conservation actions and defining the optimal level of conservation (Turpie *et al.*, 2003).

The Vaal River ecosystem is one of South Africa's most economically valuable aquatic ecosystems and is often referred to as, "Africa's hardest working river" (Braune, 1986;

Van Wyk, 2001; DWAF, 2004). This is one of South Africa's most highly developed and regulated river systems that support roughly half of the economic activity of the country (Basson *et al.*, 1997). In order to provide users, predominantly in Gauteng, with water, this ecosystem has been modified to transport unnaturally high volumes of water from many sources including the Lesotho Highlands Water Inter-basin Transfer Scheme, one of the largest and most costly water transfer schemes ever undertaken. The Vaal River not only provides water, it is also used to assimilate waste from Gauteng, this highly developed urban area which stands as South Africa's most important economic region (Basson, 1997). Due to the value of services provided by the Vaal River ecosystem this system is of considerable value to the economic and social sustainability of South Africa, and as such the management of this system forms a vital strategic component of the management of the country. Surprisingly, many of the ecosystem goods and services that are provided by the Vaal River have not been characterised and as such not considered in the management of this system.

Yellowfishes (*Labeobarbus spp.*) are amongst the most widely distributed and most easily related to of the indigenous fishes in South Africa (Skelton, 2001). The yellowfishes of the Vaal River, the Orange-Vaal largemouth yellowfish (*Labeobarbus kimberleyensis*) and the Orange-Vaal smallmouth yellowfish (*L. aeneus*) are potentially the most socially and economically important angling species in South Africa (Gaiger, 1976; De Villiers, 2007a; De Villiers, 2007b). These fishes are attractive, grow to a large size, are considered to be excellent game fish and are targeted by anglers throughout the country. As a targeted angling species, the use and related conservation initiatives of the yellowfish in the Vaal River, to facilitate this angling industry, have been poorly characterised and are infrequently considered in the establishment of management actions for this system (Pers. comm.: Pierre De Villiers⁵).

The aim of this study is to characterise the social and economic benefits and implications associated with the use of the Vaal River by yellowfish dependent angling activities and yellowfish related conservation initiatives. To achieve the aim of the study the following objectives have been proposed:

⁵ **Pierre De Villiers:** June 2007, Orange-Vaal River Yellowfish Conservation and Management Association and formerly of the Free State Nature Conservation. Cape Nature, Cape Town.

1. Characterise the economic value that stakeholders obtain as a result of the angling and related conservation of the yellowfishes from the Vaal River.
2. Characterise the social value that stakeholders obtain as a result of the angling and related conservation of the yellowfishes from the Vaal River.

In accordance with the objectives of this study has been divided into an economic assessment section and a social assessment section.

2 Materials and methods

The study area for this project includes the Middle and Lower Vaal River areas. Figure 1 presents the study area that includes the Vaal River and surrounding urban and rural areas between the Vaal Dam and the confluence of the Vaal River with the Orange River in the vicinity of Douglas in the Northern Cape. The study area extends across four provinces; Gauteng, North West, Free State and the Northern Cape (Figure 1) and nine municipalities (MDBSA, 2008). The major urban, economic centres in the study area are Johannesburg, Pretoria and surrounding areas, as well as Vereeniging, Parys, Potchefstroom, Klerksdorp, Orkney, Bothaville, Christiana, Kimberley and Douglas.

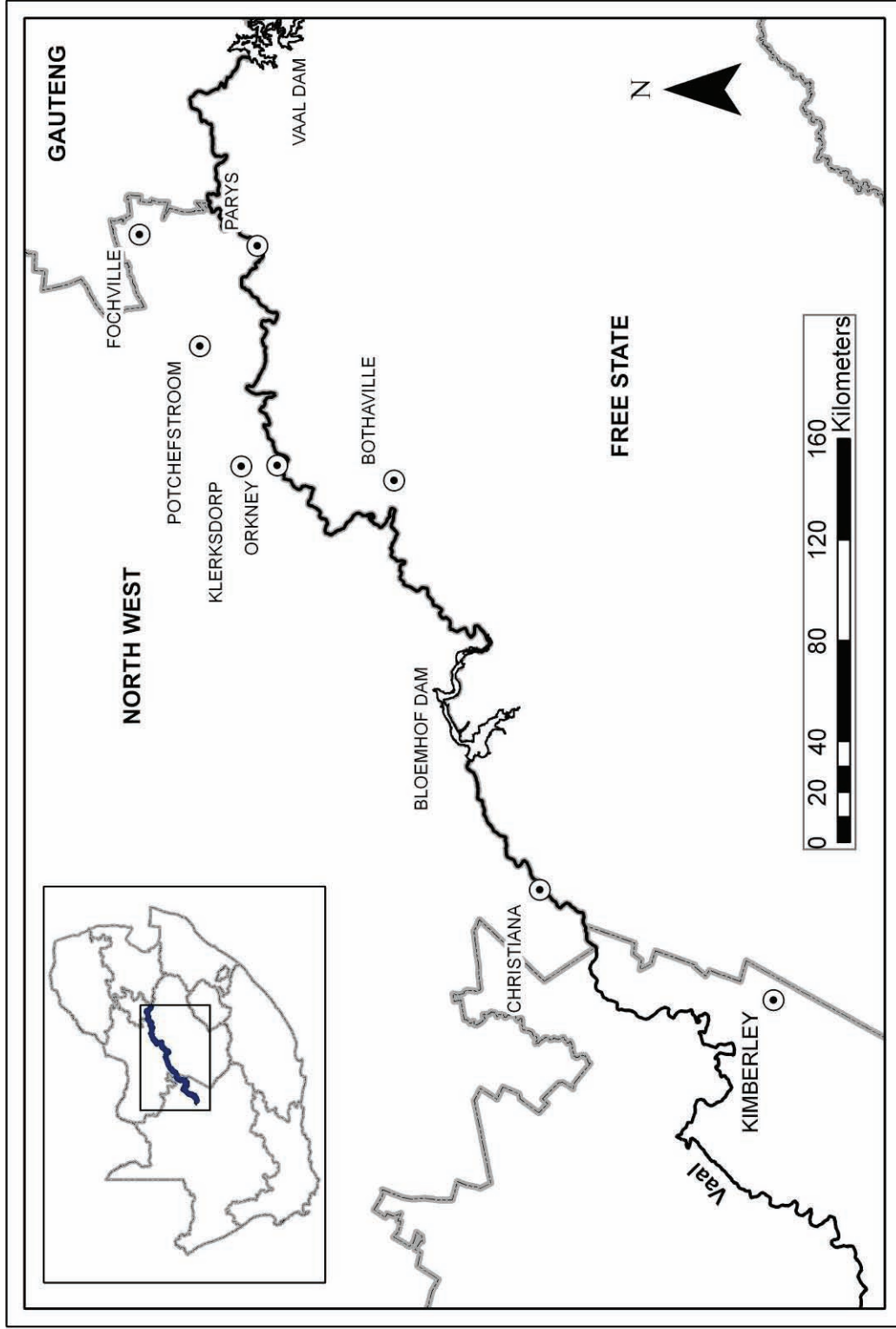


Figure 1: The focus area of the study: the Vaal River between the Vaal Dam and the confluence of the Vaal and Orange rivers, including surrounding urban areas.

2.1 Economic assessment

Various methods for the collection and analysis of data were used to characterise the economic value of yellowfish in the Vaal River. The approach adopted in this study comprised primarily of questionnaire based surveys and personal interviews, following the approach adopted by Turpie & Joubert (2001). Four different questionnaires (Appendix A) were compiled and used in the study to determine the economic value of the user groups including; fishermen, fishing equipment retail stores, the accommodation sector and yellowfish fishing guides. Data obtained from the questionnaires were captured in Microsoft Excel spreadsheets and analysed for each sector. The mean values of findings were used in the calculations to determine the estimated economic value of the use of yellowfish by angling activities in the Vaal River.

Following the approach adopted by Dobbs (1993), the majority of the questions within questionnaires were structured to be closed ended questions that provided the respondents with selection boxes where a range of values to choose from were offered. This approach was adopted so that the data could be easily collected, the outcomes could be comparable and to avoid vague or ambiguous answers (Dobbs, 1993). Where information gaps occurred, emails were sent to respondents for clarification and in some cases responders were sent additional questions to facilitate with the iteration of the questionnaires. The specific approaches adopted to assess each component of the study are presented as follows.

2.1.1 Fishing activities

Fishermen questionnaires were distributed by posting the questionnaires on websites, by emailing it to members of various fly-fishing databases in order to reach a large number of individuals at reduced costs, following the method adopted by Marta-Pedroso *et al.*, 2007. In order to facilitate this assessment, the motivation and approach of the study were presented at national workshops and conferences in South Africa. Questionnaires were handed out to fishermen at these workshops/conferences where many were completed immediately and returned to the researchers. Finally, awareness pamphlets

(Appendix B) were printed and distributed with information on the project, the websites details and a request that the questionnaires be downloaded from the website, completed and returned.

