South African Red Data Book – Fishes

P H Skelton

A report of the Committee for Nature Conservation Research
National Programme for Ecosystem Research

SOUTH AFRICAN NATIONAL SCIENTIFIC PROGRAMMES REPORT NO

137

1987

Issued by

Foundation for Research Development
Council for Scientific and Industrial Research
P 0 Box 395
PRETORIA
0001
South Africa

from whom copies of reports in this series are available on request

Printed in 1987 in the Republic of South Africa

ISBN 0 7988 4107 9

Author's address

Dr P H Skelton
J L B Smith Institute of Ichthyology
Private Bag 1015
GRAHAMSTOWN
6140
South Africa

Cover: *Oreodaimon quathlambae,* a threatened minnow once considered extinct. Drawn by Elizabeth Tarr.

PREFACE

The National Programme for Ecosystem Research (NPER) is one of several national scientific programmes administered by the CSIR. This book is produced under the auspices of one of the sectional committees of the National Programme, namely the Committee for Nature Conservation Research. The National Programme is a coordinated multidisciplinary undertaking of scientific research, concerned with problems in the environment. It includes research designed to meet purely local needs as well as projects undertaken in southern Africa as contributions to international scientific activities.

The ever increasing threat to Africa's native ecosystems and their component animal and plant species, poses enormous conservation problems. The need for development, together with the man-induced modification and destruction of natural habitats that so often accompanies it, provides conservation managers with their most taxing dilemma.

The purpose of the NPER is to obtain knowledge on current and future environmental problems sufficient to conserve and manage ecosystems most effectively. The collation of information on rare and threatened species is a vital part of this effort. The volumes of the "Red Data Book" series are intended to provide and analyse that data base. They contribute directly, not only to the monitoring and management of rare species but to the protection and sustenance of their constituent natural habitats.

To date the NPER has produced nine of these reports in the National Scientific Programmes Report series published by the CSIR (Nos 7 in 1976; 11 in 1976; 14 and 18 in 1977; 23 in 1978; 45 in 1980; 97 in 1984; 117 in 1985 and 125 in 1986), covering the groups: birds; small mammals; fishes; large mammals; reptiles and amphibians; vascular plants and; plants in fynbos and karoo biomes. These volumes, which were all explicitly provisional, were based on the best available information. This was often embarrassingly sparse, such that some sections contained little more than annotated lists of species about which little was known.

this volume represents a comprehensive revision of the earlier Red Data Book - Fishes (Skelton 1977). It provides a measure of change, both in the status of our fish species and in our knowledge of them. In so doing it provides a more thorough assessment of where future conservation and research efforts should be concentrated. The text and references were completed at the end of 1986 and exclude information that has become available after that date.

ACKNOWLEDGEMENTS

This project has depended on the cooperation and input of many individuals who have responded to the questionnaires and enquiries of the compiler. Several correspondees provided unpublished information or directed me to new sources of information. To all these individuals I express my sincere appreciation for their response to the project. In most cases where a species has been suggested for inclusion in this list there has been agreement by informed individuals as to its conservation status. In a few cases the status of the species is not settled and future research may well show the allocation to be incorrect.

Individuals responding to the questionnaire or otherwise providing information of use in this revision include: A Batchelor, Dr G W Begg, G Bell-Cross, C Benade, Dr S J M Blaber, Dr A H Bok, Prof A P Bowmaker, Prof M N Bruton, G Brett, J A Cambray, M Coke, D Cooke, R S Crass, J S Engelbrecht, A A Ferrar, Prof I G Gaigher, Dr C Gow, Dr K C Hamman, Prof T Hecht, Dr P C Heemstra, Dr P A Hulley, P B N Jackson, Dr R A Jubb, F Junor, Dr C J Kleynhans, Dr H M Kok, Dr R Kyle, P la Hausse de Lalouviere, Dr P le Roux, K J Meyer, Dr P F S Mulder, M J Penrith, Dr U de V Pienaar, T Pike, D Pistor, L Polling, B Ranchod, Prof M M Smith, R H Taylor, Dr D F Toerien, S C Thome, D Theron, R P van der Elst, Dr B C W van der Waal, Dr J H Wallace, Dr A K Whitfield.

The addresses of these persons are given in the Appendix.

The initial typing was done by Huibre Tomlinson and Elmarie Riddin. Fish illustrations were drawn by Liz Tarr, Penny Meakin and Merridy Pugh. The maps were produced by Penny Ellmore. Jennie Roberts and Lynette van Niekerk gave assistance with proof reading of the manuscript. Professor Tom Hecht assisted with translation of the abstract into Afrikaans. The project was initiated during my tenure at the Albany Museum and completed in the J L B Smith Institute of Ichthyology. I am grateful to the Directors of the two institutions (Mr B C Wilmot and Prof M N Bruton respectively) for permission and encouragement to complete the work. This work was supported by a research grant from the Nature Conservation Research Committee of CSIR's Ecosystem Programmes.

ABSTRACT

Red data sheets are provided for 50 fish species from the continental waters of South Africa and South West Africa/Namibia. The species are arranged in four groups: endemic freshwater species, endemic estuarine species, marginal freshwater species and marginal estuarine species. Within these groups the species are listed alphabetically according to the established IUCN categories of endangered, vulnerable or rare. The red data sheets include a line drawing of each species as well as maps indicating the known distribution range of the species. Of the 24 endemic freshwater fishes seven are considered endangered, eight vulnerable and nine rare. Fifteen of these threatened fish occur in the Cape, five in the Transvaal, three in South West Africa/Namibia and one each in Natal (and Lesotho), and the Orange Free State (shared with the Transvaal, the Cape and Lesotho). In the endemic estuarine group there are three vulnerable species and five rare species, one of which is possibly safe. Two species are from the Cape, four from Natal and two from both the Cape and Natal. Twelve marginal freshwater species are listed, three vulnerable and nine rare. Two of these species are from South West Africa/Namibia, two from the Transvaal, four from Natal and four from both Natal and the Transvaal. In the marginal estuarine group there are six species, one endangered, two vulnerable and three rare. All these species occur in Natal.

SAMEVATTiNG

Rooidatavelle word voorsien van 50 vis spesies wat in die kontinentale waters van Suid-Afrika en Suidwes-Afrika/Namibia voorkom. Die spesies is in vier groepe verdeel: inheemse varswater spesies, inheemse getyrivier spesies, marginale varswater spesies en marginale getyrivier spesies. Die spesies binne elke groep is alfabeties gerangskik volgens die vasgestelde IUCN spesies kategorie van bedreig, kwesbaar en seldsaam asook die wat miskien buite gevaar of twyfelagtig is. Lyn tekeninge sowel as 'n kaart wat die bekende vespreiding van die spesies aandui word gegee. Van die 24 inheemse varswater spesies word sewe as in gevaar van uitsterwing, agt as kwesbaar en nege as seldsaam beskou. Vyftien spesies vanuit die groep kom in die Kaap Provinsie, vyf in Transvaal, drie in Suidwes-Afrika/Namibia en een elk in Natal (en Lesotho), en die Oranje Vrystaat (asook die Transvaal, Kaap en Lesotho) voor. In die inheemse getyrivier groep is daar drie kwesbare en vyf seldsame spesies. Die voortbestaan van een van die is moontlik verseker. Twee spesies is vanuit die Kaap Provinsie, vier vanuit Natal en twee elk vanuit die Kaap en Natal. Daar is twaalf marginale spesies, drie is kwesbaar en nege is seldsaam. Twee van die kom in Suidwes-Afrika voor, twee in die Transvaal, vier in Natal en vier elk in Natal en die Transvaal. In die marginale getyrivier groep is daar ses spesies. Een van die is bedreig, twee is kwesbaar en drie is seldsaam. Almal kom in Natal voor.

TABLE OF CONTENTS

INTRODUCTION

The International Biological Programme (IBP) Project Aqua in the late 1960's and early 1970's provided the first national focus on threatened systems and threatened aquatic species in South Africa. Before this time particular cases were exposed through the systematic literature. Noble (1974) summarized the results of Project Aqua and included a list of threatened species and made recommendations on refuges for rare and endangered fishes. The principle threats to these species were given as pollution and the deterioration and destruction of their natural habitats, with certain species being threatened by competing or predatory introduced alien fish species.

In March 1977 the National Programme for Environmental Sciences (now National Programme for Ecosystem Research (NPER)) of the CSIR organized a workshop to discuss threatened animals in South Africa. This resulted in the first series of Red Data Books, including that on fishes by Skelton (1977). The publication of the South African Red Data Book - Fishes coincided with the revised volume of the IUCN Red Data Book on Fishes by Miller (1977). These publications focused much attention on threatened fish species and stimulated research and conservation programmes by various authorities. As a result a great deal of new information has been generated on threatened fishes in South Africa and South West Africa/Namibia. The present revision attempts to update the list and synthesize the available information.

Assessments of the status of threatened species in this revision were made by considering the opinions of people with first hand information of populations of the candidate species. This was done by means of a Questionnaire that was followed up where necessary with specific correspondence. Visits to various areas were made in order to discuss threatened fishes with individuals and to obtain a first hand assessment of the situation. In addition information from museum collections and published literature has been considered in compiling the data sheets. In several cases correspondees submitted preliminary data sheets that formed the basis of the final sheets presented here.

The present work has attempted to cover as wide a spectrum of the fish fauna of southern Africa as possible so as to include not only freshwater fishes but also marine and estuarine species. The consensus of opinion on marine species was that the available data is not sufficient to specify a conservation status for any species. Correspondees made the point that even though several marine species have declined in numbers and are "threatened" in commercial terms (see eg Wallace and van der Elst 1983) they still are not necessarily threatened in terms of total extinction.

It is a different matter in the case of estuarine fishes inhabiting the estuaries and coastal lagoons of South Africa. There has been a major research input into these environments from the mid 1970's through institutes such as Oceanographic Research Institute (ORI), the Estuarine and Coastal Research Unit (ECRU) in Stellenbosch, Port Elizabeth Museum and the zoology departments of the coastal universities. A much clearer understanding (albeit still far from complete) of the occurrence, abundance and distribution of many estuarine fish species is now available. Several species have been listed here as a result of this information and it seems likely that more will be added to the list as our knowledge improves. Some species listed in Skelton (1977) are excluded from the

present work. Changes to the status of other species have been made either because of actual improvements to their conservation status or because new information allows a more accurate assessment of their status.

Several changes have been made to the presentation of the species accounts and format of the data sheets. The species have been grouped into four categories according to whether they are endemic or not to South Africa, South West Africa/Namibia and certain other states within the region shaded in Figure 1, and secondly whether they are primary freshwater or estuarine forms. The definition of these categories is given in the following section. Whilst it is true that all threatened populations of a species deserve conservation attention, the need to conserve the endemic fauna of South Africa and South West Africa/Namibia is a higher priority in the local context.

The data sheets have also, been rearranged to make the information easier to find. An illustration of the species is presented and a general distribution map provided. If certain information is not available it has been left out, or in certain cases, mentioned as not available in order to draw attention to the point.

There has been considerable progress in the study of threatened fishes in southern Africa. The publication of the Red Data Book was probably an important stimulus in this process. This revised assessment of the threatened fishes of South Africa and South West Africa/Namibia will continue to focus some attention on these organisms and their conservation. Hopefully this will have the same effect as the first issue - promoting an awareness of the threats facing fishes in southern African waters, stimulating research into the life histories of threatened species and the places where they live, amelioration of' the threats and the conservation of their environments.

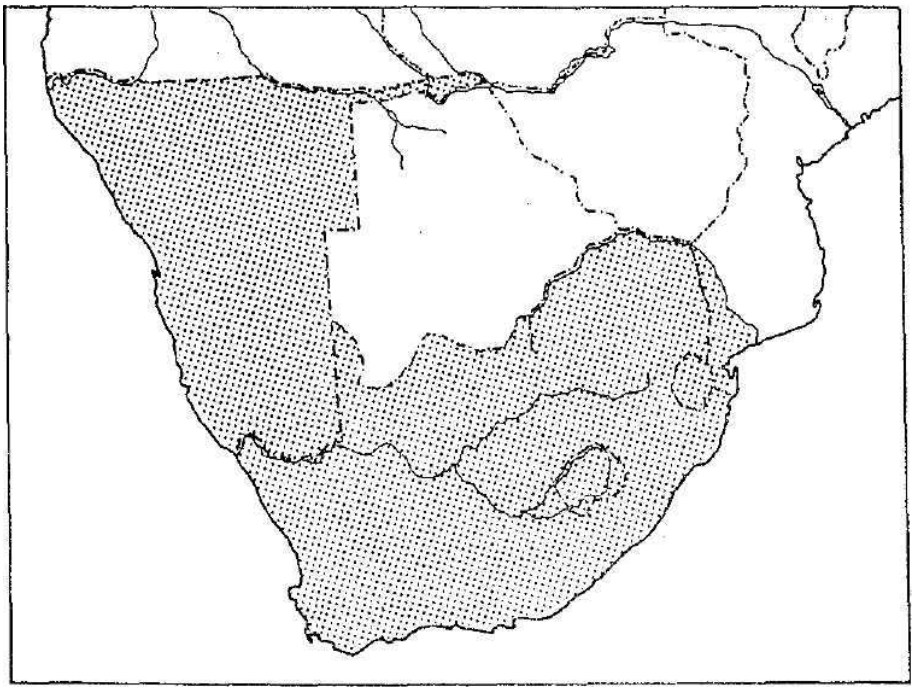


FIGURE 1. Southern Africa with the geopolitical area for fisl species included in this red data list indicated by shading.

DEFINITIONS AND CATEGORIES

The Red Data sheets are presented in alphabetical order within the categories Endangered, Vulnerable, and Rare for each of the following groups: 1) endemic freshwater fishes, 2) endemic estuarine fishes, 3) nonendemic or marginal freshwater fishes, and 4) nonendemic or marginal estuarine fishes. Family classification follows Nelson (1984). Common names follow Jackson (1975), Skelton et al (1980) and Smith and Heemstra (1986) with additions and amendments in the case of fishes subsequently described or added to their checklists.

The conservation categories used here are defined as follows in agreement with well-established IUCN usage:

ENDANGERED: Species in danger of extinction and whose survival is unlikely if the causal factors continue operating. -" Included are species whose numbers have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to be in immediate danger of extinction.

VULNERABLE: Species believed likely to move into the Endangered category in the near future if the causal factors continue operating. Included are species of which all or most of the populations are decreasing because of overexploitation, extensive destruction of habitat or other environmental disturbance, species with populations which have been seriously depleted and whose ultimate security is not yet assured, and species with populations that are still abundant but are under threat from serious adverse factors throughout their range.

RARE: Species with small or restricted populations which are not at present endangered or vulnerable but which are at risk. These species are usually localized within restricted geographical areas or habitats, or are thinly scattered over a more extensive range. These may be species which are seldom recorded but may be more common than supposed although there is evidence that their numbers are low.

SAFE: Species formerly included in one of the threatened categories and which are now considered to be relatively secure because effective conservation measures have been taken, or the previous threat to their survival has been removed, or new information is available to show that the species is not threatened.

INDETERMINATE: Species that are suspected of being threatened but for which insufficient information is currently available.

TERMINOLOGY

The term 'threatened[1] is used in this sense: the status of a species or population of a species which has deteriorated through natural or unnatural causes to the point where it may be considered as rare, vulnerable or endangered.

Skelton (1977) used the term "exotic" in the sense of belonging to or coming from another place. Current usage favours the term "alien" in place of "exotic" and alien has therefore been adopted in this work. Other possibly ambiguous terms which may confuse the nonspecialist reader

are defined here as follows (after Siegfried and Davies 1982):

Community: interacting populations of different species in a common location.

Endemic: native, restricted or found naturally only in a particular locality or distribution range.

Environment: all of the physical, chemical and biological factors impinging on a living organism.

Estuary: (after Begg 1978) that portion of a river system where it enters the sea and which is more or less openly connected to the sea (see also lagoon).

Habitat: the place where an organism naturally and normally lives.

Indigenous: occurs naturally in a particular locality or area.

Lagoon: (after Begg 1978) the termination of a river system which is generally closed to the sea.

Marginal: near the outer limits of a species' natural distribution range.

Population: a self-sustaining group of individuals of a species which occupies a distinct portion of the range of the species. In this work it generally applies to discrete geographical groups separated physically from other such groups as, for example, in independent river systems.

RED DATA SHEET ORGANIZATION

The Red Data sheets are arranged in five sections: 1) an introduction and heading, 2) a summary of the status and research, 3) species data, 4) conservation, and 5) references.

The introduction and headings include the English and Afrikaans common names, the conservation status, the scientific name, author and date, and the family to which the species belongs (after Nelson 1984).

The summary gives a brief synopsis of a) the conservation status and b) research - which is a subjective assessment on a scale poor-fair-good-excellent of the level of research which has been done on the species, its distribution and occurrence or its habitat and ecology.

The following headings are considered under the species section:

Identification - a brief sketch of the main external characteristics of the animal. This is supported by a scientifically accurate line illustration of a specimen.

Distribution - described in appropriate detail depending on the case on hand and available information. A distribution map is provided for each data sheet.

Habitat and ecology - a brief description of the habitat and ecology of the species based on the literature.

Breeding biology - a brief description of what is known in this regard.

Remarks - any remarks which pertain to the taxonomy or biology of the species are given here.

The conservation section deals with the following headings :

Threats - gives a synopsis of the known or perceived threats causing the decline of the species.

Conservation attention given - gives a brief summary of the steps that have been taken to protect or improve the conservation status of the species.

Conservation recommendations - presents suggestions for the conservation of the species.

Under the reference section the particular references used to compile the data sheet are given. This includes both published literature and unpublished sources. Correspondees contributing to the data sheet are named. The addresses of all correspondees are given in the Appendix.

SYNTHESIS OF THREATENED FISHES IN SOUTH AFRICA AND SOUTH WEST AFRICA/NAMIBIA

CHANGES TO THE LIST OF THREATENED SPECIES

In the first Red Data Book - Fishes in South Africa and South West Africa/ Namibia Skelton (1977) listed a total of 28 species. In the present work there are 50 species, an increase of 78,6%. This percentage is even greater if the two species that have been removed from the 1977 list are taken into account. A comparison of the numbers of species in each category for the two lists is given in Table 1. This comparison provides an indication of progress in the knowledge of threatened fishes since 1977.

TABLE 1. *Changes to the list of threatened fishes in South Africa and South West Africa/Namibia since 1977*

Category	1977	1986	Removed	Added
I Endemic freshwater				
Endangered	5	7	2	4
Vulnerable	1	7	-	6
Rare	12	10	5	3
II Endemic estuarine				
Endangered	-	-	-	-
Vulnerable	1	3	-	2
Rare	2	5	-	3
III Marginal freshwater				
Endangered	1	-	1	-
Vulnerable	2	2	2	2
Rare	3	10	2	7
IV Marginal estuarine				
Endangered	-	1	1	1
Vulnerable	-	2	-	2
Rare	1	3	-	2

Two endemic freshwater species have been removed from the list. These species are *Barbus afer* (the eastern Cape redfin}, and *B asper* (the smallscaled redfin). One of the reasons for the reassessment of the status of *B afer* is that the species is now known to be much more widespread following a taxonomic revision by Skelton (in preparation). Distribution surveys indicate that although the species is depleted or threatened in several systems (Jubb 1959) it is nonetheless reasonably common in many different river systems. *Barbus asper* was also revised and found to be more restricted in distribution than previously thought (Skelton 1980, in preparation). However* the habitat preference of the species includes larger pools and impoundments of the mainstream and larger tributaries of two large river systems the Gourits and the Gamtoos. It is tolerant of turbid and lentic waters and is found in certain impoundments such as the Kamanassie Dam and the Gamka Dam in the Gourits system.

It appears to be well adapted to a harsh environment and is also sufficiently widespread to be considered reasonably safe at present. Further monitoring of the status of *Barbus asper* is desirable in view of the extensive impact by man on the rivers of the southern Cape and the danger from introduced predator species such as bass *(Micropterus* species) which are in both the Gamtoos and Gourits River systems.