From the onset of this assessment the differences in the angling use of the yellowfish species by the bank angling, artificial lure (artlure) anglers and the fly-fishing angling groups were considered. The largest group of anglers that actively and effectively target the Orange-Vaal River Largemouth and Smallmouth yellowfishes, are the fly-fishing group of anglers. The remaining groups of anglers do angle for yellowfish in the Vaal River but in the case of the bank anglers, yellowfish angling is considered to generally be incidental as they actively target the exotic Carp (*Cyprinus carpio*) and Sharptooth catfish (*Clarius gariepinus*) (Pers. Comm: Johann Grobler⁶). The artlure group of anglers that angle for yellowfish in the Vaal River do specifically target the yellowfish species, however this method of angling for yellowfish in the Vaal River is a new, emerging angling activity and as such is considered to not have a noticeable contribution to the social and economic value of the use of yellowfish in the Vaal River at this time. This study, as a result, addresses the use of yellowfish by the fly-fishing group of anglers and includes a descriptive assessment to address the value of yellowfish use in the Vaal River by the bank angling and artificial angling groups.

The data obtained from the fishermen questionnaires was used to determine the total annual economic value of the use of yellowfish by fishermen targeting yellowfish in the Vaal River per season. The bulk of the data needed to perform the necessary calculations were obtained from the average values calculated from all the completed questionnaires. In addition to this data, derived data from further sources, using additional methodologies, were obtained. These data included data such as the average cost per kilometer travelled, the average replacement frequency of fishing gear and equipment and the estimated number of anglers that target yellowfish on the Vaal River in one season. In this study, fishing gear refers to the rods, reel, line, flies, etc. while the fishing equipment is refers to the complementary equipment such as float tubes and boats.

⁶ **Johann Grobler:** May 2008, Environmental Officer of the South African Sport Angling and Casting Confederation (Retired).

The average cost per kilometer travelled by the anglers was calculated using the Automobile Association of South Africa's (Automobile Association of South Africa, 2007) so-called "AA" rate. The "AA" rate is the average costs per kilometer travelled for a specific vehicle types. In this study an "AA" vehicle cost per kilometer rate of two thirds of the highest "AA" rate was used in this study. This rate was deemed to be applicable to the study as the assumption that the majority of the fishermen who travel to fishing venues use up-market Sport Utility Vehicles (SUV's), was made. The frequencies of the fishing trips were converted to represent the eight months in a year that is considered to be the fishing season. The frequency therefore for anglers who indicated that they went fishing once a day was 248, weekly was 32, monthly was 8, quarterly was 4, every 6 months was 2 and yearly 1. The replacement value for the fishing gear and equipment was established following interviews with equipment retail store employees. The estimated number of anglers that target yellowfish on the Vaal River was derived using various methods. These methods required that the fishermen be grouped into three categories in order to take the extreme differences amongst these angler groups into consideration. The three categories that were established included; infrequent fishermen (If), frequent fishermen (Ff) and dedicated fishermen (Df). The variables that contribute to the division of the three categories include: fishing frequency, value of equipment and related replacement frequency of equipment. The ratios of anglers per category were calculated by the information contained in the fishermen questionnaires. These findings however were modified following the presentation of this information to various yellowfish user stakeholder groups who considered the results to be unrealistic.

The methods used to establish the total number of anglers that fish for yellowfish on the Vaal River include:

1. Considering the estimated (obtained from equipment retailers) number of total anglers that make use of angling retailers in areas associated with the Vaal River.
2. Considering the estimated (obtained from accommodation/venues) number of total anglers that make use of venues/accommodation in areas associated with the Vaal River.
3. Consideration of the estimation of the total number of anglers by the anglers themselves.

4. Number of members or mailing lists who receive news or information relating to the angling or conservation of yellowfish in the Vaal River from angling clubs, awareness groups, retailers and guiding operations.
5. Considering the average distribution of popular angling magazines which publish articles relating to yellowfish angling and or conservation.

The total trip expenditure per category was then further divided into day fishermen (Fd) and overnight fishermen (Fo). Day fishermen were those that indicated that they only went fishing for a day at a time and would therefore only pay entrance fees to fishing resorts whereas the overnight fishermen were those that paid for accommodation to spend two or more days fishing. The total values obtained for the three categories were then summed to obtain the final total economic value for fishermen (Equation 1).

The calculation to determine the estimated total average annual economic value for fishermen of yellowfish on the Vaal River (Tf) was:

$$Tf = If + Ff + Df \dots \dots \dots \text{Equation 1}$$

Where

- If: is the total value for infrequent fishermen,
 Ff: is the total value for frequent fishermen,
 Df: is the total value for dedicated fishermen.

The value for each category was calculated by adding the total value for the day fishermen (Fd) for that category to the total value for the overnight fishermen (Fo) for the same category.

$$Fd = ((Ctd * Ft) + Ev + Mc) * Ad \dots \dots \dots \text{Equation 2}$$

And

$$Fo = ((Cto * Ft) + Ev + Mc) * Ao \dots \dots \dots \text{Equation 3}$$

Where

- Ctd: is the average total cost per trip for day fishermen,
 Cto: is the average total cost per trip for overnight fishermen,
 Ft: is the average frequency of trips per annum,

Ev: is the average total fishing equipment value,
 Mc: is the average membership cost,
 Ad: is the average number of day fishermen,
 Ao: is the average number of overnight fishermen.

The total cost per trip for day (Ctd) and overnight (Cto) fishermen was calculated as follows:

$$Ctd = (Dt * Aa * Sc) + (Ef * Fm) + Cc + (Fc * Fm) + Oc \dots \dots \dots \text{Equation 4}$$

and

$$Cto = (Dt * Aa * Sc) + (Ef * Fm) + Cc + (Fc * Fm * Td) + Oc + (Ac * Fm * Td) \dots \text{Equation 5}$$

Where:

Dt: is the average distance travelled per trip,
 Aa: is the average Automobile Association of South Africa's (AA) rate for total vehicle cost per km,
 Sc: is the average percentage for amount of times that travel costs are shared per trip,
 Ef: is the average entrance fee into fishing venues per person,
 Fm: is the average amount of family members that go on the day trip,
 Cc: is the average cost per car to enter a fishing venue,
 Fc: is the average subsistence cost per person per day,
 Td: is the estimated average duration of a fishing trip,
 Oc: is the average costs of other associated activities that are participated in during a fishing trip,
 Ac: is the average accommodation cost per person per night.

The average fishing equipment value (Ev) was calculated as follows:

$$Ev = ((Fg \times Rfg) + (Fe \times Rfe)) / Pe \dots \dots \dots \text{Equation 6}$$

Where:

Fg: is the average value of fishing gear,
 Rfg: is the average replacement frequency of the fishing gear,
 Fe: is the average associated fishing equipment value,
 Rfe: is the average replacement frequency of the fishing equipment,
 Pe: is the average proportion of the fishing gear and equipment that is exclusively used for angling for yellowfish on the Vaal River.

The average number of day (Ad) and overnight (Ao) fishermen was calculated as follows:

$$Ad = (Pf * Pc) * Pdf \dots\dots\dots \text{Equation 7}$$

and

$$Ao = (Pf * Pc) / Pof \dots\dots\dots \text{Equation 8}$$

Where:

Pf: is the population of fishermen angling for yellowfish,

Pc: is the population of fishermen in each category,

Pdf: is the proportion of the sample that is day fishermen,

Pof: is the proportion of the sample that is overnight fishermen.

2.1.2 Associated equipment retail stores

The questionnaires were mainly completed by conducting one to one or telephonic interviews with equipment retail store owners or representatives. Field surveys were carried out to the urban centres of the study area so that interviews could be conducted.

The equipment stores were divided into four different categories, namely: small retailers (annual turnover of less than R100 000), medium sized retailers (annual turnover of between R100 000 and R250 000), larger retailers (annual turnover of between R250 000 and R625 000) and mega retailers (annual turnover of more than R625 000). This was done due to the large variations in the data range for the annual turnover of equipment stores related to yellowfish. The average values for the four different categories were summed together to determine the total average annual turnover, related to yellowfish, for the equipment stores (Equation 9).

The calculation to determine the total estimated average annual turnover, related to yellowfish for equipment stores (Te) was:

$$Te = Rs + Rm + Rl + Rm \dots\dots\dots \text{Equation 9}$$

Where

Rs: is the total average turnover (Tt) for the small retailers,

Rm: is the total average turnover (Tt) for the medium retailers,

Rl: is the total average turnover (Tt) for the large retailers,
 Rm: is the total average turnover (Tt) for the mega retailers.

The total average turnover for each category was calculated as follows:

$$Tt = Av * Nr \dots\dots\dots \text{Equation 10}$$

Where

Tt: is the total average turnover for either the small, medium, large or mega retailers, depending on which category is being calculated,
 Av: is the average value of the annual turnover per category,
 Nr: is the number of retailers per category.

2.1.3 Associated accommodation sector

Similarly to the approach adopted to assess the value of the use of yellowfish use to the equipment retail stores the value of the use of yellowfish to the accommodation sector was established by holding detailed one on one and telephonic interviews as well as having accommodation sector representatives complete questionnaires. The estimated amount of accommodation venues was determined by considering the amount of venues indicated in a fishing guide book call the Makatorie which focuses on fishing venues on the Vaal River as well as considering venues mentioned by fishermen in the questionnaires (Kloppers, 2008).

The calculation to determine the total estimated average annual turnover, related to yellowfish use for the accommodation sector (Ta) was:

$$Ta = Ac * Na \dots\dots\dots \text{Equation 11}$$

Where

Ac: is the average annual turnover value, related to yellowfish use, for the accommodation sector,
 Na: is the number of accommodation venues along the Vaal River that caters for yellowfish fishermen.

The average annual turnover value, related to yellowfish use, for the accommodation sector was calculated as follows:

$$Ac = Ta / Ni \dots\dots\dots \text{Equation 12}$$

Where

Ta: is the total turnover value for all the accommodation venues interviewed,

Ni: is the total number of accommodation venues interviewed.

The total turnover value for the accommodation venues was calculated as follows:

$$At = \text{Sum of the annual turnover value, related for yellowfish use, of all the accommodation venues interviewed} \dots\dots\dots \text{Equation 13}$$

2.1.4 Associated guiding endeavours

The uses of yellowfish in the Vaal River by anglers through professional guiding operations were assessed in the questionnaire surveys and additional information was obtained by carrying out one on one interviews with established professional guides.

2.2 Social Benefits study

Research into the social benefits of the use of yellowfish and related conservation of yellowfish in the Vaal River was carried out using various social research methods. Desktop research of historical studies on fish conservation and recreation and their social benefits provided the themes of the study. A field survey of the study area (Figure 1) was carried out and interviews for this component were focused in the urban areas of Parys and Orkney. Social related questions were also added to the fishermen's economic assessment questionnaires.

To obtain further insight into the social benefits of yellowfish conservation, telephonic and face-to face in-depth interviews were conducted with representatives of key stakeholders. This included representatives from the National government, the Free

State provincial government and Local governments of the North-West Southern District in Orkney, and the Ngwate Local Municipality. Other key stakeholders included Rand Water, academic researchers, Vaal River Conservation organisations, Yellowfish Conservation Organisations, fly-fishermen and anglers, as well as business owners

The in-depth interviews focused on question relating to yellowfish conservation in South Africa; the social benefits of yellowfish conservation; as well as the challenges facing yellowfish conservation with regard to the Orange-Vaal River system.

3 Results and discussions

In accordance with the aims and objectives of this study and the methodology implemented, the results have been separated into two sections namely the economic survey findings and the social survey findings.

3.1 Economic surveys

The results and discussion of the assessment of the economic value of yellowfish in the Vaal River are presented separately according the findings associated with the fishing activities, equipment retail stores, accommodation sector and the guiding endeavours.

3.1.1 Fishing activities

During the survey, 91 questionnaires were completed by anglers and used in this assessment. Table 1 presents the findings of the angler categorisation assessment in which the frequency of the anglers, the value of the equipment per angling group and the ratio of anglers that make up each group are presented. Following the questionnaire surveys of the 91 anglers interviewed, the ratio of anglers belonging to the in-frequent, frequent and dedicated angler groups were 48%, 35% and 17% respectively. After presenting these findings to yellowfish stakeholders and following the opinions provided by interviewees the ratios were adapted to 25%, 50% and 25% respectively for the infrequent, frequent and dedicated angler groups.

Table 1: Angler categorisation findings based on questionnaires and interviews undertaken in the study

	In-frequent angler	Frequent angler	Dedicated angler
Angling frequency	< Monthly	Monthly - Weekly	> Weekly
Est. value of equipment	R550-R600	R2000-R3000	R4000 - R7000
Calculated ratio per category	48	35	17
Corrected ratios*	25	50	25

Note: (*) Refers to the ratio correction of each category carried out after consultation with the stakeholders of the study and the interviews.

These findings indicate that a clear distinction occurs between the different groups of anglers that target yellowfish in the Vaal River. The dedicated anglers (25% of the group) expend a large amount of time and resources on this activity suggesting that this activity is more of a life-style to these anglers rather than a hobby. The frequent anglers and infrequent anglers spend a noticeably lower amount of time and resources on angling for yellowfish in the Vaal River.

Table 2 presents the findings of the assessment carried out to determine the number of yellowfish flyfishing anglers that target yellowfish in the Vaal River. After carrying out the described materials and methods, findings reveal that a large range of possibly between 350 and 80000 anglers angle for yellowfish in the Vaal River. Through careful consideration of the findings of the study (Table 2), a more realistic estimation of between 3500 and 7500 anglers that target only yellowfish in the Vaal River was obtained and used in this assessment. As a result a mean number of 5000 anglers that target yellowfish in the Vaal River was selected and used in the calculations. As would be expected, the assessment method that produced the most variation in the estimation of the total number of anglers angling for yellowfish in the Vaal River came from the anglers themselves. The equipment retailers, the accommodation sector and the membership and emailing list findings were more consistent. The estimated number of 5000 anglers in total was used in this study, making up the three categories of anglers.

Table 2: Number of anglers that fish for yellowfish in the Vaal River.

Equipment retailer estimations	3000 - 5000
Accommodation/venues estimations	Max 1650 at one time = 3000 - 10000
Angler estimations	5000 - 80000
Club membership or mailing lists	350 - 5200
Average magazine distribution numbers	25000

The total estimated annual economic value for yellowfish angling on the Vaal River is R133 188 761.44 (Table 3). This value is comprised of 11 316 143.72 for infrequent fishermen, R49 391 344.68 for frequent fishermen and R72 481 273.04 for dedicated fishermen (Table 3). With a contribution of 55% of the total value, the dedicated fishermen are the largest contributor of the estimated total annual economic value of the use of yellowfish in the Vaal River, followed by the frequent (37%) and infrequent (8%) fishermen respectively (Figure 2). These values can further be divided into day and overnight fishermen for each category. Day fishermen for infrequent, frequent and dedicated contributed R2 733 138.05 (4%), R22 541 929.89 (36%) and R37 162 647.84 (60%) respectively while the overnight fishermen contributed R8 583 005.67 (12%), R26 849 414.79 (38%) and R35 318 625.20 (50%) for the same categories (Table 3 & 2). As can be expected, the total overnight fishermen (53%) contribute the most to the estimated total annual economic value of yellowfish angling in the Vaal River followed by the day visitors (47%) with dedicated day visitors making the greatest contribution of all the categories with 60% (Figure 2).

It should be noted though that the average total cost per trip for the overnight dedicated anglers seems to be an unrealistic value as it indicates that 250 anglers are spending over R4000 a week on angling trips alone, excluding fishing gear. The research team and some interviewed anglers agree that these figures may be unrealistic and suggestions made to make this total cost per dedicated overnight fisherman more realistic some of the values have been manipulated. Initially, manipulations involved a change in the frequency of trips that are taken by dedicated anglers from a trip once a week per season to a trip once every second week, this resulted in a change of the total value for the overnight dedicated fishermen from R35 318 625.20 to R18 330 147.76, a value that was considered by stakeholders to be more realistic. The total estimated annual value of fishermen angling for yellowfish in the Vaal River would then change to R116 200 284.00. Another option could be to keep the frequency of the fishing trips the same but to change the amount of family members that went on the fishing trips from 3.2 to 2 and the duration of the trips from 3.5 to 2 days. This would change the total value for the overnight dedicated fishermen to R16 485 057.20 and the total estimated annual value of fishermen for yellowfish angling in the Vaal River to R114 355 193.44. It should therefore be noted that, as mentioned before, the annual value of fishermen angling for yellowfish in the Vaal River is an estimation. The remainder of the report will be based

on the original R133 188 761.44 as the total estimated annual value of fishermen angling for yellowfish in the Vaal River but this should be considered an estimation of the upper limits of the total economic value and R114 355 193.44 as an estimation of the lower economic value.