The status of several species has improved since the 1977 assessment. Positive conservation programmes were carried out by the authorities in the Kruger National Park for the two annual killifish *Nothobranchius orthonotus* and *N rachovii,* the lungfish *Protopterus annectens brieni,* the lowveld largemouth *Serranochromis meridianus* and the orange-fringed largemouth *Chetia brevis.* These programmes have been largely successful and the mentioned species are considered reasonably safe from the conservation point of view. After research into the status of *B trevrensis* Kleynhans (1982, 1984) recommended that its status be regraded as vulnerable and no longer endangered. The status of *B trevelyani* has also been given as vulnerable and not endangered on account of the success attained in artificial breeding reported by Bok and Heard (1982) and Cambray (1985a) as well as indications that there has been a strong recovery of populations in certain rivers following a decline of trout populations (Jackson 1982).

The status of two endemic freshwater species listed in 1977 has been given a more serious rating in accordance with the results of research surveys. These are *B burgi* which is changed from rare to endangered and *Chiloglanis bifurcus* which changes from rare to vulnerable.

A total of 24 species has been added to the threatened list in this volume. The seven species added to the endemic freshwater category are *Labeo seeberi, Barbus andrewi, B serra, Austroglanis barnardi, A sclateri, Nothobranchius* species, *Tilapia guinasana* and *Sandelia bainsii.* Two of these species are new to the fauna since 1977 *(A barnardi* and *Nothobranchius* species) and are included on the list because of their extremely restricted distributions under threatened conditions. Four of the species *(L seeberi, B andrewi$_t$ B serra and S bainsii)* are Cape endemics with restricted natural distributions that have declined seriously in recent years for various reasons. *Tilapia guinasana* is found only in two sinkhole lakes in South West Africa/ Namibia and the populations are threatened by the irresponsible introductions of alien fish species.

The five species added to the endemic estuarine group include *Syngnathus watermayeri, Taenioides jacksoni, Hypseleotris dayi$_t$ Myxus capensis* and *Redigobius dewaali** The freshwater mullet *(M capensis)* has a diadromous life cycle and has declined rapidly in the wild over the past few decades on account of the increasing construction of minor and major barriers in the form of weirs and dams on rivers (Bruton et al in press). The species has been the subject of extensive study by Dr A H Bok of the Cape Department of Nature and Environmental Conservation (CDNEC) and, while not in any immediate danger of extinction, is likely to continue to decline unless large scale conservation steps are taken in its favour. Other estuarine species have been added as a result of major studies on the estuaries of Natal and the Cape providing more accurate information on the status and distribution of the fish fauna. For many of these species our knowledge is still inadequate and it is likely that others will be added in future.

There are six species new to the marginal freshwater category: *Protopterus annectens brieni, Clarias theodorae, Clariallabes platyprosopos, Ctenopoma ctenotis, Afromastacembelus vanderwaali* and *Opsaridium zambezense.* These species are considered separately for South Africa and South West Africa/Namibia. Thus certain species such as *Opsaridium zambezense, Clarias theodorae* and *Ctenopoma ctenotis* occur in South West Africa/Namibia and reach the limit of distribution in South Africa. Their status is evaluated in terms of South Africa only. Other species such as *Clariallabes platyprosopos* and *Afromastacembelus vanderwaali* reach the limit of their distribution in South West Africa/Namibia (or Botswana) and, as far as is known, do not occur in South Africa. They are considered only with respect to their presence in South West Africa/Namibia.

Six marginal estuarine species are also new to the list: *Favonigobius melanobranchius, F reichei, Redigobius bikolanus, Butis butis, Eleotris melanosoma, Glossogobius biocellatus.* There are probably other species which could be included in this category but for which our present knowledge is inadequate. In addition to species added on the recommendation of Bruton and Kok (1980) others in this group were suggested by Dr G W Begg who has conducted an extensive study of the estuaries of Natal. The forms included are generally benthic fishes which were particularly suited to Dr Begg's sampling methods.

There are no marine species included on the threatened list at this stage even though several species are often considered "rare" or "threatened" by the angling or commercial fraternities (Wallace and van der Elst 1983). The reason for this absence is that "rare" or "threatened" in commercial or angling terms is not the same as rare or threatened in terms of actual extinction. Scientists approached during the course of this work made no firm suggestions for any marine species to be included. The status of one notable species, the coelacanth *Latimeria chalumnae* Smith, is, however, being investigated at present (M N Bruton personal communication) and may well be included on the South African Red Data list in future.

An important question when considering the changes made to the list of threatened species is - to what extent are the changes due to improved information or to actual changes in the status of the species? This is always an extremely difficult question to answer and does of course depend on the particular circumstances of each case. In general it is probably fair to say that the changes to the present list are due mainly to an increase in our knowledge of each case more than actual decline or improvement of the fish populations themselves. There are some exceptions to this eg the two *Nothobranchius* species found in the Kruger National Park which have been translocated successfully to new locales.

DISTRIBUTION OF THREATENED SPECIES

The distribution of threatened endemic freshwater fishes is shown in Table 2. There is a major concentration of threatened species in the south and south-west Cape, particularly in the Olifants River system. Two species occur in the eastern Cape, one in Lesotho and four in the eastern Transvaal. The three South West African species all occur in the far north of that territory.

Threatened endemic estuarine fishes are all from the east coast, one each from the south and eastern Cape, two from Natal and a further two with a

known distribution from the south Cape to the north-eastern part of Natal. All the marginal estuarine species are from the east coastal region of the Transkei and Natal,

TABLE 2. The distribution of threatened fishes in South Africa and South West Africa/Namibia including the national states, Lesotho, Swaziland and Mocambique south of the Limpopo River.
Group 1 - endemic freshwater fishes, Group 2 - endemic estuarine fishes, Group 3 - marginal freshwater fishes, Group 4 - marginal estuarine fishes. E - Endangered, V - Vulnerable, R - Rare

Group	1			2			3			4		
Status / Region	E	V	R	E	V	R	E	V	R	E	V	R
SW Cape	3	3	6			1						
Southern Cape			1			3						
Eastern Cape		2			1	1						
Northern Cape/OFS			2									
Natal	1		1		1	5		1	6	1	2	3
Transvaal		2	2					1	6			
Lesotho	1		1									
Swaziland			1			2						
S Mocambique			2			4?			7	1?	2?	3?
South West Africa		3				2						2*

*excludes the following species that are considered rare in South Africa: *Brycinus lateralis, Clarias theodorae, Ctenopoma ctenotis and Opsaridium zambezense*

Threatened marginal freshwater species occur mainly in Natal and the eastern Transvaal with two rare species in the Zambezi and Okavango Rivers in South West Africa/Namibia.

An understanding of the underlying reasons for the above distribution of threatened species is important if effective conservation steps are to be taken to counter the decline of any one or more of these species. Two main areas of distribution of threatened species are evident - the south and south-west Cape for endemic freshwater forms and Natal and the eastern Transvaal for the majority of the marginal freshwater and estuarine species. Clearly most species are rare partly because they have a limited natural range in the areas covered in Figure 1.

In the case of freshwater species, the south-west Cape is a centre for a distinct "Cape" component of the ichthyofauna of the subcontinent (Skelton 1983, 1986a). The eastern Transvaal and north-eastern Natal areas are marginal zones for, on the one hand the northern limits of the temperate fauna and, on the other hand the south-east limits of the "tropical" fauna. These subdivisions of the ichthyofauna conform in many respects to similar divisions of other vertebrate and invertebrate faunal groups (eg Stuckenberg 1969; Poynton and Broadley 1978; Bruton and Haacke 1980; Skelton 1983). The southern limits of distribution of the tropical Indo-Pacific marine ichthyofauna also tapers out down the east coast of southern Africa (Smith and Heemstra 1986). There is also a smaller

southern fauna that extends up the coast to reach its northern limits in the Natal-southern Mocambique area where prevailing tropical conditions are occlusive.

Because the marginal areas are those where less than optimal conditions exist for the species the populations may be more sensitive to environmental perturbations. There have been large-scale changes in the conditions of rivers and estuaries over the past few decades especially in the Transvaal and Natal. This has been brought about mainly by the development of intensive agriculture and grazing as well as dam construction and other industrial, mining and urban developments in these areas.

A different situation underlies the concentration of threatened endemic freshwater fishes in the south-west Cape. Here the ichthyofauna exhibits the typical characteristics of old, well established mountain faunas viz a high degree of endemicity, isolated and geographically restricted ranges, relatively inflexible life history styles and a low resilience to disturbance. The low pH, oligotrophic character of the Cape Fold Mountain streams and rivers (King et al 1979) is probably also a factor in the sensitivity of the faunal communities to induced perturbations (Li and Moyle 1981). The indigenous fish species have proved to be extremely susceptible to introduced alien predators especially *Micropterus dolomieu* and *M salmoides* (Skelton 1986b).

Europeans have occupied the south-west Cape for longer than any other part of South Africa. Agricultural land and water resources are at a premium in the mountain areas because much of the area contains leached, nutrient poor soils (Lambrechts 1979) and dry summers are characteristic of the climate (Fuggle and Ashton 1979). Many of the streams are tapped off completely at the earliest opportunity and are therefore no longer permanently linked to the larger tributaries or mainstreams. This diversion of feeder tributaries has an impact on the mainstreams whose flow regimes have changed over the years from one of permanence to intermittent and irregular flow. The need for large storage impoundments has increased and dams and weirs are a characteristic feature of all the larger rivers of the fold belt. In consequence of these developments the fish populations have been increasingly isolated and restricted, making them even more susceptible to predation from introduced aliens. The effects of invasive aquatic organisms on aquatic ecosystems in southern Africa have been discussed in depth by Bruton and van As (1986). The larger cyprinid species of the south-west Cape generally migrate upstream for spawning and the erection of weirs and dams have disrupted the natural course of such movements.

The few threatened species in South West Africa/Namibia are naturally rare or restricted in distribution and consequently susceptible to interference or habitat destruction eg *Tilapia guinasana* which is found in only two sinkhole locales. The two rare marginal species listed from South West Africa/Namibia are habitat specialists (favouring rocky rapids), a rare habitat type for the generally sandy terrains of the north and north-east parts of the territory.

THREATS

The IUCN World Conservation Strategy (1980) recognizes six broad categories of threats to the survival of vertebrate species. These are habitat destruction or degradation, overexploitation, impacts of introduced

species, loss or contamination of food supply, killing to protect crops livestock or prey, and incidental capture or destruction. Of the IUCN categories three apply to threatened fishes in southern Africa viz habitat destruction, exploitation and impacts of introduced species. These categories cover a wide range of more specific threats which need further elaboration and explanation.

Under habitat destruction, threats can be grouped into three classes, physical, chemical and biological. The three are often interdependent. Physical destruction can mean direct damage through actions such as bull-dozing a riverbed, canalization, damage during construction of dams or bridges. Such damage is often restricted and temporary in nature and does not necessarily constitute a long-term threat to the viability of a population unless the system itself is irreversibly damaged or altered. Many species are well adapted to withstand temporary destruction of their habitat because many aquatic ecosystems such as rivers are naturally subject to unpredictable perturbations. Physically destructive phenomena like drought and flooding are events that can be as devastating on the environment as most short-term man-made actions. Cambray and Stuart (1985) documented the effect of natural flood damage to *Barbus burchelli* habitats in 1981 and report that within three years completely devastated stretches were being recolonized by the species. Of course many man-made destructive actions on the environment are intended for long-term duration eg the draining of wetlands, canalization of stream beds, and dam construction.

One of the most obvious large-scale man-made changes that has occurred on the rivers of southern Africa is the construction of dams and weirs to form standing water bodies of various sizes where flowing water channels previously existed. All the major rivers in South Africa have been harnessed by dam construction at a high rate over the past 80 years or so (Allanson and Rabie 1983; Davies and Day 1986). Gaigher et al (1980) out-line some of the implications which dams and weirs have for the conserva-tion of fishes. Impounded waters are invariably a mixed blessing as far as most river fish communities are concerned. There are always those species that flourish in the new environments but other species depend more on flowing waters and a free passage along the river. River regula-tion also favours certain species and not others, eg in the Orange River it appears that the regulated river has been beneficial to *Barbus hospes* and other strong swimming forms like *Labeo capensis* but the new conditions possibly do not favour *L umbratus* and some small *Barbus* species (Cambray 1984).

Water extraction from rivers is one of the main threats to the aquatic habitats in southern Africa (Davies and Day 1986). The larger industrial or irrigation schemes may not have the greatest impact in this regard because they usually draw the water from large impoundments or systems. Individual land owners drawing from smaller streams can, however, easily exhaust the systems in times of drought. In many cases such systems would be generally sustained in the form of small but deep pools where the fishes find refuge. The means of extracting water from a small stream can have a large impact on the stream itself. A common practice in the Cape Fold Mountains is for a diversion weir to be built and from this a lead-off furrow to a reservoir. The stream below the weir is frequently completely drained.

Indirect impacts on the environment are often less dramatic in the short terra but of greater consequence in the long term. Afforestation of

mountain catchments for example can reduce stream flow by affecting the natural hydrological cycle (Pitman 1978; Bosch 1979; Whitlow 1983). In southern Africa mountain catchment areas occupy 12% of the area but supply 53% of the runoff (van der Zel 1981). The water quality from these mountain catchment areas is usually high (Le Roux 1981) but because much of the area is under alien forests the amount of runoff is appreciably reduced (Allanson and Rabie 1983).

Sedimentation is a major threat to South African rivers and estuaries (Begg 1978, 1984a; Allanson and Rabie 1983). It sometimes occurs as a dramatic short-term phenomenon as for example with the February 1981 Laingsburg floods on the Gourits River (although the underlying cause was centuries of veld mismanagement in the catchment area) or in the silt flood of the Olifants River (Limpopo system) in January 1983 (Cheney 1983). In Natal the observed present rate of suspended sediment transport is more than 28 times the geologically normal rate (Murgatroyd 1979). Choked riverbeds are frequently too shallow for fishes (Crass 1969; Chutter 1973) but impact on fish populations usually occurs long before the river becomes too shallow for the fishes themselves. Many cyprinid fishes spawn in rocky runs and sedimentation of such habitats can smother eggs and larvae as well as eliminating benthic food sources. Not all species have larval adaptations such as that described for *Labeo capensis* by Cambray (1985b) which may function partly to counter sedimentation.

Bruton (1985) reviewed the effects of suspensoids on fishes and noted that although moderate suspensoid loads are a natural feature of many inland waters, sustained high levels have deleterious consequences on most species. Chutter (1969) concluded that increased or heavy silt and sand loads can effect considerable changes on the invertebrate communities of rivers. Sedimentation in estuaries is a natural process to which most estuarine organisms are well adjusted (Day and Grindley 1981a; Cyrus 1983), Deleterious effects do, however, result when the sedimentation process is abnormally rapid or heavy and this is the case for many South African estuaries over the past few decades (Begg 1978, 1984a,b).

Habitat destruction through chemical means constitutes major world-wide threats to the survival of aquatic animals. Water pollution is a serious problem to aquatic systems around the larger urban and industrial centres in South Africa. Such centres are still relatively restricted but gold and coal mining operations are extensive in some areas and these are sources of pollution, especially acidification (Harrison 1958; Kemp 1967). The majority of local cases of toxic pollution (eg from cattle dips, insecticide spraying) are probaly never reported. Although some populations of threatened fish species are or have been threatened by pollution (eg Brooks and Gardiner 1980) this alone does not appear to be a major threat to any species on the list. Insecticides and pesticides also are not a major factor although populations of fishes that are contaminated have been reported (eg Blaber et al 1984). A survey of pesticides in rivers of the Kruger National Park by van Dyk (1978) indicated that pesticides did not pose a serious threat to wildlife in the Park.

Eutrophication and mineralization of water resources are other environmental problems on the increase in South Africa (Allanson and Rabie 1983; Davies and Day 1986). Apart from local exceptions these are not major in the areas where threatened fishes are concentrated. The increasing degree of mineralization of the lower reaches of the Great Berg River in the south-west Cape might limit the distribution of the threatened large

cyprinid species *Barbus andrewi.*

Acidification of natural waters either from atmospheric precipitation or from mining activities forms a growing threat to the aquatic fauna of industrialized nations. Acidification of rivers from mining operations in South Africa constitutes a serious pollution problem in the gold and coal field areas of the country (eg Harrison 1958; Kemp 1967). Very little has so far been published on the quality of rainwater in South Africa (D F Toerien personal communication) but with the high concentration of coal burning power stations and mines with smouldering waste heaps in the south-east Transvaal acid rain can be expected. This could affect water acidity in the escarpment areas where several rare and threatened species occur. Increasing industrialization of other sensitive areas such as north-eastern Natal and the south-west Cape suggests that similar acidification may be a more insidious problem for threatened species than is presently realized. Problems with atmospheric pollution and acid rain are now being addressed by the CSIR (Anonymous 1984).

A variety of biological threats to the survival of indigenous fishes exist. Aquatic plant invaders such as the water hyacinth *(Eichhornia crassipes)* or Kariba weed *(Salvinia molesta)* are well known for their adverse ecological effects (Stirton 1978). There are established stands of such aquatic invasives in both the south-west Cape rivers (Stirton 1978) as well as the waters of Natal, the southern and the eastern Transvaal (Botanical Research Institute 1980). It is not known to what extent such aquatic invasives have actually affected the indigenous fish fauna.

In the fynbos areas of the Cape many river courses are lined with dense thickets of black wattle *(Acacia mearnsii)* and long-leaved wattle *(Acacia longifolia)* (Stirton 1978), Such river stretches appear to be relatively sterile, possibly as a result of the rich tannins associated with these plants polluting the water. At certain times of the year the pollen and leaf litter from these trees form dense carpets which may adversely affect the benthic fauna. Depending on the region, commercial stands of pine, wattle and gum trees *(Eucalyptus)* cover from 3,5% to as much as 71,3% of the mountain catchment areas of South Africa (Le Roux 1981). Apart from studies on the effect of afforestation on stream runoff no work has been done on the ecological affects of alien forests on the indigenous fish fauna. McDowall (1977) found that materials leaching from the *Eucalyptus* forests of Tasmania and south-eastern Australia have no serious effects on the fishes.

Bruton and Merron (1985) list the known alien and translocated aquatic animals in South Africa. The list includes 93 species of animals, 68,8% of which are fishes. The authors consider several deleterious effects which invasives may have on indigenous aquatic communities including habitat alterations, vegetation removal, water quality reduction, introduction of parasites and diseases, trophic alterations, hybridization, and elimination of indigenous species. Introduced predatory fish species like the basses *(Micropterus dolomieu* and *M salmoides)* and trouts *(Parasalmo mykiss* and *Salmo trutta)* are implicated to some extent as a threat in up to 60% of the threatened endemic freshwater fishes in South Africa (Bruton and van As 1986).

The impact from alien predatory fishes has been most severe in the south-west Cape (Skelton 1986b), The rivers of the Cape Fold Mountains are usually naturally acidic, very clear, cool and poorly mineralized (King et

al 1979). The systems are generally oligotrophic, the fish communities small and the food chains short and therefore easily disrupted (Gaigher et al 1980). There is evidence that the fishes have existed and evolved in relative isolation over a long time period (Skelton 1980, 1986a). This is similar to other long isolated faunas such as in New Zealand where the species have a low competitive ability and have consequently been grossly depleted by introduced alien predator fishes (McDowall 1968). The situation in the Cape supports the findings of Li and Moyle (1981) that nutrient poor systems are sensitive and unstable to the impact of alien species.

Bruton (1986) has evaluated the potential success of invasive fishes using the concept of ecological potential. "Ecological potential" may be defined as the ability of a species to successfully exploit a particular environment. Invasive fishes may be divided into two categories: those which thrive in disturbed environments where they are able to cope with adverse environmental conditions (eg carp, bluegill sunfish, bass); and those which out-compete indigenous species in relatively unperturbed environments (eg trout, mosquitofish, guppy or swordtails). Both groups of invasive fishes threaten indigenous species, especially when they act together in different parts of the same river system. It is emphasized that indigenous species will mainly be threatened by invasives when the environment is stressed by various factors eg environmental degradation, the downstream effects of impoundments. Some alien fishes have invaded inland waters in many parts of the world because of their adaptability eg *Parasalmo mykiss, Carassius auratus, Cyprinus carpio, Gambusia affinis, Poecilia reticulata.*

From the general situation in South Africa it seems that the greatest impact results when a successful invasive predator is introduced into communities with a low species saturation and a high degree of isolation. Thus the impact of bass *(Micropterus* species) appears to be more severe in the Cape than in the other areas such as Natal and the Transvaal. The indigenous fish communities of Natal and the Transvaal are more complex and have been less isolated than those of the south-west Cape.