Table 3: The values used to calculate the estimated total average annual economic value for angling of yellowfish on the Vaal River

Number of interviews undertaken										91
	Infrequent (If)			Frequent (Ff)			Dedicated (Df)			
	Day fishermen	Overnight fishermen	Day fishermen	Overnight fishermen	Day fishermen	Overnight fishermen	Day fishermen	Overnight fishermen	Overnight fishermen	
Average frequency of trips per annum (Ft)		3	2	8	8	32	32	32	32	
Average total cost per trip per angler (Ctd & Cto)	R 1,165.49	R 5,291.22	R 1,206.77	R 4,516.76	R 993.62	R 4,247.12				
Average total distance travelled (km) (Dt)	305.38	732.33	433.67	315.33	260.36	216.00				
Average AA rate for total vehicle costs (R/km) (Aa)	R 3.62	R 3.62	R 3.62	R 3.62	R 3.62	R 3.62				
Average percentage of times when travelling costs are shared per trip (Sc)*	0.7	0.7	0.6	0.5	0.6	0.5				
Average entrance fees into fishing venues per person (Ef)	R 39.58	R 39.58	R 39.58	R 39.58	R 39.58	R 39.58				
Average number of family members that go on fishing trip (Fm)	1.94	2.67	1.64	2.56	1.68	3.20				
Average cost per car to enter fishing venue (Cc)	R 17.50	R 17.50	R 17.50	R 17.50	R 17.50	R 17.50				
Average subsistence costs per person per day (Fc)	R 119.62	R 167.17	R 101.82	R 263.00	R 204.25	R 160.50				
Average amount spent on other activities during a fishing trip (Oc)	R 15.50	R 21.69	R 10.71	R 34.56	R 33.98	R 98.00				
Average accommodation cost per person per day (Ac)	~	R 194.94	~	R 159.88	~	R 159.88				
Average duration of a fishing trip (Td)	~	3.50	~	3.50	~	3.50				
Average number of fishermen (Ad & Ao)	607	643	1810	690	1000	250				
Estimated population of fishermen angling for yellowfish (Pf)	5000	5000	5000	5000	5000	5000				
Estimated percent of the population of fishermen in each category (Pc)*	0.25	0.25	0.50	0.50	0.25	0.25				
Average percentage of population that are day (Pdf) and overnight (Pof) fishermen*	0.49	0.51	0.72	0.28	0.80	0.20				
	For day & overnight fishermen	For day & overnight fishermen	For day & overnight fishermen	For day & overnight fishermen	For day & overnight fishermen	For day & overnight fishermen				
Average total fishing equipment value (Ev)	R 874.20	R 2,726.58	R 5,197.48							
Average value of fishing gear (Fg)	R 4,871.86	R 8,612.48	R 9,280.38							
Average replacement frequency of the fishing gear in years (Rfg)	5	2.5	2							
Average value of fishing equipment (Fe)	R 4,906.72	R 4,710.50	R 7,989.61							
Average replacement frequency of the fishing equipment in years (Rfe)	5	5	5							
Average percentage of fishing gear & equipment is used exclusively for catching yellowfish (Pe)*	0.45	0.62	0.83							
Membership fees (Mc)	R 130.96	R 71.02	R 169.20							
Average membership fees for 2006 to angling associations (MC)	R 130.96	R 71.02	R 169.20							
Total value for day (Fd) and overnight fishermen (Fo) per category of fishermen	R 2,733,138.05	R 8,583,005.67	R 22,541,929.89	R 26,849,414.79	R 37,162,647.84	R 35,318,625.20				
Total value per category of fishermen (If, Ff and Df)	R 11,316,143.72	R 49,391,344.68	R 72,481,273.04	R 133,188,761.44						
Estimated total annual value of fishermen for yellowfish in the Vaal River (Tf)										

* Values to be multiplied by 100 for actual percentage values

Data obtained from questionnaire surveys

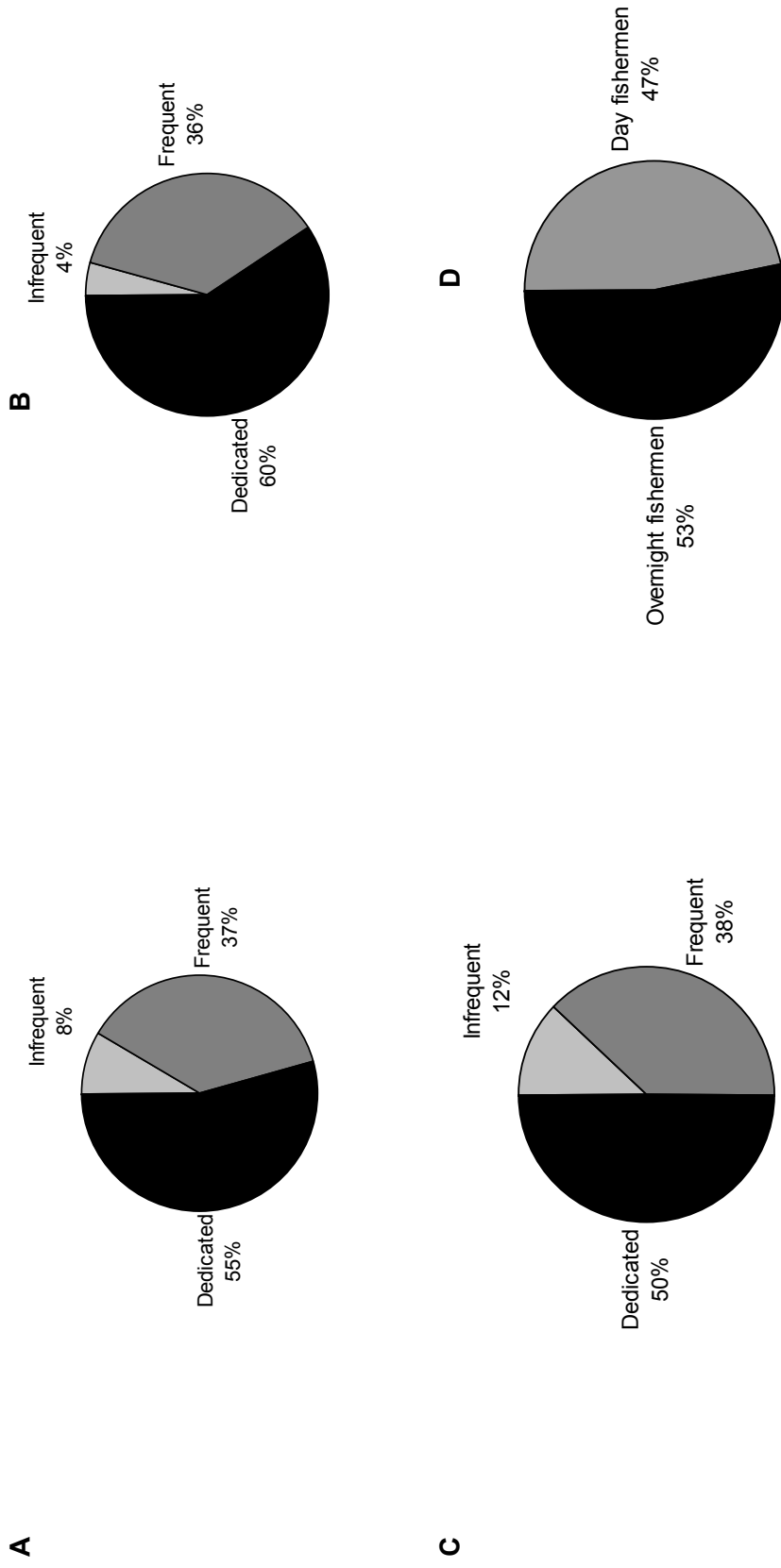


Figure 2: Graph A represents the percentage contribution that each category of fisherman contributes to the total estimated annual turnover for yellowfish angling on the Vaal River. Graph B represents the percentage that the day fishermen and graph C the percentage that the overnight fishermen, for each category contribute to the total estimated annual turnover for yellowfish angling on the Vaal River. Graph D represents the percentage that the day and overnight fishermen contribute to the total estimated annual turnover for yellowfish angling.

In consideration of the distribution of the economic value of the use of yellowfish amongst the users (Figure 2), the dedicated anglers make the most noticeable contribution towards the total economic value of this activity. These dedicated anglers, angle for much longer periods during the season and own noticeably more expensive equipment. As would be expected, the fishermen that angle for longer periods at a time (overnight anglers) increases the individual cost per trip as the frequency of the angling trip are comparable to the frequency of the day visitors. This results in the overnight anglers contributing more to the total economic value of the user groups than the day anglers.