The rapid development of aquaculture in southern Africa in recent years (Safriel and Bruton 1984) poses certain conservation problems at the same time (Gaigher 1983; Bourquin 1985). The main threat as far as indigenous species are concerned are the dangers of introducing alien species into natural systems. Not only can this result in predation and competition but there are the possibilities of simultaneously introducing diseases and parasites, or if the introduced species is closely related, of genetic contamination. Future developments in the field of genetic engineering may escalate such problems (Wilkens 1985),

Genetic contamination has not yet been exposed as a particular threat to the species on the Red Data list. This may be misleading because genetic aspects of fish species in South Africa have not been well studied. There has been considerable translocation of certain indigenous species within the subcontinent (Bruton and Merron 1985) and some degree of genetic contamination may have unknowingly resulted. Gaigher et al (1980) point to groups such as the large yellowfish *(Barbus* species) as species with demonstrable potential for interbreeding and hybridization and which have already been moved about for aquacultural or sport fishing purposes. Another example is the widespread translocation of small minnow species such as the chubbyhead barb *Barbus anoplus* for bait purposes in Natal

and the Cape (Crass in littera; Harrison 1952b). The rapid development of interbasin water transfer schemes as a means of translocation of indigenous fish species is of concern to conservation because the species and populations involved are frequently closely related and the potential for genetic contamination high (Bruton and Merron 1985; Laurenson and Hocutt 1985).

Several of the fishes on the Red Data list are small and attractive species, well suited for aquariums. For some of these species (eg the *Nothobranchius* species) the threat from exploitation for the aquarium trade is particularly serious because of their high trade-value and often accessible but restricted and easily damaged habitats. Several other fishes are, or may become, sought after by the aquarium trade (eg the anabantids *Ctenopoma* and *Sandelia,* and the redfin minnows) and these need to be guarded from the threat of over-exploitation. Although the collecting of wild stock for commercial purposes is a threat to rare species it is important to recognize that the commercial sector can play an extremely valuable conservation role through captive breeding programmes, and studies on the life history, habits and environmental requirements of threatened species.

CONSERVATION OF THREATENED FISHES

The conservation of threatened species is a complex issue with very few straightforward solutions to any single problem. Each threatened species has its own set of circumstances which calls for different solutions. It is generally recognized that the road to effective species conservation is through sound 'ecosystem' conservation (Siegfried and Davies 1982) but, as in the example of the white rhinoceros and certain other endangered mammal or bird species, threatened species sometimes demand urgent individual attention if they are to survive at all. Even if there is little or no room for a strategy aimed at the species level in South Africa (Hall 1984) the species themselves can be most useful indicators as to what are threatened ecosystems.

Although it is ironic that one should have to convince people that conservation of freshwater ecosystems is vital this is often the most important step to be taken for the conservation of threatened fish species. A land owner who is sympathetic to the cause of conserving a threatened species, no matter how spectacular or commercially viable the species may be, is essential for effective conservation. The land owner who is indifferent or unsympathetic to the conservation cause is himself a threat to the species. An ignorant land owner is likewise a potential threat because his care or management of the water resource on his land will be made without consideration to the interests of the species.

Thus one of the most important aspects of species conservation is for the conservation authorities to ensure that they themselves are not ignorant of the conservation needs of threatened species and then to educate not only the general public but specifically the public on whom the conservation action depends. It is encouraging to see that some steps to this end have been taken by certain conservation departments and two noteworthy examples can be mentioned. The first is the conservation programme for threatened fish species of the (Clanwilliam) Olifants River, especially the yellowfish *Barbus capensis,* instituted by the Cape Department of Nature and Environmental Conservation (see Scott 1982; Scott and Hamman 1984). This programme involves not only direct conservation steps being

taken such as the establishment of a fish breeding hatchery for the yellowfish (possibly the only one of its kind in the world set up for the conservation of a threatened species), but also an extensive educational programme through angling competitions and the distribution of educational literature . The second example is a programme on the conservation of the southern kneria *(Kneria auriculata)* in the Transvaal. Following research on the status of this species in the Transvaal by Kleynhans (1982, 1984) the Transvaal Nature Conservation Division has produced and distributed to relevant land owners a pamphlet outlining the plight of this species and making conservation recommendations.

Several practical conservation exercises have been carried out by the authorities in the Kruger National Park (Pienaar 1978a). Examples include the translocation to additional sites of *Nothobranchius orthonotus, N rachovii* and the lungfish *Protopterus annectens brienl.* These temporary pool or pan-dwelling species are particularly suited to such measures. It is not always possible to do this with riverine species whose introduction to other rivers might be contrary to the conservation of the receiving system. In fact the effective conservation of riverine and estuarine species is extremely difficult in that it may involve far reaching land management steps being taken throughout the catchment concerned. In spite of the obviously limited potential for reserves in the strict sense, for many fish species, reserves could be important for the conservation of a number of threatened species. Many threatened minnows for example survive in restricted tributary streams which may be isolated by waterfalls and have limited headwater catchments. These catchments are often under the land ownership of the Forestry Department or a single authority who may be prepared to manage the catchment as a reserve. Such situations do exist for a few threatened species in southern Africa (eg *Oreodaimon quathlambae* in the Sehlabathebe National Park in Lesotho, *Barbus treurensis* in a catchment owned by Mondi Timbers in the eastern Transvaal) but the concept should be developed for other threatened species, especially in mountain catchment areas. McDowall (1984) and Maitland (1985) show that this aspect is being given serious attention in New Zealand and the British Isles respectively.

Research is an essential component of any conservation exercise. Conservation authorities need to know what species are threatened, why they are threatened and what the priority requirements are for the effective conservation of those species. In the case of freshwater fishes it is essential that the conservation authorities carry out regular or at least semiregular surveys of the water bodies within their jurisdiction. Data banks are required at established institutions so that they are not dependent on particular individuals for continuity. This should be a reasonably simple thing to do given the present era of computerization. The kind of data bank which is needed is similar to the one established by the New Zealand Fisheries Research Division (McDowall and Richardson 1983).

Distribution surveys have been carried out by the Nature Conservation authorities in all the Provinces of South Africa at one or other time since 1950. In the Transvaal Kleynhans (1982, 1984) based and extended his investigation of threatened fish species on the distribution data established by Gaigher (1969). A series of surveys on tributaries of the Limpopo River system was initiated by Hecht and coworkers (Hecht and Mashego .1981; Hecht et al 1983; Hecht and Saayman 1981; Hecht and Scholtz 1983; Polling et al 1983). In the Cape an extensive baseline survey has been carried out over the period 1977 to 1983 (Gaigher et al 1980; Skelton

et al in preparation). This has provided valuable evaluations of conservation status, which are built into the present account. The Natal authorities are now looking into a survey of waters within that province after a period of more than 20 years since data was gathered for the book by Crass (1964), In addition considerable work on fish populations in certain parts of Natal has been carried out by university and institution-based research workers (eg Bruton and Kok 1980; Begg 1984a,b). Surveys done in the Orange Free State were summarized by Janse van Vuren (1978) but further attention is required to establish more precisely the distribution and status of fishes in that province.

Apart from establishing data bases for fishes (and other aquatic organisms), the nature conservation authorities need to formulate and publish conservation policies with regard to the aquatic environment (Skelton 1983). This need was clearly exposed in a controversial debate that ensued after the Cape Department of Nature and Environmental Conservation announced its intention to change the legislation protecting certain alien sport fishes (Skelton and Davies 1986). Unless the members of a department and the public at large are familiar with, and tuned to, the policies of the department there is likely to be confusion in both quarters. The public will be ill-informed and confused as to what is correct and desirable practice or what their legal standing may be. Employed conservationists need an operational framework in order to direct and apply their research and management programmes. Known policies also provide a template for public expectation, guidance and education.

SOUTH AFRICA AND SOUTH WEST AFRICA/NAMIBIA

Species	Status	Status 1977
GROUP 1: ENDEMIC FRESHWATER FISHES		
Barbus burgi	Endangered	Rare
Barbus phlegethon	Endangered	Endangered
Oreodaimon quathlambae	Endangered	Endangered
Austroglanis barnardi	Endangered	-
Clarias cavernicola	Endangered	Endangered
Tilapia guinasana	Endangered	-
Nothobranchius sp nov	Endangered	-
Barbus andrewi Barbus	Vulnerable	
erubescens Barbus	Vulnerable	Vulnerable
serra Barbus	Vulnerable	-
treurensis Barbus	Vulnerable	Endangered
trevelyani	Vulnerable	Endangered
Chiloglanis bifurcus	Vulnerable	Rare
Sandelia bainsii	Vulnerable	-
Astatotilapia brevis	Rare	Rare
Austroglanis gilli	Rare	Rare
Austroglanis sclateri	Rare (Indetenninate)	_
Barbus burchelli Barbus	Rare	Rare
capensis Barbus calidus	Rare	Rare
Barbus hospes Barbus	Rare	Rare
tenuis Labeo seeberi	Rare	Rare
Serranochromis meridianus	Rare	Rare
	Rare	-
GROUP 2: ENDEMIC ESTUARINE SPECIES		
Hippocampus capensis	Vulnerable	Vulnerable
Syngnathus watermayeri	Vulnerable (Indeterminate)	*Taenioides*
jacksoni	Vulnerable	
Croilia mossamhica	Rare (safe ?)	*Hypseleotris dayi*
Rare *Myxus capensis*	Rare	*Redigobius dewaali*
Rare *Silhouettea sibayi*	Rare	Rare
GROUP 3: MARGINAL FRESHWATER SPECIES		
Oreochromis placidus	Vulnerable	Endangered
Protopterus annectens	Vulnerable	
Afromastacembelus vandeiwaali	Rare	*Brycinus lateralis* Rare
Rare *Chiloglanis emarginatus*	Rare	Rare
Clarias theodorae	Rare	*Clariallabes platyprosopos* Rare
	Rare	Rare

Vulnerable

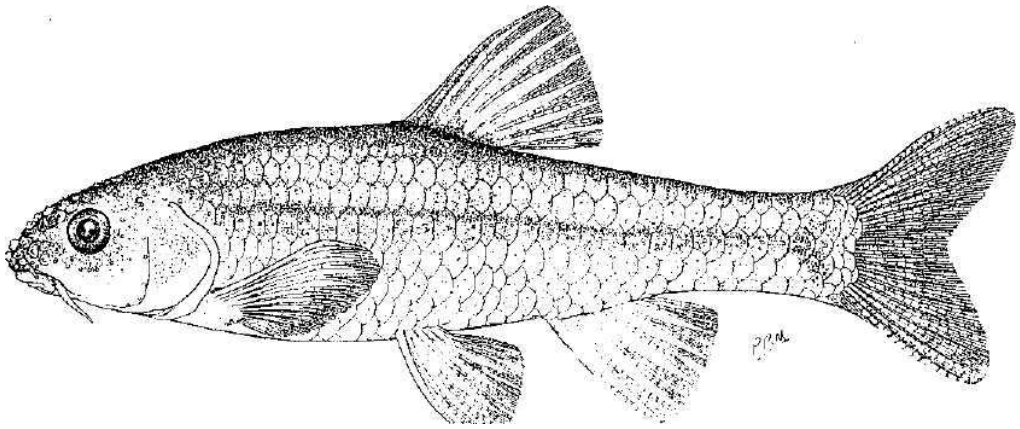
CIES

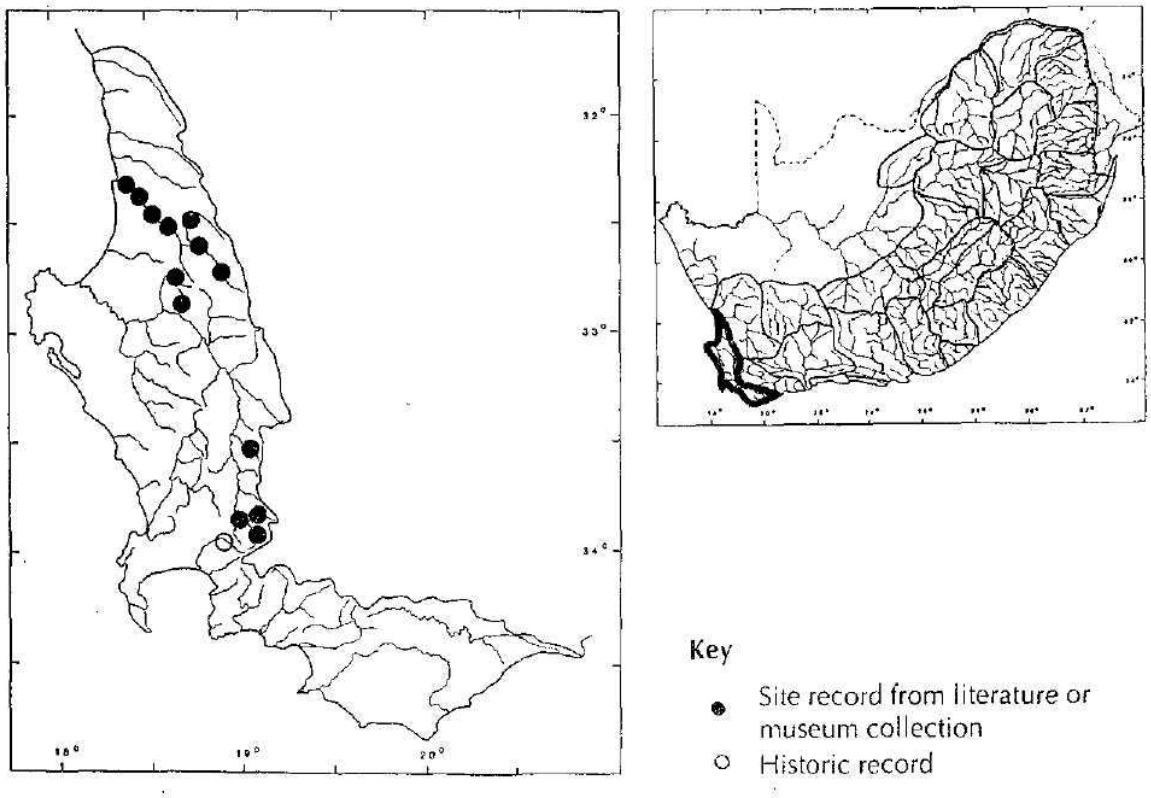
Species	Status	Status 1977
Ctenopoma ctenotis	Rare	
Kneria auriculata	Rare	Rare
Nothobranchius orthonotus	Rare	Vulnerable
Nothobranchius rachovii	Rare	Vulnerable
Opsaridium zambezense	Rare	
GROUP 4; MARGINAL ESTUARINE	SPECIES	
Favonigobius melanobranchus	Endangered	
Butis butis	Vulnerable	
Redigobius bikolanus	Vulnerable	
Eleotris melanosoma	Rare	Rare
Favonigobius reichei	Rare	
Glossogobius biocellatus	Rare.	

RED DATA SHEETS

BERG RIVER REDFIN / BERGRIVIER-ROOIVLERKIE

FIGURE 2. Berg River redfin, *Barbus burgi,* 80 mm SL, with distribution in south-west Cape region.





BERG RIVER REDFIN / BERGRIVXKR-ROOXVLERKIE **ENDANGERED**

Barbus burgi Boulenger 1911

FAMILY: Cyprinidae SUMMARY

Status: Endangered. This redfin minnow has been extirpated from a large part of its range and its continued existence is seriously threatened by increasing pressures on the environment.

Research: Fair. Several distribution and population status surveys of *B burgi* have been carried out in recent years (Gaiger et a! 1980; Skelton et al in preparation). No specific biological or ecological studies of the species are known.

SPECIES DATA

Identification: A moderate sized redfin minnow (maximum size 109 mm SL) with two pairs of barbels, the anterior pair only develops above 40 mm SL and is always short. Adults have bright red fins, and mature ripe males develop large conical tubercles on the head.

Distribution: Tributaries of Berg River and Verlorevlei River, south-west Cape. Previously recorded from the Eerste River but has not been collected from there since the 1930's and the population is probably extinct. The most recent surveys have shown that there are only a few small, isolated populations in the Berg River system. The species is comparatively widely distributed in the Verlorevlei River system.

Habitat and ecology: Occurs in variety of habitats from clear flowing mountain tributaries to quiet well vegetated lowland streams. The smaller mountain tributaries of the Berg River have clear flowing and cool water, the substrate of mainly rocks or pebbles and vegetation is limited to patches of marginal grasses (Cyperacea) and emergent macrophytes (a comprehensive description of this habitat is given by Harrison and Elsworth 1958; Harrison 1964). In the Verlorevlei River the habitat is more of a lowland river type with quiet, slowly flowing or standing turbid water in deep pools and channels with a muddy substratum and bordered with dense rush and reed beds.

Breeding biology: Not studied. Males develop conical nuptial tubercles during spring and summer months when breeding takes place. The species has been maintained successfully without breeding in aquaria. This species bred successfully in an earth dam at the Jonkershoek Fish Hatchery during the summer of 1985/6 and further work on the captive breeding of the species is being done by the CDNEC at Jonkershoek (K C D Hamman and S C Thome personal communication).

Remarks: The taxonomy of redfin species is being revised by Skelton (1980, in press).

CONSERVATION

Threats: *B burgi* is threatened by several factors. Introduced alien predators (especially black bass) *Microptervs* species, bluegill *Lepomis macrochirus* and trout *(Salmo* species) have been held responsible for the elimination of this minnow from much of its former range (Harrison 1952a; Skelton 1977; Gaigher et al 1980; Skelton et al in preparation). Industrial and agricultural pollution adversely affects large parts of the Berg, Eerste and Bree River systems. Other problem factors in these and other rivers in the range of this species are: regulation and mineralization, agricultural, industrial and domestic abstraction of water, channelization of streambeds and introduced alien aquatic and riparian plants (eg Harrison 1958; Fourie and Steer 1971; Fourie and Gorgens 1977; Stirton 1978).

Conservation attention given: Surveys to determine the distribution and status of populations have been made by the Cape Department of Nature and Environmental Conservation (CDNEC) (Gaigher et al 1980; Skelton et al in preparation). A revised conservation policy for inland waters was first applied by the Department in 1978 (I Gaigher personal communication; K C D Hamman personal communication; Gaigher et al 1980). This effectively shifted conservation effort from stocking of alien sport fishes to one of priority for indigenous fish conservation. A captive stock has been established at the Jonkershoek Fish Hatchery and breeding has occurred (K C D Hamman and S C Thome personal communication).

Conservation recommendations: In the case of the Berg River redfin specific action is necessary to avoid any further decline of the already very small populations. Suggested steps to be taken include: i) establish sanctuary streams for the species in tributaries of Berg River, ii) secure protection or a sanctuary for the Verlorevlei population, iii) study the reproductive biology and life history strategies and requirements of the species in order to optimize applied conservation efforts, iv) apply a captive breeding programme for restocking natural populations, v) riparian land owners and other authorities within the distributional range of the species should be informed about the conservation of the species.

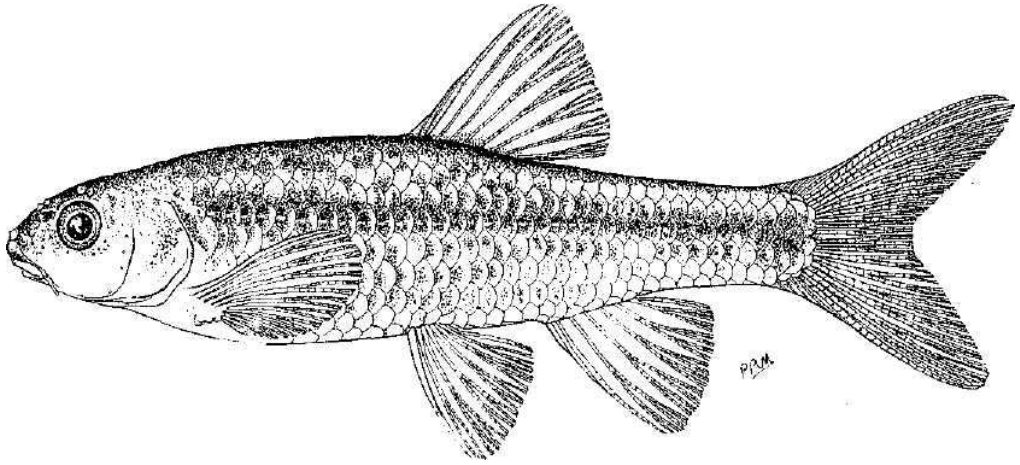
REFERENCES

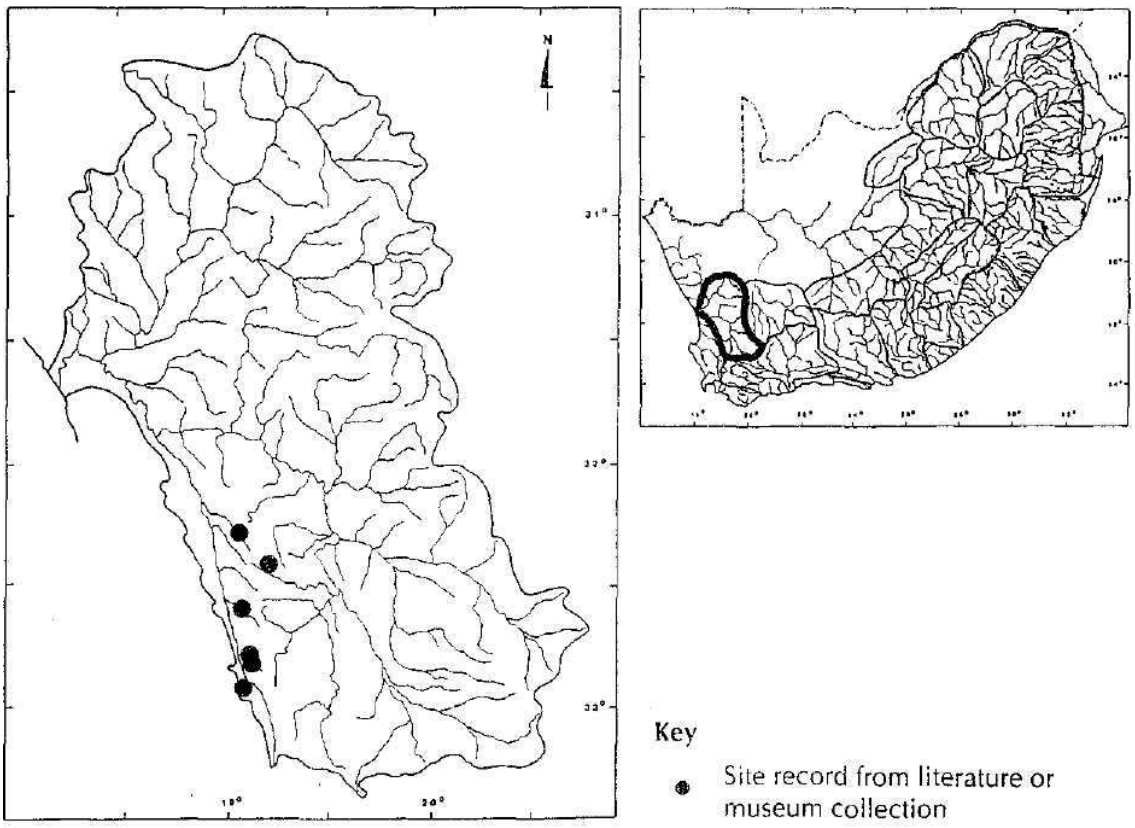
Barnard (1943); Fourie and Steer (1971); Fourie and Gorgens (1977); Gaigher et al (1980); Harrison (1958, 1964); Harrison and Elsworth (1958); Jubb (1965, 1967a); Noble (1974); Skelton (1977, 1980, in preparation); Skelton et al (in preparation); Stirton (1978),

Correspondence: Prof I G Gaigher; Dr K C D Hamman; S C Thome.

FIERY

FIGURE 3. Fiery redfin, *Barbus phlegethon,* 50 mm SL, with distribution in the Olifants River system, western Cape Province.





FIERY RED™ / VURIGE ROOIVLERKIE

Barbus phlegethon Barnard 1938

Family: Cyprinidae

SUMMARY

Status: Endangered. *Barbus phlegethon* has an extremely limited distribution range and the known populations are small and seriously threatened by several factors.

Research: Poor - fair. Surveys to determine the distribution and status of populations have been carried out but little is known of the species biology, life history or ecology.

SPECIES DATA

Identification: A small (maximum size 70 ram SL) attractive minnow species. The mouth is small and inferior and there is a single pair of very short barbels only. Adult specimens develop brilliant red fins and the body colour includes black blotches on a light brown to silvery-white background.

Distribution: This species is endemic to the Olifants River system. Known populations are confined to certain tributaries of the mainstream in the Clanwilliam Valley and a single tributary of the Doring River in the Cedarberg (CDNEC records; AMG records; Skelton 1980; Gaigher et al 1980). The most recent surveys indicate that the species is not present in some of the previously recorded locales (K C D Hamman and S C Thome personal communication).

Habitat and ecology: The known habitats of this species are clear and rocky or sandy bottomed streams. The population in the River has the highest relative abundance and the locale is optimal habitat. This stream consists mainly of runs over interspersed with shallow rocky pools. The substrate between small pebbles and clean white sand. Aquatic vegetation is of restioid reeds, mosses and *Scirpus.* Cohabiting *Galaxias zebratus, Barbus calidus,* the small fish species include catlets *Austroglanis gilli, A barnardi* and juveniles of *B capensis.* flowing, Noordhoeks probably an loose rocks the rocks is scarce and consists

Breeding biology: Breeds in summer months. Males are territorial (P H Skelton personal observation, S C Thorne personal communication). Attempts to keep specimens in captivity have not been as successful as with other redfin species.

CONSERVATION

Threats: Predation by introduced bass *(Micropterus dolomieu* and *M salmoides)* presents a major threat to this species. Other known threats include habitat destruction through stream channelization, water abstraction, and alien riparian plant growth. The Noordhoeks River was severely damaged by Idozing the riverbed in February 1982 (S C Thorne personal communication).

The Driehoeks River is a very small stream and

part of its catchment is planted with pine forest *(Pinus* species) which is likely to decrease the streamflow especially in dry periods during the summer. The Driehoeks stream is also diverted for agricultural purposes. This population of *Barbus phlegethon* is limited downstream by bass *(M salmoides)* and is in immediate danger of being eliminated. It is the only known population from eastern side of the Cedarberg.

Conservation attention given: The entire Olifants River system has been declared a priority conservation area by CDNEC (K C D Hamman personal communication; Scott 1982), Distribution surveys have been carried out on a semiregular basis since 1977 (Gaigher et al 1980; Skelton et al in preparation), Intensive conservation exercises such as a special angling tournament for bass have been organized and various educational publications produced (eg Scott 1982; Scott and Hamman 1984).

Conservation recommendations: The Olifants River system harbours a rich endemic freshwater fish community of which several species are threatened. A comprehensive ecosystem study with particular reference to fish ecology and conservation therefore is a high conservation priority. The autecology and biology of the species should be investigated with emphasis on the breeding biology and habitat preferences. A captive breeding programme should be instituted with a view to stocking of safe habitats. An extension programme to inform riparian land owners of the rich natural ichthyofauna of the system and the urgent need for its conservation is strongly recommended.

Remarks: Recent surveys have shown this species to be very rare and in some locales possibly eliminated. Concerted and positive conservation attention is essential to ensure its survival,

---

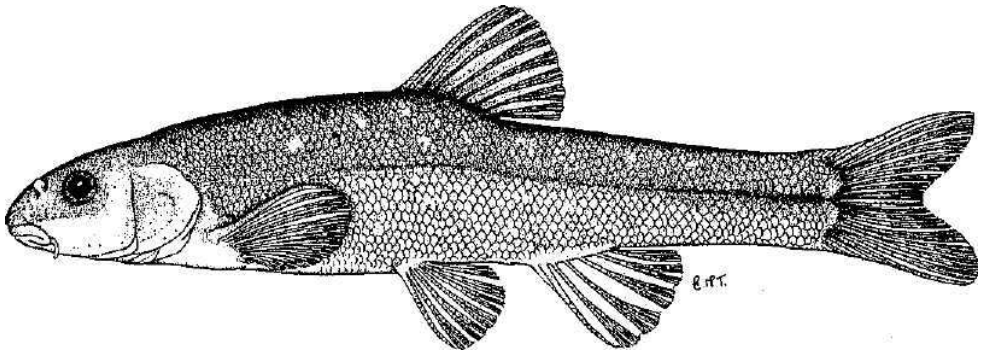
REFERENCES

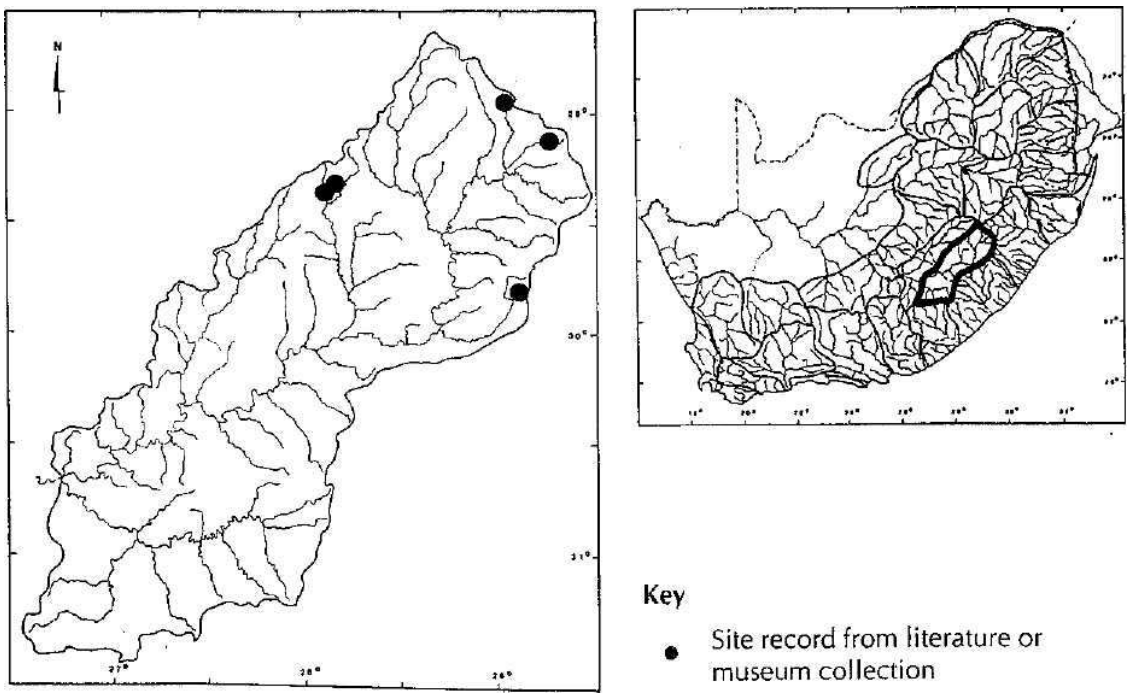
Barnard (1938b, 1943); Gaigher C M (1973a,b); Gaigher et al (1980); Jubb (1965, 1967a); Scott (1982); Scott and Hamman (1984); Skelton (1977, 1980, in preparation); Skelton et al (in preparation); Van Rensburg (1966).

Correspondence: Prof I G Gaigher; Dr K C D Hamman; S C Thome.

DRAKENSBERG or MALUTI MINNOW / DRAKENSBERG-GHIELIEMIENTJIE

FIGURE 4. Drakensberg or Maluti minnow, *Oreodaimon quathlambae,* 95 mm SL, with distribution in the upper Orange River system m Lesotho.





DRAKENSBERG (MALUTI) MINKOW / DRAKENSBERG-GHXELIEMXENTJXE ENDANGERED

Oreodaimon quathlambae (Barnard 1938) Family: Cyprinidae SUMMARY

Status: Endangered. The known populations of this unusual minnow are threatened by deteriorating catchment environments and introduced fishes.

Research: Fair - good. Several surveys for this species have been carried out and investigations into its biology and breeding have been made,

---

SPECIES DATA

Identification: A slender cyprinid minnow reaching a maximum size of 130 mm SL. Characterized by very small scales and a single pair of short barbels. Breeding adults have small tubercles on the head and body. Colour varies from olive brown to blue-grey and light cream or white below. Mature fishes have red patches at the base of the fins. Several distinct spots or dark vermiculations occur on the back.

Distribution: Known only from five high altitude source tributaries of the Orange River system in Lesotho (Rondorf 1976a; Gephard 1978; K J Meyer personal communication). These include the Tsoelikana River in the Sehlabathebe National Park, the Moremoholo River, the Senqu River (Rondorf 1976a) and the Jordane and Bokong tributaries of the Senqunyane River (K J Meyer personal communication). The type locality was given as the Umkomazana River in Natal (Barnard 1938a) (see remarks). In Lesotho the winter distribution range of the species totals 112 km with elevations ranging from 1 950 to 3 020 m (K J Meyer personal communication).

Habitat and ecology: Pools and sheltered parts of rocky rivers in clear low or moderate gradient mountain streams. The substratum is mainly bedrock, boulders and rocks of basaltic origin. The substratum in the Tsoelikana River is gravel and loose rocks with approximately 18% sand and silt. The Tsoelikana is the only stream in which cohabiting fish species have been found, namely trout *Parasalmo mykiss* and, in summer, yellow-fish *B aeneus, Oreodaimon quathlambae* feeds on stream invertebrates chiefly the aquatic nymphs of ephemeroptera and diptera and, in summer, also the adults of these insects and simulid larvae (Rondorf 1975, 1976b; Gephard 1978).

Populations: The only population for which there is any information is that in the Tsoelikana River. Rondorf (1975) found this population distributed over seven kilometres of the Tsoelikana River and estimated from catch results using an electro-fishing apparatus that the population size was about 308 individuals with 95% confidence levels of 90 to 526. There was a 1:1 sex ratio and most specimens were mature adults with few subadults and a minimum of recruitment. Further studies on this popula-tion have been made by Meyer (in preparation), Meyer estimates higher population figures (based on a mark and recapture exercise) and gives the population 618 ±1 425 adults and 5 386 ±11 542 juveniles (young of the year). Meyer records recruitment in all five populations when he sampled these in the winter of 1985 or 1986.

Breeding biology: Spawning occurs during summer months from November to February, and takes place in and around crevices and boulders of running water (Rondorf 1976b; Gephard 1978). There were indications of a clear movement into suitable spawning sites in the shallow flowing habitats by the breeding fishes. According to Rondorf (1975) fecundity is high with total number of ova per individual varying from 13 000 to 53 000 with ova greater than one millimetre varying from 36 to 1 455. Ova size varied considerably suggesting that individuals are fractional spawners with relatively few ova being laid during a spawning bout. This is confirmed by K J Meyer (personal communication) who found that the number of completely yolked ova of nine fishes that ranged from 66 to 108 mm FL was 225 to 2 875. The collection of larvae of a wide size range during a four day period in the backwaters of the Tsoelikana River also corroborates the suggestion that the species is a fractional spawner (Cambray and Meyer in preparation). Laid ova are only slightly adhesive. The larval fish undertakes a swim-up period during which it is carried by the current from the mid-channel spawning site to quiet backwaters where it commences feeding. Cambray and Meyer (in preparation) note that during these early stages *Oreodaimon quathlambae* larvae are likely to be susceptible to trout predation.

Aquarium potential and captive breeding: Specimens have been maintained in aquaria and Rondorf (1976b) and Gephard (1978) report one case of captive spawning. Incubation time was from eight to nine days and larvae were able to swim freely after eight days post hatching. Eggs and larvae are sensitive to silt. A study of the early life history and ontogenetic development is being prepared by J A Cambray (personal communication).

Remarks: The common name of the species was given by Jackson (1975) as the Drakensberg minnow. Gephard (1978) suggested the euphonius alternative Maluti minnow. The type locality of this species was given by Barnard (1938a) as the Umkomazana River in Natal. This was confirmed by the collector (Mr R S P Vaughan) in a letter to Dr R A Jubb in 1966 (the letter is in RUSI files). Crass (1977, 1985) nevertheless suggests that the original specimens might have been collected in Lesotho and that it is possible that *O quathlambae* never occurred in Natal.

CONSERVATION

Threats: Environmental degradation through overgrazing, road and dam construction and the cultivation of steep gradient slopes leading to soil erosion poses the major threat to this species (Gephard 1978; K J Meyer personal communication). The planned Mohale Dam of the Lesotho Highlands Water Scheme will flood 86% of the habitat of the Jordane River and 29% of the Bokong River habitat of *0 quathlambae.* It is expected that the development of this Highland Water Scheme will increase human access to the area and rivers, and lead to increased pressures from associated sources such as stocking with trout *(Salmo trutta and Parasalmo mykiss)*. At the present time introduced trout are a threat to the Tsoelikana population only.

Conservation attention given: In the mid 1970's the Lesotho Fishery Department conducted surveys of Drakensberg streams and research on the biology and ecology of species (Rondorf 1975, 1976a,b; Gephard 1978). This work is presently being extended and has resulted in the recent discovery of previously unknown populations of the species in the Jordane

and Bokong Rivers (K J Meyer personal communication). One of five known locales occurs within the Sehlaba-Thebe National Park. The Maluti minnow was successfully translocated to a previously unpopulated stretch of river within the National Park (Gephard 1978). In the winter of 1986, 135 fish were translocated to an uninhabited section of the Bokong River (K J Meyer personal communication).

Conservation recommendations: Additional sanctuary streams should be located and stocked if necessary. The ecology and biology of *Oreodaimon quathlambae* ought to be more thoroughly investigated and if necessary a captive breeding programme instituted. All trout stocking in Tsoelikana River and other known locales should be prohibited. Impoundments at the headwaters of the Tsoelikana should be reclaimed in a manner that is not in itself destructive to the environment. Impact assessment studies for the Lesotho Highlands Water Scheme must take cognizance of the existence and habitat of *0 quathlambae* and a suitable conservation strategy for this species should be incorporated into the planning, construction and management programmes.

Remarks: Gephard (1978) discussed the status and conservation of this species in Lesotho pointing out the practical difficulties of conservation in developing nations. Concerted international assistance should be raised to conserve the Maluti minnow. Studies on the biology of this species are being done by Meyer (in preparation).