With a total seasonal value of the use of yellowfish in the Vaal River by predominantly fly-fishing anglers of just below 134 million rand a year, this activity is a considerable user of the goods and services of the Vaal River ecosystem. In order to place the economic value of the yellowfish dependent angling activities in the Vaal River in context, a comparison with another user group that is predominantly dependent on the Vaal River has been made. The value of such a user group is available in the form of the total economic contribution of the agriculture, forestry and fishing sector to the Gross Domestic Product (GDP) of South Africa originating from the Free State Province (STATSSA, 2006). The annual regional contribution (in Rands) to the GDP of South Africa from the agriculture, forestry and fishing sector of the Free State Province alone is available for the years 1995 to 2005 (Figure 3). Although the economic value of the yellowfish dependent use activities for the Vaal River were determined for the angling season of 2006/7 the most recent data to compare these findings with is the 2005 regional value of the agriculture, forestry and fishing contribution from the Free State Province (R3 501 million), a user sector that is largely dependent on the Vaal River ecosystem. In comparison to this value, the value of the yellowfish dependent use of the Vaal River determined in this study is 3.8% of the total 2005 regional value of the agriculture, forestry and fishing contribution from the Free State Province. This further indicates that the use of yellowfish in the Vaal River, predominantly by the fly-fishing community, has a considerable economic value year on year. Taking this into account, very little consideration is given to this user group by the managers of the Vaal River. Specific management plans should be established to facilitate the sustainability of this activity which indirectly requires management interventions to ensure the sustainability of the yellowfish populations in the Vaal River.

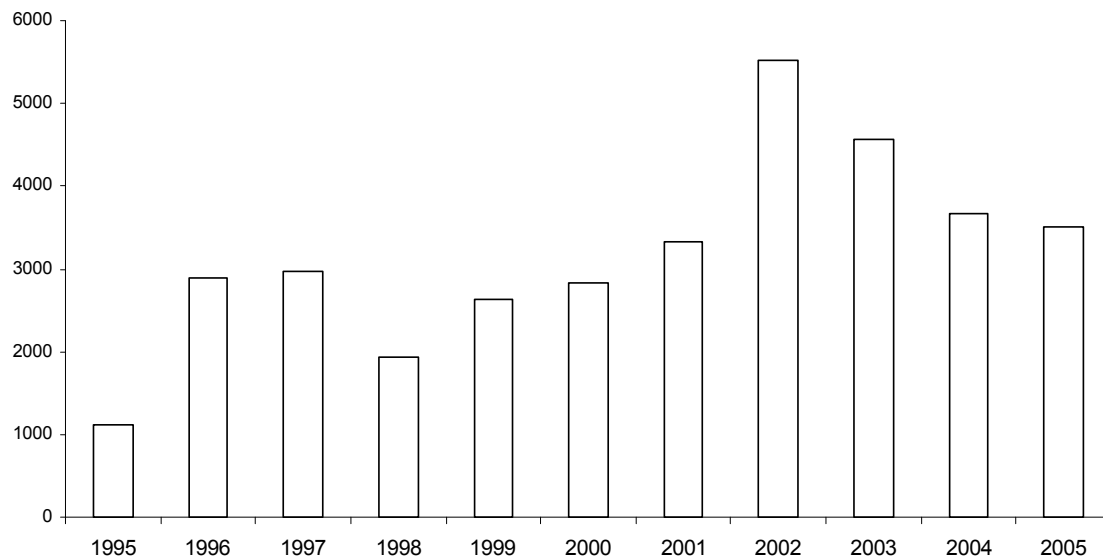


Figure 3: Graphical representation of the total economic contribution of the agriculture, forestry and fishing sector to the Gross Domestic Product (GDP) of South Africa from the Free State Province from 1995 to 2005.

Table 4 presents the estimated total average annual economic value of yellowfish on the Vaal River separated into the categories of anglers and the proportional values spent on equipment, travel, accommodation, memberships and other activities. The value of the equipment that fishermen own has a total estimated annual value of R14 406 053.37, total travel expenses per annum are R41 416 274.64, total accommodation expenses per annum are R74 535 859.46, total other activity costs per annum are R2 277 835.88 and the total spent on memberships per year are R552 738.10. The amount spent on accommodation, including food and entrance fees contributes the largest amount (56%) to this value, followed by the travelling expenses (31.1%), equipment costs (10.8%), other activities (1.7%) and memberships (0.4%) respectively (Figure 4).

Table 4: The estimated total average annual economic value of yellowfish on the Vaal River separated into the categories of anglers and the proportional values spent on equipment, travel, accommodation, memberships and other activities.

	Infrequent	Frequent	Dedicated	Total
Equipment	R 1,092,755.86	R 6,816,445.91	R 6,496,851.60	R 14,406,053.37
Travel	R 4,150,039.67	R 16,852,649.53	R 20,413,585.44	R 41,416,274.64
Accommodation	R 5,848,877.95	R 25,198,845.51	R 43,488,136.00	R 74,535,859.46
Other activities	R 60,773.81	R 345,862.07	R 1,871,200.00	R 2,277,835.88
Memberships	R 163,696.43	R 177,541.67	R 211,500.00	R 552,738.10
Total				R 133,188,761.44

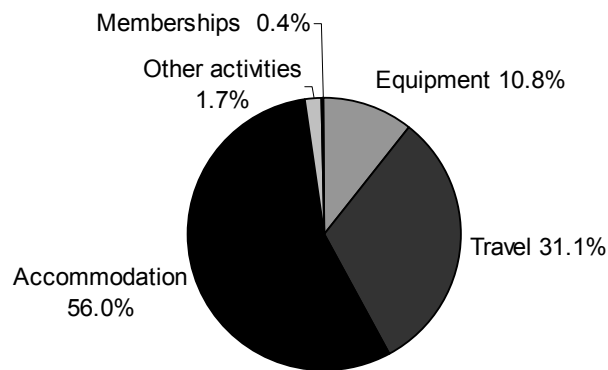


Figure 4: The division of the estimated total average annual economic value for fishermen of yellowfish on the Vaal River, into the various total values for sectors that compromise the value.

These findings indicate that the travelling cost to the angling venues, accommodation and equipment makes up the majority of the cost to the anglers to carry out this activity. Very little financial costs are incurred in the form of other related activities being conducted and the membership fee costs. No indication of any financial contributions being made by anglers towards angling licences, and resource conservation was determined.

3.1.2 Associated equipment retail stores

Table 5 indicates that out of 55 estimated equipment retail stores in the study area, 23 were interviewed but only 12 were willing to give financial information regarding their businesses. The four categories of equipment retail stores, namely small, medium, large

and mega retailers had estimated annual turnovers related to yellowfish angling as R397 500.00, R1 550 001.00, R3 830 000.00 and R10 575 000.00 respectively (Table 5). These amounts summed together gave the total estimated average annual turnover, related to yellowfish angling for equipment stores as R16 352 501.00 (Table 5). Mega stores make the greatest contribution to this value at 66%, large at 23%, medium at 9% and small at 2% (Table 5).

Table 5 The values used to calculate the total estimated annual turnover for equipment retail stores related to yellowfish angling in the Vaal River.

Number of retailers in study area		55			
Total number of interviews undertaken		23			
Retail category information	Retail categories	Small Retailers (Rs)	Medium sized retailers (Rm)	Large retailers (RI)	Mega retailers (Rm)
	Retail/wholesale	Retail	Retail	Retail	Both
	Ordering frequency from wholesalers	Irregular	Regular	Consistent	Consistent
	Annual turnover range	>100K/annum	100K - 250K/annum	250K - 625K/annum	>625K/annum
Data obtained from questionnaire surveys	Respondent 1*	R 1,000.00	-	-	-
	Respondent 2*	R 6,250.00	-	-	-
	Respondent 3*	R 32,500.00	-	-	-
	Respondent 4*	-	R 112,500.25	-	-
	Respondent 5*	-	R 125,000.00	-	-
	Respondent 6*	-	R 150,000.00	-	-
	Respondent 7 [#]	-	-	R 340,000.00	-
	Respondent 8 [#]	-	-	R 400,000.00	-
	Respondent 9 [#]	-	-	R 550,000.00	-
	Respondent 10*	-	-	R 625,000.00	-
	Respondent 11 [#]	-	-	-	R 630,000.00
	Respondent 12 [#]	-	-	-	R 3,600,000.00
	Number of retailers per category (Nr)	30	12	8	5
	Number of data available per category	3	3	4	2
	Average value of annual turnover (Av)	R 13,250.00	R 129,166.75	R 478,750.00	R 2,115,000.00
	Total turnover per category (Tt)	R 397,500.00	R 1,550,001.00	R 3,830,000.00	R 10,575,000.00
Estimated total annual sector turnover (Te)		R 16,352,501.00			

Note (*) Refers to data which were provided as categories

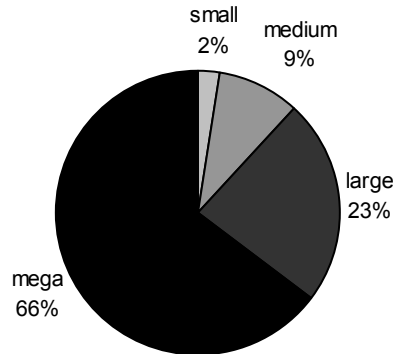


Figure 5: The percentage contribution that each category of equipment retail store contributes to the total estimated annual turnover for equipment retail stores related to yellowfish angling in the Vaal River.