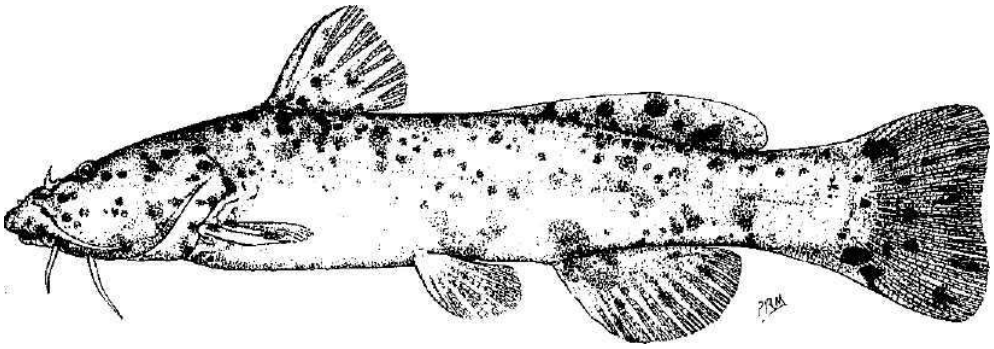
REFERENCES:

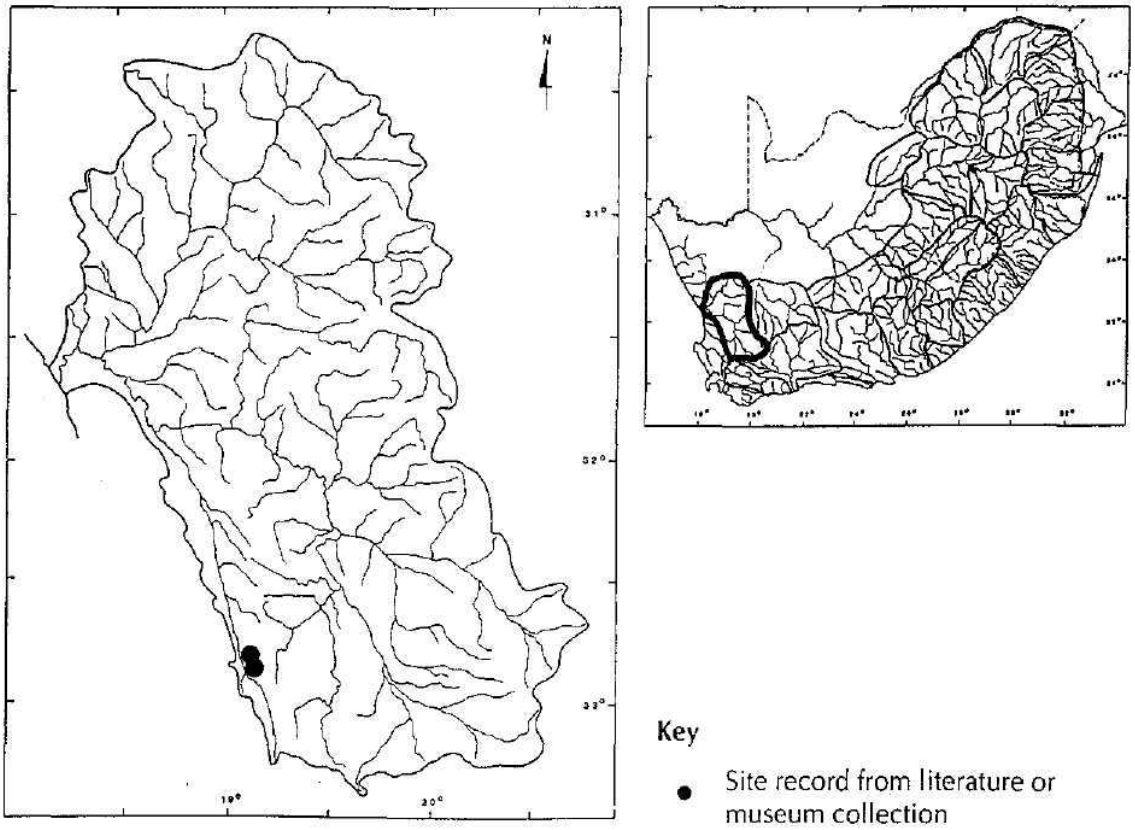
Barnard (1938a); Cambray and Meyer (in preparation); Crass (1977, 1985); Gephard (1978); Greenwood and Jubb (1967); Jackson (1975); Jubb (1971a); Pike and Tedder (1973); Rondorf (1975, 1976a,b); Skelton (1974a, 1977); Skelton (1980, in preparation).

Correspondence: J A Cambray; M Coke; K J Meyer.

BARNARD'S ROCK CATFISH / BARNARD SE KLIPBABER

FIGURE 5. Barnard's rock catfish, *Austroglanis barnardi,* 68,5 nun SL, with distribution in the Olifants River system, western Cape Province.





BARNARD'S ROCK CATFISH / BARNARD SE KLIPBABER **ENDANGERED**

Austroglanis barnardi (Skelton 1981)

Family: Bagridae

SUMMARY

Status: Endangered. *Austroglanis barnardi* is only known from two small tributaries of the Olifants River (Skelton 1981). It is uncommon in these streams, and both locales have been adversely affected by agricultural practices in recent years.

Research: Fair. Irregular monitoring surveys in the Olifants River system have been made since 1977 (Gaigher et al 1980; Skelton et al in preparation).

SPECIES, DATA

Identification: A small bagrid catfish (maximum size 75 mm SL). Head depressed with eyes placed dorsally. Mouth subterminal with fleshy lips, a pair of maxillary and two pairs of mandibular barbels. Humeral process are short and inconspicuous. The dorsal and pectoral fin spines are curved and relatively weak. There are six branched rays in the dorsal fin, a large adipose fin is present and the caudal fin is truncate. The colour is generally a light yellowish-brown with variable dark blotches.

Distribution: The species has been recorded only from the Thee River and the Noordhoeks River, both western Cedarberg tributaries of the main Olifants River (Skelton 1981).

Habitat and ecology: The species inhabits riffles among loosely bedded rocks and course sand. The Thee and Noordhoeks are both foothill streams typically with clear flowing water over loose, smooth rounded rocks, pebbles and course clean sand. Cohabiting species include the fiery redfin *(Barbus phlegethon)*, the Clanwilliam redfin *(B calidus)* and the Clanwilliam rock catfish *(A gilli)*.

Breeding biology: The breeding biology is not known. It has been found that *A barnardi* is difficult to maintain alive in aquaria for prolonged periods (KCD Hamrnan and S C Thome personal communication).

CONSERVATION

Threats: The late discovery of this species makes it difficult to gauge if it is naturally rare or that its range has been reduced by man-made factors. Habitat destruction from several causes including stream channelization, water abstraction, and sedimentation is an important threat to this species. The impact of invasive alien riparian plants such as Rooikrans *(Acacia cyclops)* has not been determined but may be extensive. Predation by introduced aliens, especially smallmouth bass *(Micropterus dolomiev)*, has possibly had an impact on the abundance and distribution of this species.

Conservation attention given: Surveys of the Clanwilliam Olifants have been carried out by CDNEC. This river system has been declared a priority conservation area and certain conservation measures have been introduced

by the CDNEC (Scott 1982). In particular the stocking and promotion of alien predator fishes has been suspended.

Conservation recommendations: Primarily the conservation of this species is tied to the overall conservation of the Olifants River system (Gaigher et al 1980; Scott 1982). The biology and ecology of this species should be investigated. The captive or artificial breeding potential requires investigation with a view to the stocking and restocking of natural habitats. Sanctuary areas should be investigated and established.

Remarks: The late discovery of this species in a well explored system attests to its rarity and suggests it is a habitat specialist. The extremely restricted distribution in sites accessible to human interference coupled with the likely increase in demand for water resources in the area give cause for high concern on the survival prospects of Barnard's rock catfish.

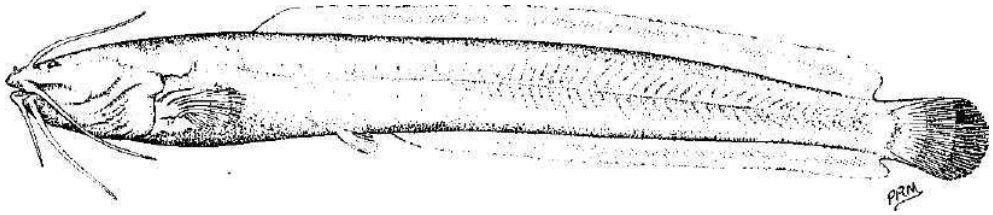
REFERENCES:

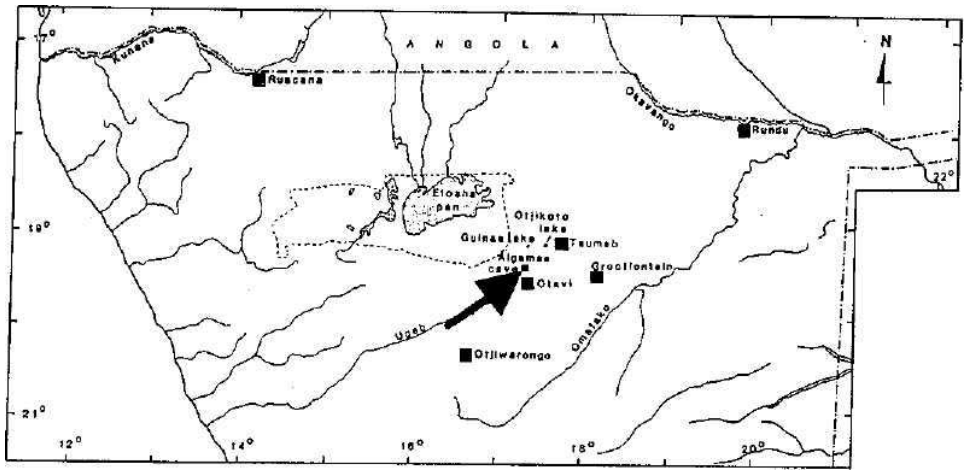
Gaigher et al (1980); Scott (1982); Scott and Hamman (1984); Skelton (1981); Skelton et al (1984); Skelton et al (in preparation).

Correspondence: Dr K C D Hamman; S C Thorne.

CAVE CATFISH / SPELONK-BABER

FIGURE 6. Cave catfish, *Clarias cavernicola,* 155 nun SL, with distribution in northern South West Africa/Namibia.





Key

♦ Translocation record

CAVE CATFISH / SPELONK-BABER ENDANGERED

Clarias cavernicola Trewavas 1936

Family: Clariidae

SUMMARY

Status: Endangered. Known from one underground lake within a cave. The survival of the species is dependent on the conservation of feeder ground-water resources that are subject to exploitation.

Research: Fair. The species is known from casual reports only and no detailed population estimates or studies on the biology or the ecology of the species have been made.

SPECIES DATA

Identification: A small clariid catfish (up to 130 mm SL) that is devoid of pigment and transparent to pinkish-white in life. Head depressed, slightly longer than broad, its length 4,2 to 4,6 times in the body length. The eyes are degenerate, often completely absent. Four pairs of barbels are present on the head: nasals subequal to head length, maxillary 1,25 to 1,5 times head length, outer mandibular 1,1 to 1,2 times and inner mandibular subequal to head length. Dorsal and anal fins are long, reaching the base of the caudal.

Distribution: The only known locale is within a cave on the farm Aigamas 471, Otavi district, South West Africa/Namibia (19° 25'S 17° 18'E).

Habitat and ecology: Subterranean waters, where the species is the only known piscine inhabitant. The size of the population has not been accurately determined but Penrith (in littera) states that there appears to be a healthy stock. The fish feeds on allochthonous food sources such as terrestrial invertebrates and bat guano (Hennig 1977). Von Wrede (1977b) reports that the bat colony directly or indirectly provides food items for the catfish from bat carcasses, parasites and coprophagous cave-dwelling invertebrates. This is supported by Penrith (in littera) who found the chitinous remains of moths and beetles in gut contents and suggests that bat guano is the main food source. Trewavas (1936) mentions baboon faeces as a possible food source. Aigamas cave was described by Jaeger and Waibel (1921) and has been partially surveyed by members of the Speleological Society (Gow 1968; von Wrede 1969; Maxwell 1974) from which the following information is obtained: the cave forms a long narrow cleft in the hillside and von Wrede (1969) provides a plan as far as the water surface. There are two entrances, one is a narrow opening in a cliff which drops vertically about 100 feet (30 m) to the water, the other approximately 100 m distant forms a four metre chimney which opens into a large chamber. Jaeger and Waibel (1921) gives the water surface as 18 m in length and on average 2,5 *m* wide. The depth of water near the entrance was in excess of 52 m. The water is very clear and the temperature recorded by Jaeger and Waibel (1921) was 24,5^{a}C.

Breeding biology and aquarium potential: There is no data available on breeding. The species has been kept in captivity on different occasions (eg Hennig 1977) and 20 specimens were collected and placed in the

aquarium of the National Zoological Gardens in Pretoria in 1985 (Penrith in littera; Pretoria News 7 November 1985). Hennig (1977) notes aspects of the behaviour of the species in aquaria.

CONSERVATION

Threats: Restricted to a single known locality and subject to allochthonous food sources. The general exploitation of the Karstland aquifers may provide the most serious long-term threat to the habitat of *Clarias cavernicola.* The water level in the cave has declined from previous levels and at one stage the open waters in the cave were used as a direct source of irrigation water (Jaeger and Waibel 1921; H H Boye personal communication). Uncontrolled collecting by aquarists could provide a future threat but this is not the case at present.

Conservation attention given: The owner of Aigamas farm (Mr H H Boye) is aware of the value of the cave catfish and does not allow access or collection without a Nature Conservation permit (Penrith in littera; H H Boye personal communication). The pumping of water directly from the cave has not been carried out for many years. Twenty specimens were caught in 1985 and taken to the National Zoological Gardens' aquarium in Pretoria (Penrith in littera; Pretoria News 7 November 1985). These could provide a captive breeding nucleus.

Conservation recommendations: It is important to provide specific protection of the locale and species through legislation if the long-term security of the species is to be safeguarded. Regular monitoring of the habitat and status of the cave catfish by the conservation authorities is advisable. A programme to study the breeding biology and captive breeding potential of the species should be undertaken with the assistance of experienced fish aquaculture experts. The habitat and species status should be studied with a view to proposing a conservation programme. The sanctuary status of Aigamas Cave could be enhanced through a scheme similar to the National Heritage Programme of South Africa.

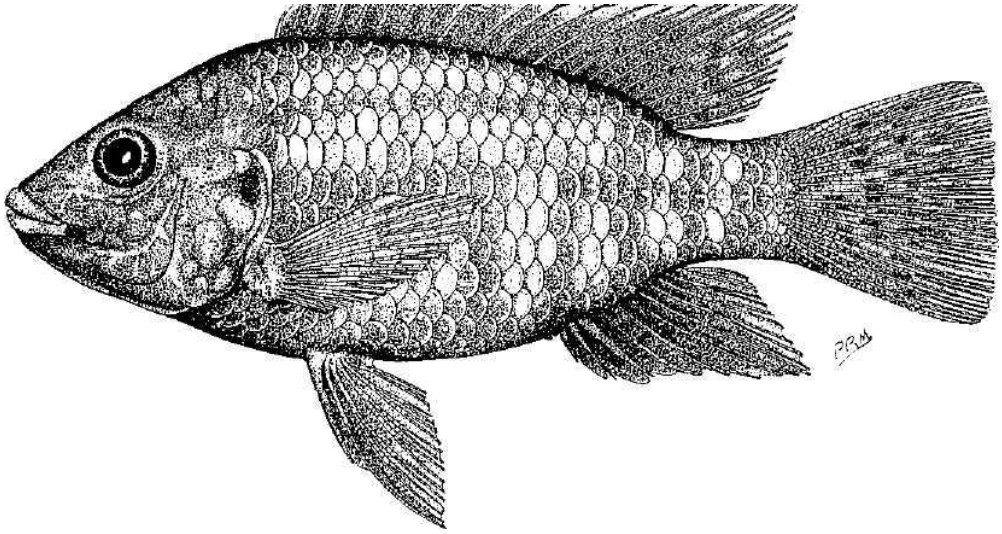
REFERENCES:

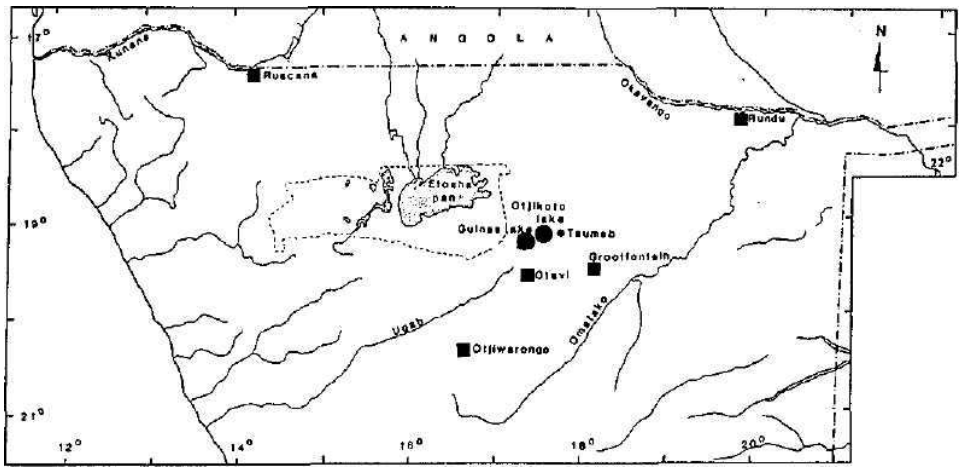
Gow (1968); Hennig (1977); Jaeger and Waibel (1921); Jubb (1958, 1967a, 1969a); Maxwell (1974); Scheide (1977); Skelton (1977); Teugels (1986); Trewavas (1936); von Wrede (1969, 1977a,b).

Correpondence: Dr C Gow; J Irish; C Maxwell; M J Penrith; H H Boye.

OTJIKOTO TILAPIA / OTJIKOTO-TILAPIA

FIGURE 7. Otjikoto tilapia, *Tilapia guinasana,* 73 ram SL, with distribution in northern South West Africa/Namibia.





Key

^ Site record from literature or museum collection

♦ Translocation record

QTJIKOTO TILAPIA / OTJIKOTO-TILAPIA ENDANGERED

Tilapia guinasana Trewavas 1936

Family: Cichlidae

SUMMARY

Status: Endangered. Known from two sinkhole locales only, both of which are subject to human interference and exploitation.

Research: poor - fair. The species is known only from casual reports and unpublished information.

SPECIES DATA

Identification: A tilapiine cichlid reaching up to 140 mm TL. The colour and pigmentation of this species is extremely variable from a uniform dark greenish-black or olive-brown with darker vertical bars to specimens which are vividly particoloured in white, blue, yellow and black (see figures page 19 in Jubb 1969a). The dorsal spines number XIII-XIV usually XIII. The gill rakers are short with eight to 11 on lower anterior arch. There are one or two series of scales on the cheeks only.

Distribution: Occurs only in Lake Guinas (19°14'S, 17°18'E) and Lake Otjikoto (19"12'S, 17ºº32'E) South West Africa/Namibia. The species has been translocated to farm dams and reservoirs in northern South West Africa/Namibia (Penrith in littera).

Populations: Penrith (1978) recorded his 1972 estimate of the population of 268 000 in Lake Otjikoto. This estimate was based on a capture, recapture study using fin-clipped fish. More recently the population appears to have declined as a result of the introduction of *Oreochromis mossambicus* (H Hawley personal communication; Penrith in littera). Competition may be less intense in Lake Guinas due to the difference in size and shape of the lake, availability of nesting sites and the greater clarity of the water.

Habitat and ecology: Jaeger and Waibel (1921) gave the dimensions of Lake Otjikoto as approximately 70 to 80 m diameter and from 40 to 58 m deep. The water level, appears to have subsided since that time and Penrith (1978) gives its depth as between 27 to 36 m. The water is moderately clear and greenish in colour (Jubb 1969a; Penrith 1978). Jaeger and Waibel (1921) recorded water temperatures 19 to 24°C in May 1914. Lake Guinas is approximately 60 m wide by 120 m long (Jaeger and Waibel 1921) and up to 108 m deep (Penrith in littera). The water in this lake is crystal clear and deep blue in the sunlight. In the winter of 1914 Jaeger and Waibel (1921) recorded the water temperature as 25 to 27°C. *T guinasana* and *Pseudocrenilabrus philander* inhabit Lake Guinas. *T guinasana* coexists with two other cichlid species *(0 mossambicus* and *P philander)* in Lake Otjikoto. Food is scarce and consists mainly of algae and allochthonous material.

Breeding biology: *Tilapia guinasana* is a substrate spawner and nest guarder (Penrith 1978). Narrow rocky ledges are used as nesting sites and competition is intense (Penrith 1978). In Lake Guinas nests have been observed as deep as 67 m (Penrith in littera). Aquarium and captive

breeding potential is excellent as several garden ponds have been stocked and the species breeds readily in these (P H Skelton personal observation). *Tilapia guinasana* crosses readily with *Tilapia sparrmanii* and the crossed offspring are fertile (Penrith in littera).

CONSERVATION

Threatsi With regard to the population in Lake Otjikoto the main concern is the potential impact from the introduced fish species *Oreochromis mossambicus.* Direct and indirect abstraction of water presents a long-term threat to both lakes. Physical pollution in the form of litter and military hardware has occurred in Lake Otjikoto but not to the extent of posing a serious threat to fish life (Penrith 1978). The water from Lake Otjikoto is used for agricultural purposes and for the Tsumeb mine. Water from Lake Guinas is used mainly to irrigate lands around the lake. Pollution from insecticides used on these lands is a potential threat to the lakes. In the case of Lake Guinas pollution from the diesel pumps used to extract the water is also a threat to the lake.

Conservation attention given: Concern for the survival of the species in Lake Otjikoto was expressed by the property owners (Tsumeb Mining Corporation). This resulted in the Nature Conservation authorities carrying out an investigation but the outcome of this investigation is not known at the time of writing. Lake Otjikoto is a declared National Monument of South West Africa/Namibia,, The species is kept in garden ponds (eg at the Alte Feste in Windhoek) and are known to breed under these conditions.

Conservation recommendations: An investigation of the biology and ecology of *T guinasana* in both Lake Guinas and Lake Otjikoto is urgently required in order to draw up conservation recommendations. A conservation strategy for both lakes should be devised and instituted as soon as possible. Lake Guinas and Lake Otjikoto and the fishes therein represent natural phenomena that should be respected as a national resource of great scientific value. The scientific study of the lakes and their fauna by suitably qualified and acknowledged scientists should be a priority concern of the authorities. Such studies are necessary if the lakes are to be properly managed and conserved.

Remarks: The original derivation of the Lake Otjikoto population of *T guinasana* is uncertain. Although the first European to discover the lake (F Gallon in 1851) reported that there were fishes therein, it is not known what species they were (Jubb 1969a). Jordan (1936) collected only *Pseudocrenilabrus philander* in Otjikoto. The first collection of *T guinasana* from Lake Otjikoto was apparently that made by C Gow in 1967 (Jubb 1969a). Penrith (1978) mentions only that "someone took *T guinasana* from Guinas to Otjikoto where they flourished". It seems that the original population of *P philander* declined following the introduction of *T guinasana* (Penrith 1978).

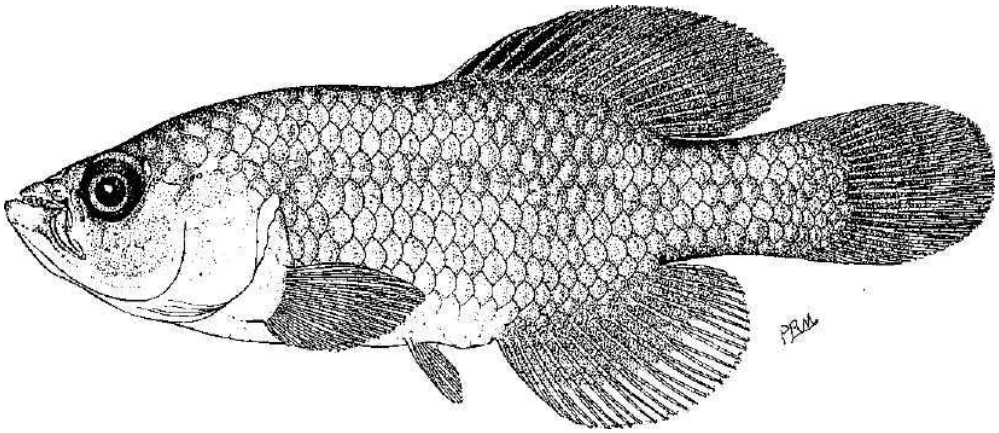
REFERENCES:

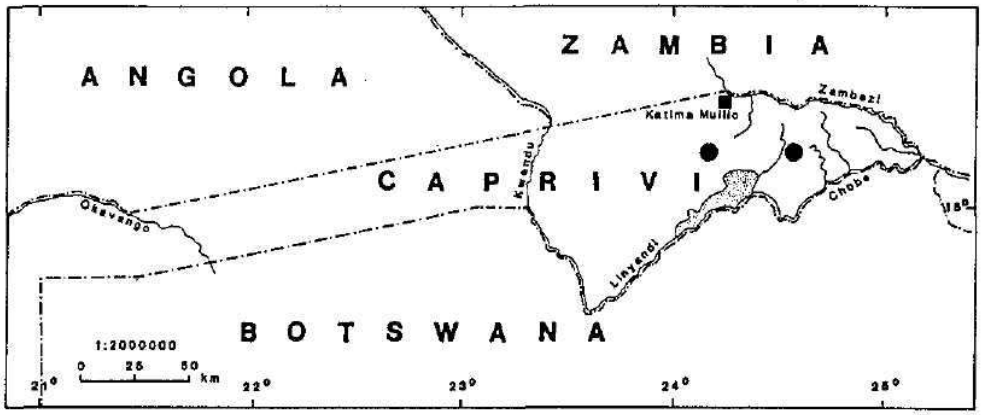
Jaeger and Waibel (1921); Jordan (1536); Jubb (1969a); Penrith (1978); Trewavas (1936).

Correspondence: Dr I G Gaigher (1976); M J Penrith.

STRIPED KILLIFISH / GESTREEPTE KUILVISSIE

FIGURE 8. Striped killifish, *Nothobranchius* species, 29 mm SL, with distribution in eastern Caprivi.





Key

- ● Site record from literature or museum collection
- ◆ Translocation record

STRIPED KILLIFISH / GESTREEPTE KUILVISSIE ENDANGERED

Nothobranchius species

Family: Aplocheilidae

SUMMARY

Status: Endangered. The species is known only from two small rainwater pans both of which are subject to interference from human activities.

Research: Poor. This species was discovered during a survey of eastern Caprivi by Dr B C W Van der Waal.

SPECIES DATA

Identification: This is a small (maximum size 60 mm TL) stout-bodied cyprinodont (topminnow). The head is pointed and flat above with the mouth opening upwards. The large ovoid dorsal and anal fins are positioned opposite each other on the posterior half of the body. Males are an attractive light blue with irregular vertical maroon stripes. Anal and caudal fins have a broad yellow submarginal band with an outer concentric black edge. The dorsal fin is blotched with red and black on the membrane and rays. The females are a plain light olive-brown.

Distribution: Known only from two temporary rainpools in Caprivi at Gunkwe and Bukalo (Van der Waal and Skelton 1984).

Habitat and ecology: Small depressions temporarily filled with eutrophic rainwater and overgrown with coarse sedges *(Cyperus* species) grasses, and *Otellia* species (see Van der Waal and Skelton 1984, plate 10). There is a rich invertebrate community present in the pans. The pan at Gunkwe was temporarily colonized by a number of other fish species in 1975 during an exceptionally high flood. The following species were collected, *Barbus paludinosus*$_t$ *B bifrenatus, B haasianus, Tilapia ruweti* and *Ctenopoma multispine.*

Breeding biology: Not known for this species. The aquarium and captive breeding potential is, however, excellent because *Nothobranchius* are popular aquarium fishes which are regularly spawned in captivity. Specimens have been kept in an aquarium for up to three months (B C W Van der Waal personal communication).

Remarks: The taxonomy of this species is being investigated at present (Jubb and Skelton in preparation). A general account and history of this species is given by Sainthouse (1985).

CONSERVATION

Threats: The major threat to the species is gross habitat destruction from road building activities as both the pans are adjacent to gravel roads which are constantly being resurfaced. In addition the pans are subject to human interference during the rainy season when they are used for domestic washing purposes. Collecting for the aquarium trade poses a potential threat to wild populations.

Conservation attention given: Proposals were made by Dr Van der Waal in 1976 to the Caprivi Government to declare both sites sanctuaries. No protective measures have been taken and overgrazing of the vegetation of the Bukalo Pan was observed in 1985 (B C W Van der Waal personal communication).

Conservation recommendations: The proposals for the sanctuary status and protection of the habitat should be reconsidered by the authorities. Specimens should be collected and supplied to expert aquarists for the establishment of a captive breeding stock. The possibility for this species to be translocated to other suitable locales which are less exposed or subject to interference should be investigated.

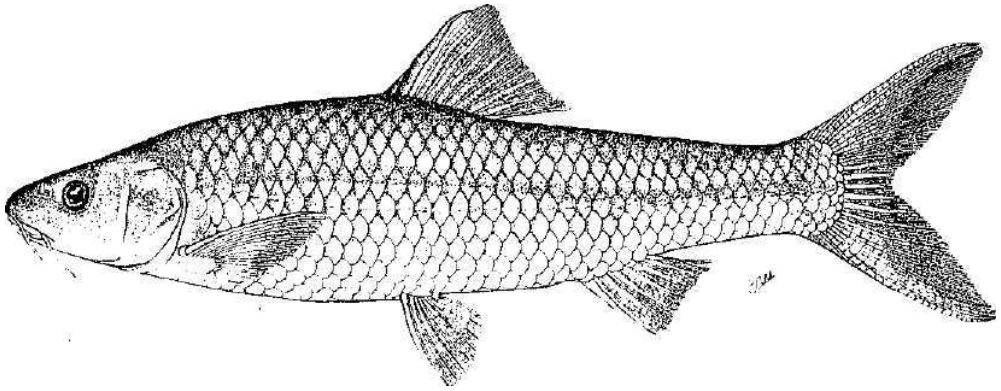
REFERENCES:

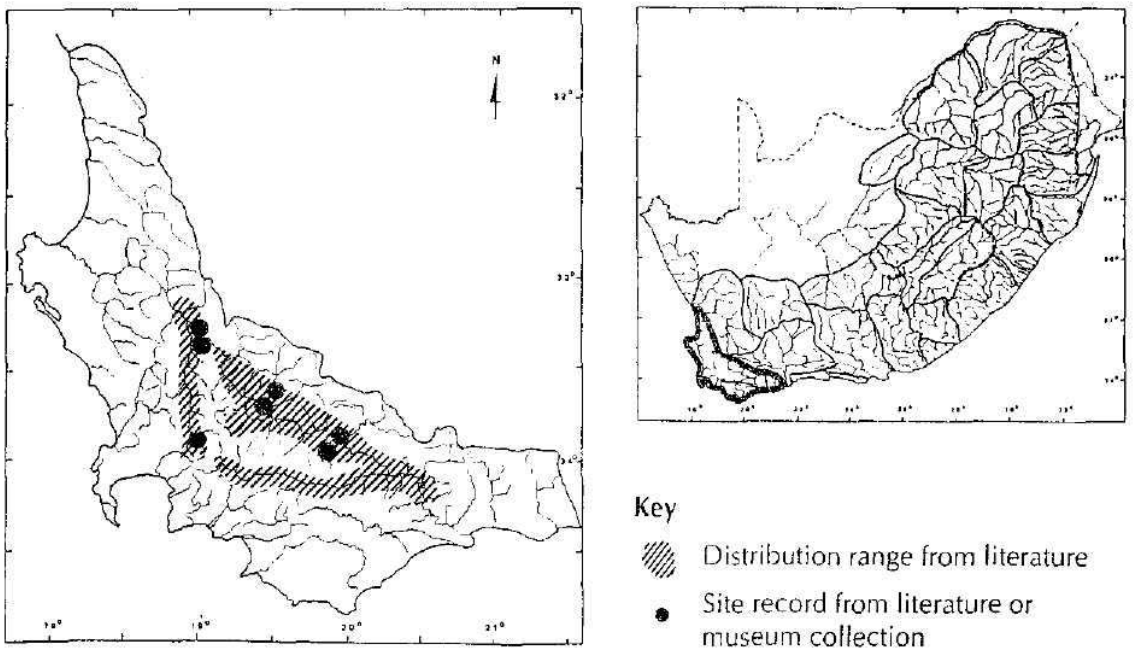
Jubb (1981); Sainthouse (1985); Van der Waal (1976); Van der Waal and Skelton (198A).

Correspondence: Dr B C W Van der Waal.

CAPE WHITEFISH / HITVIS

FIGURE 9. Cape whitefish, *Barbus andrewi,* ±300 mm SL, with distribution in the south-west Cape Province.





CAPE WHITEFISH / WITVIS **VULNERABLE**

Barbus andrewi Barnard 1937

Family: Cyprinidae SUMMARY

Status: Vulnerable, possibly endangered. The numbers of this species has declined in its natural habitat to the point where it is now of major concern to conservationists (Edwards 1986; K C D Hamman and S C Thome personal coiranunication).

Research: Fair. Distribution and population status surveys have been carried out by the CDNEC since 1977. Artificial breeding methods are being applied with some success.

SPECIES DATA

Identification: The whitefish is a relatively large (maximum size 3,4 kg, 600 ram TL) silvery (young) or golden-olive cyprinid. It is distinguished by having a serrated dorsal spine, radiately striated scales and six branched rays in the anal fin. It has a long pointed snout, an inferior mouth and two pairs of barbels.

Distribution: The whitefish inhabits larger tributaries and the main-streams of the Berg and Bree Rivers, south-west Cape. A summary of the distribution of *B andrewi* in the Bree River based on CDNEC records from 1978 to 1983 is given by Cambray and Stuart (1985). Good populations are reported from the Voelvlei and Brandvlei reservoirs that are connected to the Berg and Bree Rivers respectively.

Habitat and ecology: The species is most common in large pools and deeper flowing sections of rivers where the water is clear and the substrate rocky with interstitial sand. Typical habitat in the Berg River is described in detail by Harrison and Elsworth (1958). The main features of the Bree River catchment are described by Carter (1983). Cohabiting fish species in the Berg River are known to include *Galaxias zebratus, Sandelia capensis,* and the alien species *Cyprinus carpio, Micropterus dolomieu, M salmoides, Lepomis macrochirus, Salmo trutta* and 5 *gairdneri.* In the Bree River a similar range of cohabiting species occurs (Cambray and Stuart 1985) as well as the eel *Anguilla mossambica.* In a few locales the redfin minnow *Barbus burchelli* may also be present.

Breeding biology: Spawning congregations (described by Harrison (1936, 1952b) as the annual spawning "run") occur during mid-summer at the head of pools and below rapids. Previously large shoals were reported to congregate below barriers such as waterfalls. A congregation of the species was observed above a weir in the Hex River on 3 June 1982 (K C D Hamman personal communication). Fertilized eggs take from two to five days to hatch. Barnard (1943) and Anonymous (1945) reports artificial propagation by stripping wild-caught spawning fish and hatchery care of fertilized ova. Renewed attempts are being made to artificially propagate the species (A B Smith personal communication).

Remarks: Distribution surveys indicate the scarcity of this species in rivers where it was formerly abundant (CDNEC records; Cambray and Stuart 1985; Skelton et al in preparation). Populations in the Brandvlei and Voelvlei reservoirs appears to be healthy (Gaigher et al 1980) but the species is virtually extirpated from the Berg River (K C D Hamman and S C Thome personal communication), A study of aspects of the biology and ecology of *Barbus andrewi* is being carried out through Stellenbosch University (K C D Hamman personal communication).

CONSERVATION

Threats: A combination of factors is certainly responsible for the marked decline in abundance and distribution of the whitefish (Edwards 1986). Major contributing threats include: industrial and agricultural pollution; mineralization; water abstraction for agriculture; industrial and domestic consumption; weirs and other obstructions; sedimentation; the effects of alien aquatic and riparian plants; and the introduction of a number of alien fish species such as bass *(Micropterus* species) and trout *(Salmo trutta* and *Parasalmo mykiss)*. In addition the gross physical destruction of stream courses for agricultural purposes (canalization) or excavation of construction material (sand gravel and rocks) has been observed.

Conservation attention given: Fish surveys of the Bree and Berg River systems to determine the conservation status and present distribution of species have been made by the CDNEC (Gaigher et al 1980; Skelton et al in preparation). Artificial breeding techniques have been successfully applied (A B Smith personal communication) and restockings of natural waters will be carried out in due course. Important changes to the Cape Nature and Environmental Conservation Ordinance of 1974 are being introduced to provide protection for indigenous fish species (K C D Hamman personal communication).

Conservation recommendations: Urgent attention must be given to the development of a comprehensive conservation strategy for the major river systems of the south-west Cape. Broad ecological surveys to identify the threats to the fauna should be made. The restocking of suitable natural waters with hatchery propagated stock should be carried out. Studies of the life history, biology and ecology of this species are important if a sound conservation strategy is to be applied.

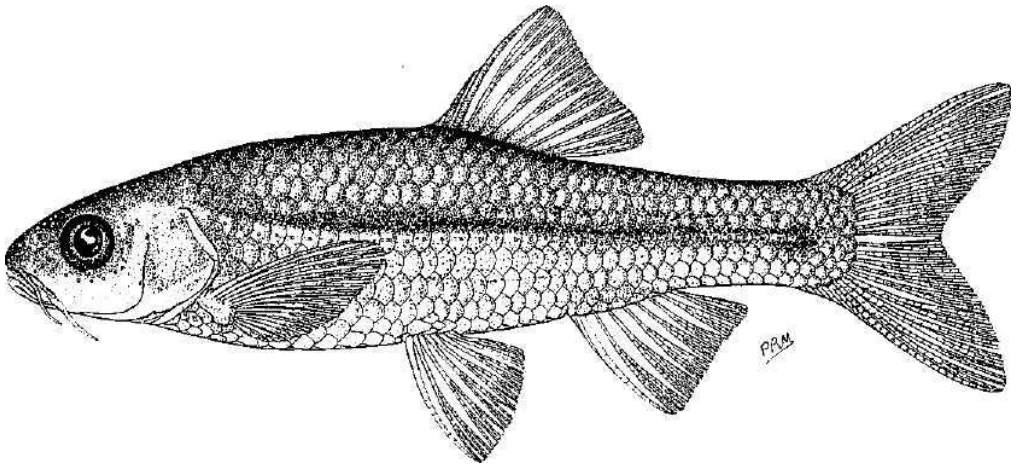
REFERENCES:

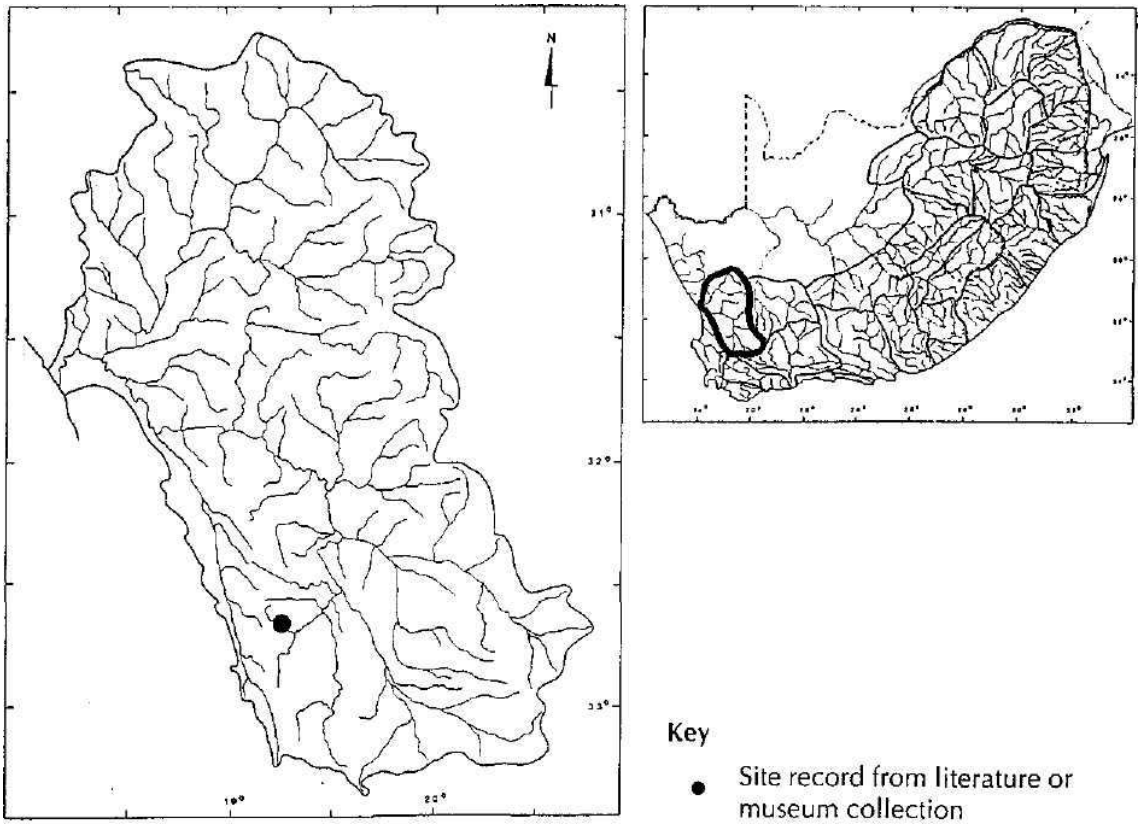
Anonymous (1945); Barnard (1943); Cambray and Stuart (1985); Carter (1983); Edwards (1986); Gaigher et al (1980); Harrison (1936, 1952b); Harrison and Elsworth (1958); Jubb (1965, 1967a).