The low percentage of equipment retailers that were willing to present their financial data is concerning and this may indicate that;

- these retailers may be unwilling to give up information in fear of the information negatively impacting on their competitiveness in the market,
- these retailers might not have the financial information indicating that a large percentage of the retailers do not keep sound financial management practices, or
- these retailers are not declaring the total turnover or income pertaining to sales and turnover and as such are afraid of legal action being taken against them.

The dominance in the value of the equipment supplied by the mega stores (66%) indicates that these suppliers have somewhat of a monopoly in the industry. The mega stores are possibly able to reduce profit margins due to the high volumes of stock that they sell compared to smaller retailers who have to offer good service or trade in remote areas that do not have the market to support the large mega stores.

If a comparison is made between the seasonal cost of equipment presented by the anglers (Table 4) to the supply of equipment presented by the equipment retail stores

(Table 5) the values of R14.4 million (from anglers) is close to R16.3 million (from suppliers) which is indicative of the accuracy of this assessment.

3.1.3 Associated accommodation sector

The findings of the assessment into the value of the yellowfish in the form of accommodation use, by predominantly fly-fishing anglers, are presented in Table 6. Findings indicate that there are 45 estimated accommodation venues in the study area which provide accommodation to the fly-fishing anglers who target yellowfish. Of these, 17 were interviewed but only 9 gave financial information regarding the annual value that angling for yellowfish contributed to their turnover. The total estimated annual value for the accommodation sector related to yellowfish angling in the Vaal River is R3 950 705.13 (Table 6).

Table 6: The values used to calculate the estimated total annual turnover for the accommodation sector related to angling for yellowfish in the Vaal River.

		Total annual turnover	% contribution from yellowfish users	Annual turnover from yellowfish users	
Total number of interviews undertaken				17	
Data obtained from questionnaire surveys	Respondent 1	R 1,500,000.00	10%	R	150,000.10
	Respondent 2	R 750,000.00	5	R	37,500.03
	Respondent 3	R 150,000.00	10	R	15,000.05
	Respondent 4	R 150,000.00	60	R	90,000.30
	Respondent 5	R 750,000.00	30	R	225,000.15
	Respondent 6	R 150,000.00	80	R	120,000.40
	Respondent 7			R	67,200.00
	Respondent 8			R	72,000.00
	Respondent 9			R	13,440.00
Count (Ni)					9
Total (At)				R	790,141.03
Average (Ac)				R	87,793.45
Number of accommodation venues (Na)					45
Estimated total annual sector turnover (Ta)				R	3,950,705.13

Similarly to the equipment assessment, the low percentage response of the accommodation providers that were willing to present their financial data is concerning and this may similarly indicate that;

- these providers may be unwilling to give up information in fear of the information negatively impacting on their competitiveness in the market,

- these providers might not have the financial information indicating that a large percentage of the accommodation sector do not keep sound financial management practices, or
- these providers are not declaring the total turnover or income pertaining to turnover and as such are afraid of legal action being taken against them.

Following this assessment, from the accommodation sector the annual value of the declared value of accommodation utilised by anglers is R3.9 million. This is in contrast to the estimation provided by the anglers themselves (Table 3) who estimate the annual value of the accommodation usage as R74.5 million, 19 times greater than the estimation provided by the accommodation sector themselves. These findings indicate that the estimation provided by the anglers may be an over estimation of the true value and/or that the estimation provided by the accommodation providers is a gross underestimation of the true value of the accommodation provided to this user group. The low percentage of accommodation providers incorporated into this study further suggests that this outcome may be incorrect. The use of these data as such is considered to be of a low confidence and should be used with caution.

3.1.4 Associated guiding endeavours

Following the assessment of the potential value of the use of yellowfish by fly-fishing guides, results revealed that there are only a very few professional guides who specialise in guiding fly-fishermen clients who wish to target yellowfish on the Vaal River. One interesting case study of a business plan by a potential guiding operation was presented to the study team as follows;

- A professional guiding operation operating out of Johannesburg sold R342 032.91 worth of fishing gear to 55 guided clients in the 2007/2008 season, specifically for yellowfish angling in the Vaal River. Each customer therefore spent on average R6 218.78 on fishing gear, per trip, for targeting yellowfish on the Vaal River alone. The total yellowfish guiding fee income by this guiding operation in the 2007/2008 season was R39 082.03. This operation indicated that their ability to effectively market yellowfish as targeted species is limited, due to the unpredictable angling conditions in the Vaal River. A detailed business

plan of the guiding operation revealed that if the environmental conditions of the Vaal River that influence the potential to angle for yellowfish were more predictable, the demand exists for the operation to sell R300 000 (guiding fees) worth of guiding trips to the Vaal River per season. This fee excludes the basic fishing gear sold which would include a minimum estimated total amount of R600 000 per season. The estimated total value per season of the use of yellowfish within this business plan would be in excess of R900 000 for one guiding operation.

3.2 Social Benefits of Yellowfish Conservation

According to Vogelsong and Thomas (2004) a social benefit, in contrast to an economic benefit, is an outcome that results from motives that are directed to sustaining a social relationship rather than gaining financial profit from a relationship. Vogelsong and Thomas (2004) further suggest that empirical studies supporting claims of social benefits arising from recreational activities and angling such as; family cohesion, friendship development, and an improved quality of life, are not well documented therefore there are few studies to support these claims. This is due to the difficulty of quantifying social benefits.

The findings of the study suggest that links between social benefits and economic benefits of yellowfish conservation particularly pertaining to improved livelihoods and local economies from yellowfish angling and related activities exist. In particular, the social benefits were identified as:

- Yellowfish as an indicator species,
- Yellowfish as a food source,
- Yellowfish promotes social cohesion in families,
- Yellowfish conservation can improve quality of life and,
- Yellowfish conservation promotes stewardship and community engagement.

3.2.1 Yellowfish as an indicator species

Yellowfish can and are used as indicators of river health in South Africa. Within the Vaal River ecosystem conservation endeavours have been established to maintain and improve the distribution, abundance and health of the yellowfish populations within this system (Pers Comm. Pierre De Villiers⁷). By attempting to change the land-use practices of Vaal River ecosystem by resource users along the river banks, reduce pollution and change the in-stream activities of anglers, for example, an increase in yellowfish numbers and the overall state of the aquatic ecosystem of the Vaal River has occurred. The ripple effect of these endeavours includes an improvement of the overall state of the Vaal River aquatic ecosystem. Many formal and informal communities making use of the goods and services of the Vaal River ecosystem have benefitted from this increase in the state of the Vaal River ecosystem.

3.2.2 Yellowfish as a food source

In the Vaal River, yellowfish are an important source of protein for local communities that consider both yellowfish species occurring in this system to be a source of food. A healthy environment results in healthier fish which can be made use of by communities. Yellowfish are not particularly targeted by subsistence fishermen, but they form a part of many communities' diets. Some groups of anglers from the urban areas of the study area target yellowfish for consumption purposes. Although these activities are frowned upon by conservation groups who practice the ecologically sound approach of catch and release, the importance of yellowfish as a protein source to various communities in South Africa cannot be ignored.

⁷ **Pierre De Villiers:** June 2007, formerly of the Free State Nature Conservation. Cape Nature, Cape Town.

3.2.3 Yellowfish promotes social cohesion in families

The benefit of Orange-Vaal Largemouth yellowfish in promoting social cohesion within families and communities is an important social benefit. Angling is an accessible sport that is not only a leisure activity but also as a tool for social inclusion involving families and other members of the community. This is because it appeals to all ages and does not discriminate against gender, race or athletic ability. A report for the California State Parks (2005) asserts that families that participate in recreational activities such as angling tend to be more cohesive, and form close bonds whilst transferring important values through shared experiences.

3.2.4 Yellowfish conservation can improve quality of life

Participating in yellowfish conservation and angling activities improves the quality of life through recreational activities (Wolhuter and Impson, 2007). Outdoor recreation activities have health benefits and improve the well-being and self-esteem of the participants. Unfortunately, due to frequent contamination of the Vaal River, fishing activities in polluted parts of the Vaal River can pose a health risk and anglers can be in danger of waterborne diseases and infections (Braune and Rogers, 1987). Refer to the section titled challenges facing yellowfish conservation.

3.2.5 Yellowfish conservation promotes stewardship and community engagement

In South Africa, yellowfish conservation has the potential to promote stewardship and community engagement. This is considered by interviewees to possibly be one of the most important social benefits of yellowfish conservation in South Africa. By participating in yellowfish angling and associated activities, such as camping and hiking, the concept of conservation and volunteerism is promoted as participants become more familiar with the environment and its resources.

Interviewees further suggest that as the participants of recreational activities become more environmentally aware, they would be more likely to maintain or conserve the

quality of the natural environment. This in turn means that they are more likely to invest time and money in the protection, conservation and maintenance of the natural environment and increasingly become politically involved in environmental issues (California State Parks, 2005). When asked how important conservation initiative are, The outcomes of the questionnaire based assessment showed that between 91.7% and 100% of the respondents agreed that the conservation initiatives for yellowfish were very important (Figure 6). From this study 7.2% of the fishermen and 8.3% of the equipment retail store representatives indicated that conservation initiative were fairly important (Figure 6).

The importance of public and private sectors stakeholder involvement in yellowfish conservation is revealed in the questionnaire based evaluation whereby when respondents were asked; with regards to who should be responsible for the management of yellowfish in the Vaal River, there was a relatively even distribution (between 50% and 69.2% (Figure 6)) between government, conservationists and resources users. Graph B of Figure 6 indicates that 91.7% of equipment retail stores representatives and 87.5% of guides considered it conservationists responsibility to manage the yellowfish in the Vaal River while 75% of the equipment retail store representatives also thought it to be the resource users responsibility.

Successful conservation initiatives such as the catch and release practice, have been initiated by organisations that promote conservation sustainable use of yellowfish. Anglers who catch adult yellowfish are encouraged to minimise the capture and handling time and then to released these individuals back to the river as soon as possible when the fish can swim away on its own. Respondents indicated that by carrying out the practice of catch and release there appears to be an improvement in the size of fish caught in these areas. In addition, the initiative has promoted changes in the angling methods, as anglers have become more aware of their impact on the river system. Examples include; anglers may angle upstream and then move downstream at a very slow pace and not target sensitive areas such as spawning beds over extended periods of time to allow the river to repair itself resulting in more fish and less degradation of the river.

Successful river ecosystem conservation endeavours require cooperation from all stakeholders and yellowfish conservationists have been successful in involving riparian landowners, lodges, fly-fishing clubs, as well as national, provincial, and local governments such as the Department of Water Affairs and Forestry in their conservation initiatives (Wolhuter and Impson, 2007). Public participation in conservation has been undertaken by schools, clubs and local communities aimed at raising awareness concerning yellowfish use and conservation as well as Vaal River conservation (Pers. Comm. De Villiers⁸). As a result river litter clean up programmes have been voluntarily established and many local stakeholders are monitoring the Vaal River environment and reporting illegal activities and or strange events occurring in the system. Information is available and is distributed to riparian land owners, businesses and anglers to promote the awareness of the importance of conserving the Vaal River ecosystem and the use of resources from this system by stakeholders of the Orange-Vaal River Yellowfish Conservation and Management Association (OVRYCMA).

Yellowfish conservation awareness initiatives have been very successful among the angling and associated industries and Vaal river resource users. This is evident in the findings whereby guides indicated the greatest awareness that conservation initiatives are being carried out on the Vaal River (100%), 83.3% of the equipment retail store representatives, 78.7% of fishermen and 64.3% of the accommodation sector were aware of conservation initiatives related to yellowfish in the Vaal River (Figure 6). In addition, Graph D of Figure 6 indicates that 75% of the guides, 58.3% of the equipment retail store representatives, 42.9% of the accommodation sector and 36% of the fishermen were involved in some aspect of conservation initiatives related to yellowfish in the Vaal River (Figure 6).

⁸ **Pierre De Villiers:** June 2007, Orange-Vaal River Yellowfish Conservation and Management Association and formerly of the Free State Nature Conservation. Cape Nature, Cape Town.

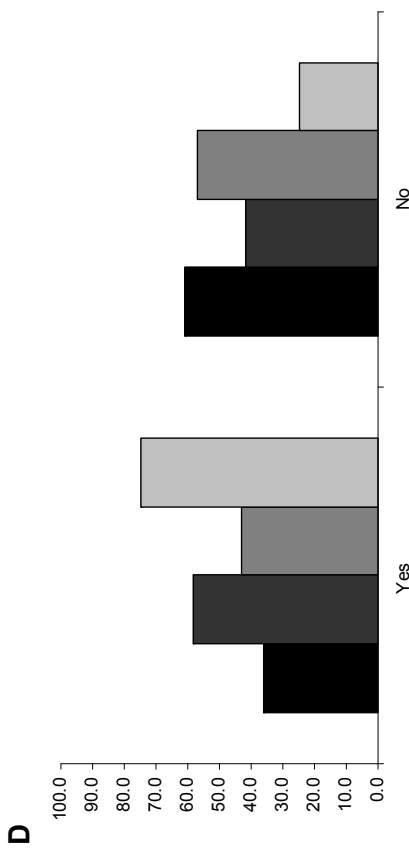
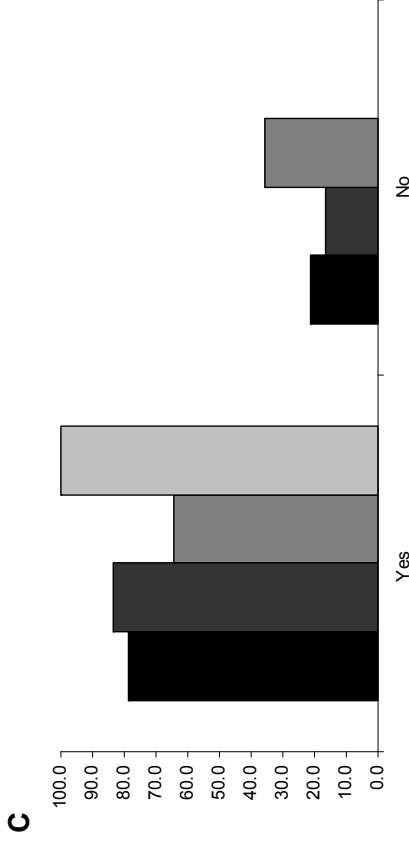
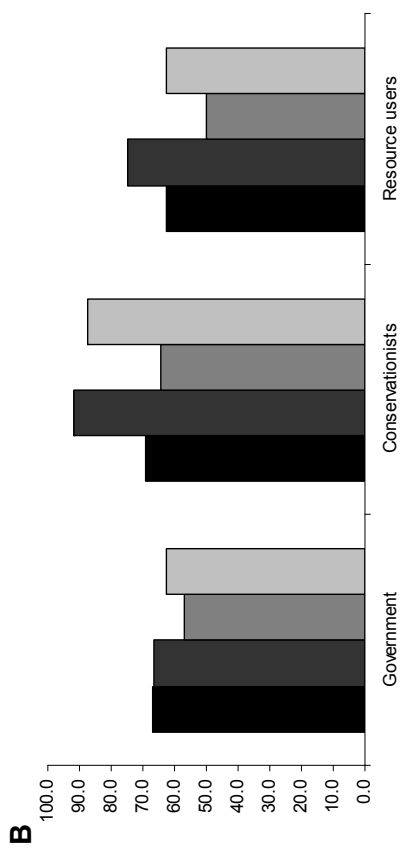
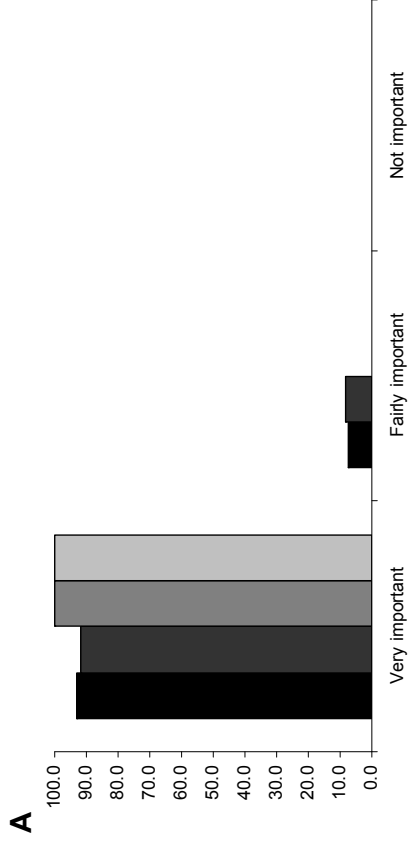


Figure 6: Graph A to D represents the fishermen, equipment retail stores, accommodation sector and guides opinions regarding conservation initiatives for yellowfish in the Vaal River. Graph A indicates who the respondents thought conservation initiatives related to yellowfish on the Vaal River were important. Graph B indicated who the respondents thought was responsible for management of yellowfish in the Vaal River. Graph C indicates whether the respondents were aware of any conservation initiatives regarding yellowfish in the Vaal River and Graph D indicated if they were involved in any of the conservation initiatives.