Correspondence: Dr K C D Hamman; A B Smith; S C Thome.

THEE RIVER REDFIH / TWEERXVIER-ROOIVLERKIE

FIGURE 10. The Twee River redfin, *Barbus erubescens,* 66 mm SL, with distribution in the Olifant River system, western Cape Province.





TWEE RIVER REDFIN / TWEERIVIER-ROOIVLERKIE **VULNERABLE**

Barbus erubescens Skelton 1974

Family: Cyprinidae

SUMMARY

Status: Vulnerable. The natural distribution of *B erubescens* is restricted (Skelton 1974b). Threats against the species are increasing and include introduced fish species and habitat deterioration.

Research: Fair. Distribution and population status surveys for conservation purposes have been made.

SPECIES DATA

Identification: A moderate sized cyprinid minnow (reaches 95 nan SL). The mouth is terminal and there are two pairs of well developed barbels. The dorsal fin has a flexible leading ray, and the anal fin seven branched rays. Colouration is generally olive-brown with a dark lateral band. In breeding condition the males and to a lesser extent the females, assume a bright red body hue.

Distribution: The species is confined to the catchment of the Twee River, an eastern Cedarberg tributary of the Olifants River system (Skelton 1974b). A vertical waterfall of approximately 15 m marks the downstream distribution limits of the species.

Habitat and ecology: The two main tributaries of the Twee River are clear cool water streams with pools interspersed between rocky runs. The substratum generally consists of coarse sand, loose rocks and boulders as well as bedrock. Marginal vegetation consists of restioid reeds. The pools vary in size but seldom exceed one or two metres depth. The Twee River contains a series of large (up to 20 or 30 m wide and long) and deep (three or four metres) pools connected by fast flowing rocky river stretches with numerous cascades and waterfalls. Stretches of bedrock are interspersed with sand and gravel pools. Fish species present include *Galaxias zebratus* and the introduced *Sandelia capensis* (Hamman et al 1984). *Barbus erubescens* feeds mainly on aquatic and allochthonous invertebrates.

Breeding biology: Breeds in spring and summer, males congregate in nuptial schools in flowing water over loose pebble substrates. Individual females join the school and are attended by two or three of the males (P H Skelton personal observation). Specimens have been held in captivity but there are no reports of captive breeding.

CONSERVATION

Threats: Agricultural activity within the catchment of the Twee River is affecting the river environment. There is visual evidence of eutrophication probably through runoff from cultivated lands. This eutrophication results in the smothering of the substratum by filamentous algae. In summer water abstraction for irrigation is a threat to the habitat. Insecticide spraying occurs on adjacent lands and also constitutes a possible threat. In addition the introduction of an alien fish predator

Sandelia capensis (Hamman et al 1984) compounds the situation for this extremely confined species. Bass *(Micropterus* species) are present in neighbouring catchments and the probability of them being introduced to the Twee catchment is high.

Conservation attention given: The entire Olifants River system has been declared a priority conservation area by CDNEC (Gaigher et al 1980; Scott 1982; KC D Hamman personal communication). Several monitoring surveys on the population of *Barbus erubescens* have been carried out (Hamman et al 1984; Skelton et al in preparation).

Conservation recommendations: The entire drainage of the Twee River and its tributaries the Middeldeur and the Suurvlei Rivers should be accorded sanctuary status. The regular monitoring of the system is essential for the security of the species. A programme to inform the riparian land owners of the presence of *B erubescens,* the threats to its survival and ways and means to conserve the species and its habitat is recommended. A study of the ecology and biology of the species is needed to draft an effective conservation strategy. The captive breeding potential of the species should be investigated.

Remarks: The Middeldeur stream is the tributary in which the decline of *B erubescens* is most notable. This stream is subject to eutrophication from agricultural sources and a dense growth of filamentous algae is smothering the substratum. The algal growth may have destroyed suitable habitat for spawning and occluded suitable substratum for the benthic organisms which form a dietary component of *B erubescens,*

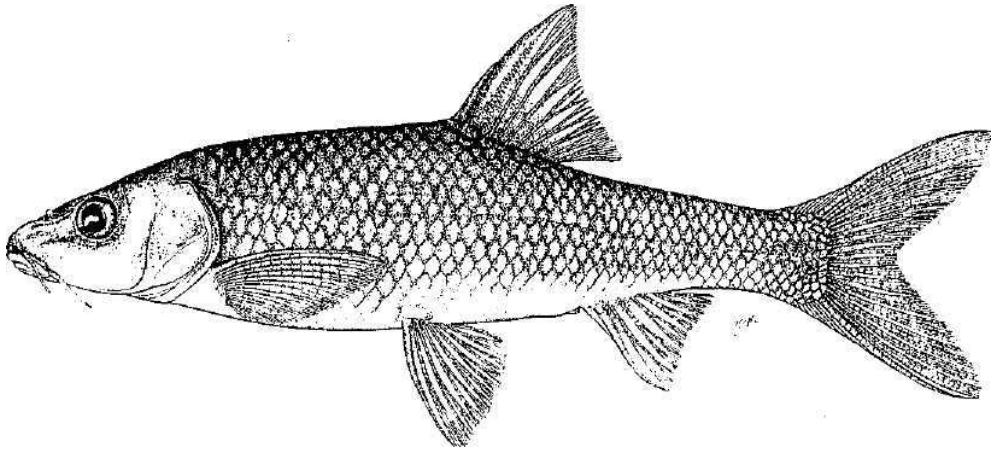
REFERENCES:

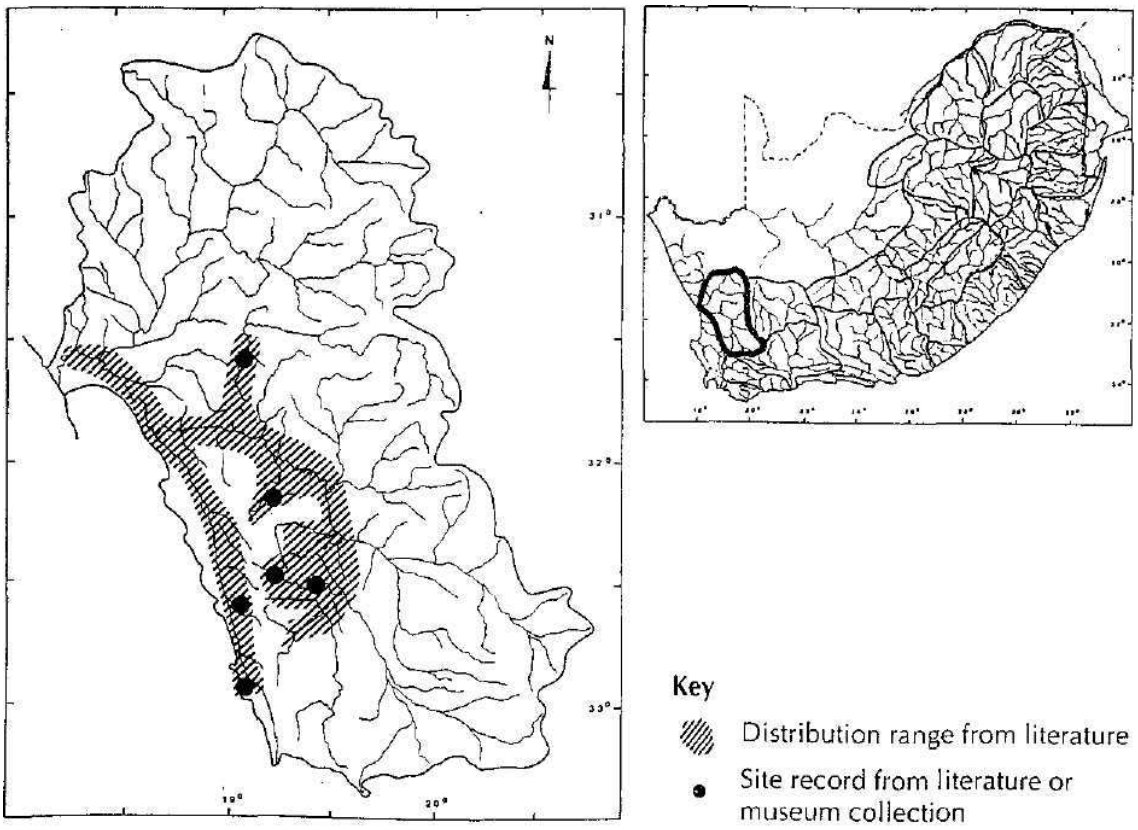
Gaigher et al (1980); Hamman et al (1984); Scott (1982); Skelton (1974b, 1977, 1980).

Correspondence: Dr R C D Hamman; S C Thorne.

SAWFIN / SAAGVIN

FIGURE 11. The sawfin, *Barbus serra,* +150 mm SL, with distribution in the Olifants River system, western Cape Province.





SAWFIN / SAAGVIH **VULNERABLE**

Barbus serra Peters 1864

Family: Cyprinidae

SUMMARY

Status: Vulnerable, The sawfin is endemic to the Olifants River system, western Cape where recent surveys indicate that it has declined to low numbers.

Research: Fair. Several distribution and conservation status surveys by the CDNEC have been made since 1977. Elementary biological studies have been made (van Rensburg 1966; Gaigher 1973a).

SPECIES DATA

Identification: A moderately large barbine cyprinid (maximum size recorded: 1,5 kg, ±530 mm FL). It is similar to the whitefish *(B andrewi)* but has only five anal fin branched rays. The snout of this species is relatively long and pointed, the mouth is subterminal and there are two pairs of barbels. The scales are radiately striated. The last unbranched dorsal ray is bony and serrated. Juveniles are silvery-gold with dark blotches, adults are olive-gold.

Distribution: The sawfin is endemic to the Olifants River system, western Cape Province (Barnard 1943; Jubb 1965, 1967a). Within the system the species is recorded from the lower reaches of the mainstream approximately 15 km from the mouth (Day 1981 in Morant 1984) to the head of the valley mainstream (van Rensburg 1966; Gaigher 1973a) as well as in tributaries of the Doom River branch of the system (CDNEC records).

Habitat and ecology: Juveniles are found in the pools of tributaries; adults occur in large deep pools of tributaries, the mainstream and in mainstream impoundments. The habitat is usually flowing clear water with a rocky, or stone and gravel substrate. Palmiet *(Prionium serratum)* is often present. Associated fishes include redfin minnows (B *calidus, B phlegethon)* the Clanwilliam yellowfish *(B capensis)*, the Clanwilliam sandfish *(L seeberi)* and the Clanwilliam rock catfish *{Austroglanis gilli)*. The sawfin feeds primarily on bottom-dwelling invertebrates, especially insects like chironomid larvae, as well as copepods and ostracods, and a significant amount of plant material including algae and diatoms (van Rensburg 1966).

Breeding biology: Breeds during summer months (October to January) when indications of upstream breeding migrations have been reported. Juveniles are found in smaller tributaries of the system (van Rensburg 1966; Gaigher 1973a). The size attained by this species makes it unsuitable for any but large aquariums. The potential for artificial propagation of this species is good in view of the success reported for the artificial breeding of other large barbine cyprinids including the related *B andrewi,*

CONSERVATION

Threats: Predation from introduced alien fishes (primarily *Micropterus dolomieu* and *M salmoides)* species is a major cause of the decline of

this species (van Rensburg 1966; Gaigher 1973a). Other likely threats are the obstruction to movement posed by dams and weirs, habitat deterioration through water abstraction* canalization and sedimentation. Pollution from urban and agricultural sources is a potential threat because there are several adjacent towns and extensive cultivated riparian lands.

Conservation attention given: A conservation programme for the Olifants River system has been initiated by the Cape Department of Nature and Environmental Conservation (see Clanwilliam Yellowfish data sheet). This species is protected under the Nature Conservation Ordinance. Distribution and conservation status surveys have been carried out in recent years by the CDNEC (Gaigher et al 1980; Skelton et al in preparation).

Conservation recommendations: The biology and ecology of the sawfin needs to be studied in order to ascertain life requirements to develop a suitable conservation strategy. A programme to propagate and restock the species using artificial breeding methods should be undertaken. The conservation programme on the Olifants River system (see Clanwilliam yellowfish sheet) should be continued and extended.

Remarks: The sawfin is added to the list of threatened species as recent surveys have indicated a continued and serious decline in numbers since earlier surveys by van Rensburg (1966); Gaigher (1973a) and (R C D Hamman and S C Thome personal communication).

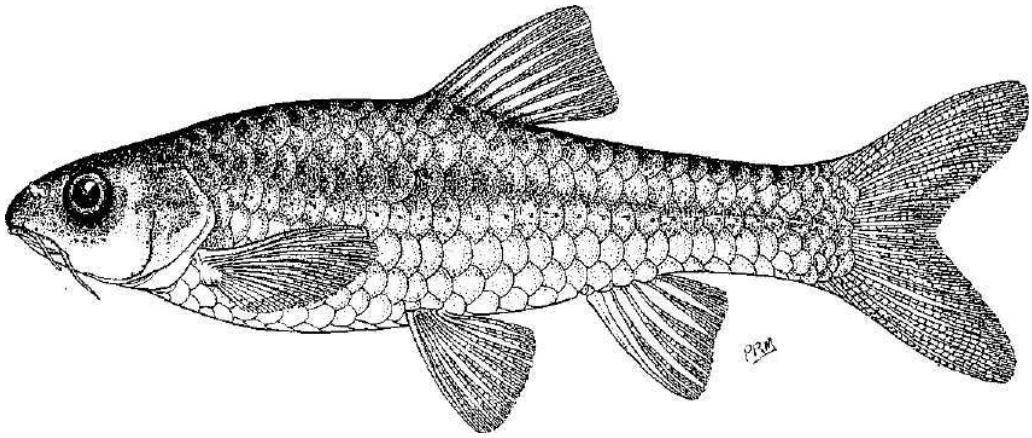
REFERENCES:

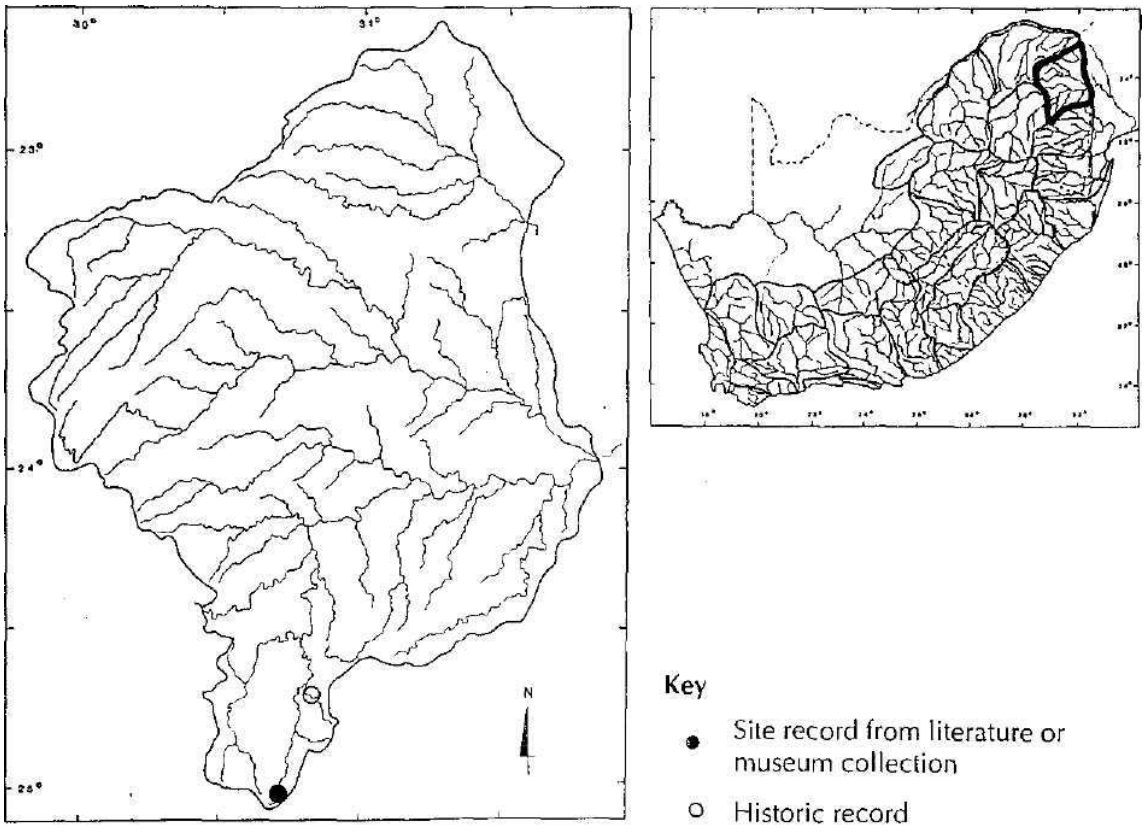
Barnard (1943); Gaigher C M (1973a, 1973b); Gaigher et al (1980); Jubb (1965, 1967a); Morant (1984); van Rensburg (1966).

Correspondence: Dr K C D Hamman; S C Thorne.

TREUR RIVER BARB / TREURRIVIER-GHIELIEMIENTJIE

FIGURE 12. The Treur River barb, *Barbus treurensis*, 67 mm SL, with distribution in the Blyde River, Olifants-Limpopo River system eastern Transvaal.





TREUR RIVER BARB / TREORRIVIER-GHIELIEMIEMTJIE VULNERABLE

Barbus treurensis Groenewald 1958

Family: C yp rinidae

SUMMARY

Status: Vulnerable. The range of this species has declined to a single stretch of river (Kleynhans 1982, 1984). The existing population is protected by a downstream waterfall barrier.

Research: Good. The distribution, and pertinent aspects of the biology and ecology of the Treur River barb were investigated by Kleynhans (1982, 1984).

SPECIES DATA

Identification: A fusiform cyprinid minnow reaching about 95 mm SL. The mouth is subterminal and there are two pairs of well developed simple barbels. The unbranched dorsal ray is flexible. Scales are moderately large and the pigmentation is relatively inconspicuous with some irregular dark spots on the back and caudal peduncle.

Distribution: The only known population is restricted to a 4,5 km stretch of the upper reaches of the Blyde River, a tributary of the Limpopo River system (Kleynhans 1982, 1984). Previously the species was reported from the Treur River which is a tributary to the Blyde River, and the Sabie River (Groenewald 1958). The Sabie is a lowveld tributary of the Incomati River system and the record from there is questionable. It has not been found in either of these latter locales in subsequent surveys.

Population: This was estimated by Kleynhans (1982, 1984) to vary between 7 245 and 25 200 individuals during the period January to July 1979. Monitoring during 1985 indicated a similar order of abundance (C J Kleynhans personal communication).

Habitat and ecology: The upper Blyde forms a clear flowing mountain stream with loose rock substrate and banks with grass and bushes. The species is found mainly in small pools (three to four metres in diameter and 1,3 to 2,3 m deep) and behind rocks in flowing runs. It coexists with the small amphiliid catfish *Amphilius natalensis. Barbus treurensis* feeds primarily on aquatic invertebrates, particularly insects.

Breeding biology: The species is a total spawner that breeds during October to December. Fecundity increases with size and age from about 350 ova in a young female of 65 mm TL to 2 040 ova in the largest specimen examined (108 mm TL). Males and females develop small evenly distributed nuptial tubercles on head in breeding season that suggests the species is possibly a group spawner. Although no captive breeding has been reported the species has been held in aquaria successfully for a number of years.