Groups such as The Yellowfish Working Group and the OVRycMA are examples of organisations whose members are keen anglers and active conservationists involved in both the private and public sectors of South Africa. These organisations support and provide for conservation initiatives in the Vaal River that generally involves ecological state monitoring of the Vaal River and research studies into the yellowfish population management and biology (Bloomer *et al.*, 2008). Findings and outcomes of these studies that are of value to the management of the Vaal River ecosystem as a whole are presented to management departments such as the Department of Environmental Affairs and Tourism (DEAT) and the Department of Water Affairs (DWAF). Catchment forums have also been established with municipalities to increase awareness, share ideas, and find solutions for the conservation and rehabilitation of the Vaal River.

Finally, members of organisations such the OVRycMA, commit human and financial resources to the conservation of yellowfish in the Vaal River. This practice is unfortunately limited and often un-coordinated due to financial constraints.

3.2.6 Challenges facing yellowfish conservation

Angling is a popular sport along the Vaal River which is accessible to anglers from Gauteng and surrounding areas. In spite of the numerous economic and social benefits that can be derived from yellowfish angling and its associated activities, a number of challenges face yellowfish conservation initiatives. Documentary reviews and information gathered from respondents revealed a number of challenges.

In areas the impaired state of the water quality of the Vaal River is of great concern as it is hampering social and economic progress of conservation initiatives (Braune and Rogers, 1987). The main reason for the degradation of the water quality of the Vaal River is widely considered to have resulted from the inadequately treated waste water released into the river from industries including mines, municipalities and agricultural farmers in the vicinity of the Vaal River and its tributaries (Grabow *et al.*, 1984; Nadene and Roos, 1999; Van Wyk, 2001). In light of the mandates established by the South African Government to ensure service delivery and implement policies, local governments, particularly within the study area, are struggling to ensure a safe

environment for humans and aquatic biodiversity (Constitution of the Republic of South Africa No 108 of 1996). Interviewees suggest that Municipal Integrated Development Plans (IDP), focus on housing, job creation, and poverty alleviation, while the environmental management and conservation are low on the agenda. They further consider this not due to a lack of policy, or a lack of willingness by the officials interviewed regarding environmental conservation but rather pressing issues such as poverty alleviation, economic development and service delivery, which takes precedence. The situation is considered to be further exacerbated by a lack of funds to expand waste water treatment works and, poor maintenance of existing waste water works, and a lack of trained personnel to manage the works. Stakeholders interviewed further argue that Water treatment works have not been upgraded in recent years to accommodate the expansion of housing such as the RDP homes and other industrial and residential developments. As a result, current waste water works are therefore not able to cope with increased waste from developments or with natural phenomenon such as heavy rain, which causes overflows of untreated sewage into the Vaal River. This situation has had adverse effects on aquatic species, human and economic activities within the study area (Grabow *et al.*, 1984; Nadene and Roos, 1999; Van Wyk, 2001). In particular, the polluted waters of the Vaal River pose numerous health risks from waterborne diseases and infections such as hepatitis, cholera, or typhoid for humans (Braune and Rogers, 1987; Wolhuter and Impson, 2007). Participants interviewed commented on the added expense that anglers/waders now have due to the requirements of the anglers to purchasing protective clothing to avoid contaminants in the water. Stakeholders of their yellowfish use and conservation generally agree that the risk contaminations causing health threats has had a negative affect on the angling, and other recreational activities associated with the Vaal River. In addition, many angling operators and retail store owners feel it is their social responsibility to anglers to warn potential anglers of the health risks associated with the use of the Vaal River. This practice is frowned upon by many other members of the tourism industry associated with the Vaal River who are losing revenue as a direct result of these actions.

4 Conclusions

In this study, a total of 91 questionnaires were comprehensively completed by anglers, an additional 23 equipment retail store representatives were interviewed, 17 accommodation sector representatives were interviewed and numerous interviews were carried out with professional guides, conservationists, specialist consultants and academic researchers as well as with various magazine editors, Vaal River ecosystem managers and municipality representatives. The study team was brought into contact with various stakeholders responsible for the management, conservation and use of yellowfish in the Vaal River. Many of these stakeholders were exceptionally courteous and helpful and attempted as far as possible to facilitate the study although many were reluctant to provide detailed financial information pertaining to their businesses.

In conclusion, the majority of anglers on the Vaal River who target yellowfish from the Vaal River predominantly belong to the fly-fishing group of anglers who can further be divided into three categories of anglers including infrequent, frequent and dedicated anglers. These anglers (approximately 5000 in total) undertake between 2 and 32 trips per season which can last between 1 and 3.5 days per trip. During these trips, between 216 and 732 km are covered, which indicates that although some of the angling activities occur within or close to 100 km from where these anglers live, some anglers travel up to three times the distance in search of better angling waters. At fishing venues anglers pay approximately R40 for entry and or rod fees to venue owners per angler and spend on average between R100 and R263 per day for subsistence. On occasion some anglers take additional family members on angling trips and spend between R10 and R100 on other activities. The fishing equipment that is used by anglers on the Vaal River is replaced every two to five seasons by the various anglers and costs between R850 and R5200. If anglers belong to angling clubs, they spend between R70 and R170 per season on membership fees to belong to a fishing club.

Finally, this study has revealed that the estimated value of the yellowfish dependant fishing industry on the Vaal River that actively targets yellowfish is just over R133 million per season. Of this total economic value, the equipment sector is worth R14.6 million, the amount spent on travel is R41.4 million, accommodation costs total R75.5 million, other costs incurred while undertaking angling trips equal R2.2 million a season and

membership fees paid by anglers to belong to clubs, etc. exceeds R500 thousand per season/annum.

The social value of the use and associated conservation of yellowfish in the Vaal River occurs in the form of yellowfish acting as an indicator species whereby communities benefit from the improvement of the overall health of the river ecosystem as an indirect result of the conservation of the yellowfish, yellowfish being an important source of protein to local communities; yellowfish have a recreational value in that they are an actively targeted angling species; yellowfish conservation promotes social cohesion, stewardship and community engagement and as such, yellowfish-use and conservation has the potential to improve the quality of life of many South Africans.

Although the use and conservation of yellowfish in the Vaal River has proven social and economic values, a threat to these benefits exist in that currently insufficient management actions have been implemented in the study area, limited resources have been made available to ecosystem managers and conservationists. Participants of this survey feel that it is not the absence of laws/policies required to protect the environment that is lacking but rather that the enforcement and implementation of these policies/laws is lacking. The social benefits of conservation initiatives can potentially promote the enforcement of these policies/laws particularly by lobbying at grassroots and national level to increase awareness and encourage public participation in conservation initiatives. Successful conservation of the Vaal River and the yellowfish can only be accomplished through partnerships between civil society and public institutions.

Finally, the yellowfish-dependant angling practices in the Vaal River continues to be a growing sport in South Africa and it presents numerous social and economic benefits, not only to the yellowfish angling community, but to society as a whole.

5 Recommendations

Following the completion of the study, in view of the outcomes, the following recommendations should be taken into consideration by ecosystem managers and conservationists:

1. Initially, the establishment of an integrated use and associated conservation plan for the yellowfish in the Vaal River should be carried out. This management plan should consist of economic, social and ecologically sound approaches that take into account the needs of all user groups of the Vaal River system. The focus of the management plan should be the maintenance and, if possible, improvement of the biodiversity of the aquatic biota in the Vaal River, using the yellowfish as an indicator and or flagship species.
2. The risk posed to the continued survival of yellowfish individuals by the so-called ecologically friendly practice of catch-and-release of yellowfish should be researched and method for the suitable use for this species should be established to ensure the sustainability of this important resource.
3. Following the outcomes of this study, the social and economic value of the use and conservation of yellowfish in the Vaal River should be considered when the ecological goods and services of the Vaal River are allocated for use through the aquatic ecological reserve determination process.
4. This study has the potential to change the allocation of importance of the goods and services of river ecosystems towards the conservation of yellowfish. Similar assessments should be undertaken on other yellowfish species and ecosystems in South Africa.
5. The continuation of this type of research into the use of yellowfish in the Vaal River ecosystem should be continued in order to improve on the confidence of this assessment. Results from continued research can facilitate forums that lobby for increase in conservation action.

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