CONSERVATION

Threats: it is likely that introduced predatory fish species *(Micropterus dolomieu* and *Parasalmo mykiss)* are largely responsible for eliminating *B treurensis* from all but single portion of former range

(Kleynhans 1982, 1984). That part of the upper Blyde River where the species is found at present occurs within commercial forestry area (the catchment hill slopes are planted with *Pinus* species). Stream flow is likely to have been affected and forestry operations such as logging and pesticide spraying constitute a potential threat to the system. Pollution from mining operations may also have occurred in the past.

Conservation attention given: A detailed investigation into the distribution and conservation status of the species was carried out by the Transvaal Nature Conservation authorities (Kleynhans 1982, 1984). The TNC Division prohibits the release of alien fish species in the known range of *Barbus treurensis.* Pott (1981) reports an attempt at translocation of species within the Treur River catchment. The success of this translocation is unconfirmed. The Upper Blyde River catchment has been declared a National Heritage site (de Wet 1986) and the land owners are sympathetic to the conservation of *B treurensis.*

Conservation recommendations: The recommendations made by Kleynhans (1982, 1984) for this species are endorsed and include (i) existing population and habitat should be monitored on a regular annual basis, (ii) reestablish *B treurensis* in original locale (Treur River) and other suitable locales in the Blyde-Treur River catchment, (iii) grant existing locale of species sanctuary status and prohibit interference with habitat or the species itself. The last mentioned recommendation is catered for to a large extent by the declaration of the area as a National Heritage site.

Remarks: The habitat of the single population of *B treurensis* is presently in excellent condition and the species has received research and conservation attention from both the Transvaal Nature Conservation Division and the land owners (Mondeor Timber), For this reason the conservation status is revised from endangered to vulnerable.

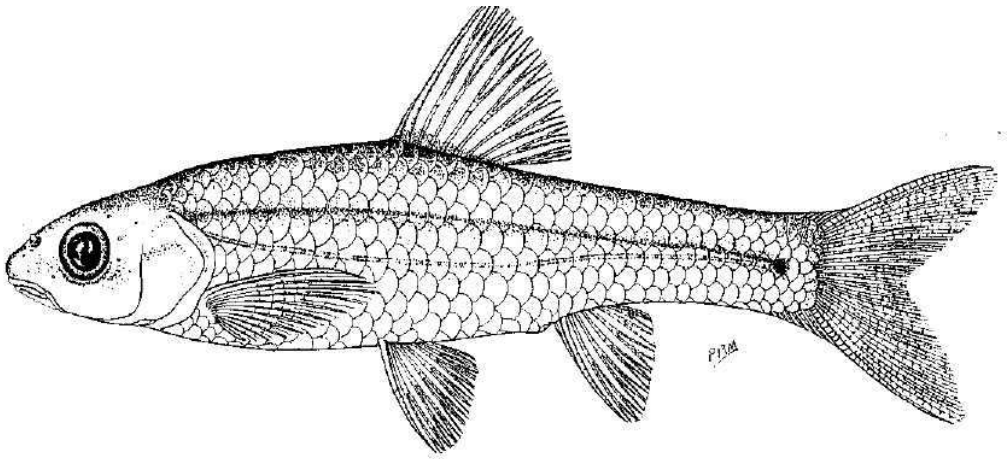
REFERENCES:

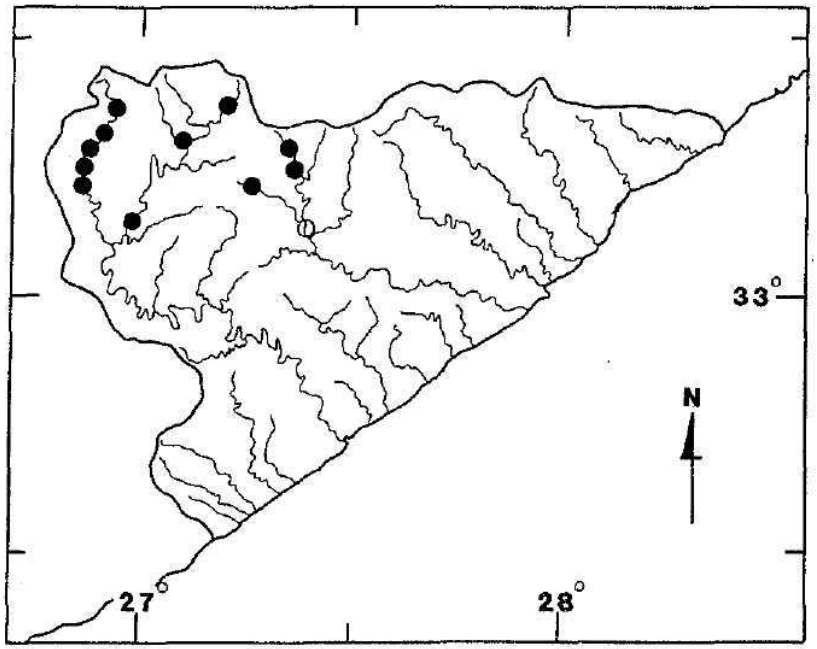
de Wet (1986); Groenewald (1958); Jubb (1967a, 1968a); Noble (1974); Pott (1970, 1981); Skelton (1977); Kleynhans (1982, 1984).

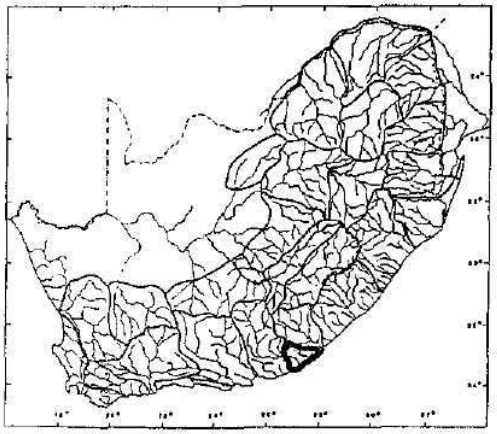
Correspondence: Dr C J Kleynhans.

BORDER BARB / GRENS-GHIELIEMIENTJIE

FIGURE 13. The Border barb, *Barbus trevelyani,* 58 mm SL, with distribution in the Buffalo and Keiskamma River systems, eastern Cape Province and Ciskei.







Key

- ● Site record from literature or museum collection
- ○ Historic record

BORDER BARB / GRENS-GHIELIEMIENTJIE **VULNERABLE**

Barbus trevelyani Gunther 1877

Family: Cyprinidae

SUMMARY

Status: Vulnerable. Since the initial assessment in 1977 the status of this species appears to have improved. Successful artificial breeding techniques for the species have been developed. Surveys have shown the species to be present in adequate numbers at several locales.

Research: Fair - good. Distribution surveys of the Buffalo and Keiskamma Rivers have been made in 1979 to 1981 by the CDNEC and also of the Keiskamma by Mayekiso (1986). Artificial breeding techniques are reported by Bok and Heard (1982) and larval development by Cambray (1985b).

SPECIES DATA

Identification: A fusiform cyprinid minnow (maximum size + **100** mm SL). Colour is olive-grey with a characteristic pattern of horizontal lateral stripes forming a bow on the body. One thin stripe follows the myoceptum and another the lateral line, uniting to form a single line on the caudal peduncle and terminating in an expanded spot at the base of the caudal fin. The mouth is subterminal and there are one or two pairs of barbels. Both sexes develop small scattered tubercles on the head in the breeding season.

Distribution: Tributaries and upper reaches of the Keiskamma and Buffalo River systems in the Ciskei and eastern Cape province (Jubb 1965, 1967a; Visser 1969; Gaigher 1975; Mayekiso 1986). Reports of the species in the Nahoon River (Jubb 1965, 1967a) have not been confirmed in recent surveys of that river (CDNEC records). Mayekiso (1986) confirmed the presence of the species in the upper reaches (above 520 m altitude) of the Keiskamma and Tyume Rivers. In the Buffalo River the type locality and other early records are given as King William's Town but it is not known to what extent this can be taken literally. Recent records indicate the species to be present in the mainstream below and above Maden Dam as well as in the Mgqakwebe and Cwengcwe streams above Pirie (AMG and CDNEC records).

Habitat and ecology: Clear perennial streams with rocky and stony sub-strata (Gaigher 1975). It inhabits pools and shelters behind rocks in the flowing waters of shallow runs. Cohabiting fish include *Barbus anoplus, Labeo umbratus, Sandelia bainsii, Anguilla mossambica* and trout *(Parasalmo mykiss)*. Other species which inhabit the river systems where *B trevelyani* occurs include *Tilapia sparrmanii, Micropterus salmoides, M dolomieu, Salmo trutta, Glossogobius callidus* and *Myxus capensis* although several of these are not generally found in the upper reaches (Gaigher 1975; Jackson 1982; Mayekiso 1986). The main food of *B trevelyani* is aquatic invertebrates especially ephemeropteran nymphs (Gaigher 1975).

Breeding biology: The species is a partial spawner that breeds in early to mid-summer (September to December). Its fecundity varies from 900 in smaller females (65 to 69 mm FL) to about 5 000 ova in large specimens (Gaigher 1975). *Barbus trevelyani* has been kept successfully in

aquaria and ponds. It has been bred in captivity using artificial means (Bok and Heard 1982; Cambray 1985b), The larval development and early life history has been studied by Cambray (1985b).

CONSERVATION

Threats: Habitat destruction from siltation, water extraction and pollution constitutes the major threat to this species (Gaigher 1975, 1978; Gaigher et al 1980). Much of the Buffalo River system especially downstream of the King William's Town environs has been grossly affected by urban and industrial developments (Hart 1982). These changes have most likely reduced and restricted the range of *B trevelyani* in the system. Erosion is a problem in the upper Keiskamma River basin (Gaigher 1975; Mayekiso 1986). Several introduced species including trout *(Parasalmo mykiss)* and black bass *(Micropterus salmoides)* also threaten this species (Jackson 1982; Mayekiso 1986).

Conservation attention given: Surveys to determine distribution and status have been carried out by the CDNEC in 1979 to 1981. Successful artificial spawning techniques have been developed (Bok and Heard 1982). Aspects of the biology of *B trevelyani* were reported on by Gaigher (1975). Surveys of the Keiskamma River were made by Mayekiso (1986) as part of a study on the biology and ecology of *Sandelia bainsii.*

Conservation recommendationsi Suitable sanctuary streams need to be selected and proclaimed. Once established these should be monitored on a regular basis. Restocking of depleted populations may be necessary in certain cases. Sound catchment management is necessary to prevent further deterioration of the environment.

Remarks: The major threat of habitat destruction through over population and poor land management is increasing throughout the range of this species. Thus the survival and long-term existence of the species remains threatened. The transfer of the Pirie trout hatchery from the Cape Department of Environmental Conservation to the Ciskei authorities caused a considerable disruption to the stocking with trout of catchment streams of the Winterberg-Amatola range. In addition the severe droughts of 1979 to 1980 reduced trout numbers in many of the upland streams and Jackson (1982) remarks that this appears to have favoured the recovery of *B trevelyani* populations. The Ciskei authorities have resumed the trout programme and it is essential that some streams are maintained as sanctuaries for indigenous species.

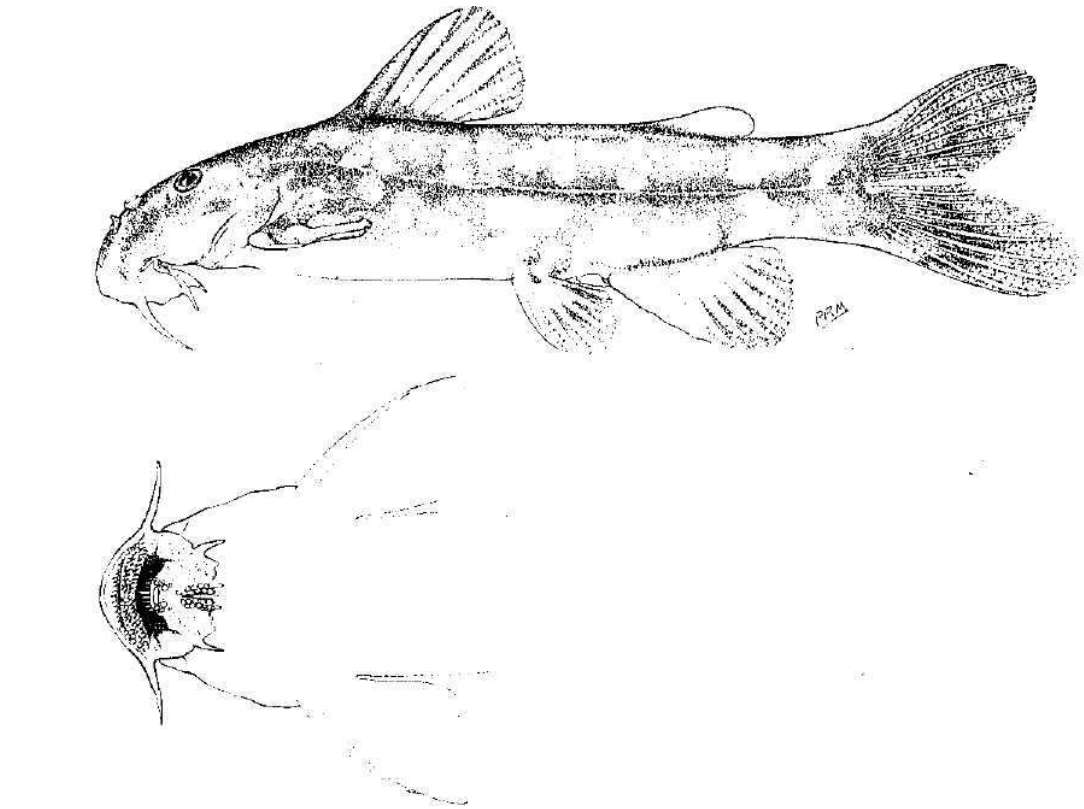
REFERENCES:

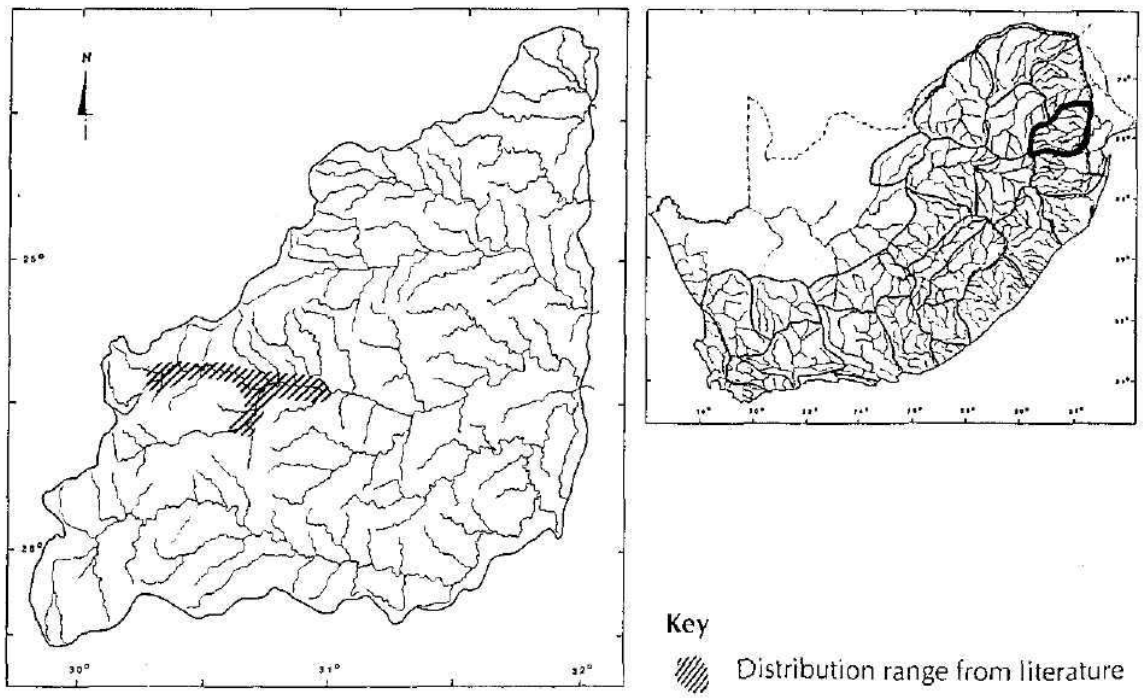
Bok and Heard (1982); Cambray (1985b); Gaigher (1975, 1978); Gaigher et al (1980); Hart (1982); Jackson (1982); Jubb (1965, 1967a); Mayekiso (1986); Noble (1974); Skelton (1977); Visser (1968).

Correspondence: Dr A H Bok; J A Cambray; Dr K C D Hamman; H W Heard; M Mayekiso.

INCOMATI ROCK **CATLET / INCOMATI-SUIERBEKKIE**

FIGURE 14. The Incomati rock catlet, *Chiloglanis bifurcus,* 46 mm SL, with distribution in the Incomati River system, Transvaal.





ROCK-CATFISH / KLIPBABER RARE - INDETERMINATE

Austroglanis sclateri (Boulenger 1901)

Family: Bagridae

SUMMARY

Status: Rare - indeterminate. The rock-catfish is habitat-restricted within the heavily degraded and progressively more regulated Orange-Vaal River system.

Research: Poor - fair. The species is known only from museum records and incidental catches during fishery programmes and general distribution surveys.

SPECIES DATA

Identification: A moderately large bagrid catfish (maximum recorded size 300 mm TL). The head is obtusely pointed and sloped at an angle of + 35°. There are three pairs of relatively short simple circumoral barbels. The dorsal fin is short based with a strong simple spine. The pectoral fins have strong spines that are serrated along the inner margin. On either side of the pectoral girdle there is a pointed humeral process. The caudal fin is forked with obtuse lobes. The colour is usually a drab olive-brown with scattered smallish dark spots.

Distribution: The rock catfish is endemic to the Vaal-Orange River system where it is reported to occur only in the permanently flowing mainstream and larger tributaries (Barnard 1943; Jubb 1965, 1967a, 1972; Janse van Vuren 1978; Gaigher et al 1980; Skelton and Cambray 1981; Cambray 1984). It is uncommon in impoundments such as Lake Verwoerd or Lake Le Roux (Jackson et al 1983). The species has been translocated to the Great Fish River system via the Orange-Fish canal (Laurenson and Hocutt 1984).

Habitat and ecology: This species prefers rocky habitats in flowing water (Skelton and Cambray 1981; Jackson et al 1983; Cambray 1984). A recent overviev of the Orange-Vaal River is given by Cambray et al (1986). The current status and descriptions of various environmental factors and problems of the the Vaal River are presented in detail by Walmsley and Rogers (1986). *Austroglanis sclateri* is omnivorous, feeding primarily on aquatic insects with larger specimens also predating on small fishes (Jubb 1965, 1967a, 1972).

Breeding biology: No data available.

Remarks: Skelton (1981) and Skelton et al (1984) consider the taxonomy of *Austroglanis* species.

CONSERVATION

Threats: The construction of large impoundments and numerous smaller weirs has adversely affected the abundance and distribution of this species (Jackson et al 1983). Large-scale water abstraction for urban, industrial and agricultural purposes, and consequent urban and industrial pollution are major threats to the environment, especially of the Vaal River system (Walmsley and Rogers 1986). Soil erosion is a major problem

in the Orange River catchment and sedimentation has undoubtedly destroyed much of the habitat of this species in certain areas eg the upper Orange and Caledon Rivers (Jacot-Guillarmod 1972; Marshall 1972). Alluvial mining in the lower Vaal River is a restricted threat through localized habitat destruction. River regulation below the two major hydroelectric dams on the Orange River may favour the habits and enhance the status of this species (Cambray 1984).

Conservation attention given: No specific attention has been paid to this species but incidental collections made in the regular gill net surveys of the Verwoerd and Le Roux Lakes by the CDNEC are recorded (Jackson et al 1983). This species is being given specific protective legislation under the proposed new ordinance of the Cape Department of Nature and Environmental Conservation (RC D Hamman personal communication).

Conservation recommendations: Studies to determine the conservation status, distribution, biology and ecology of the rock catfish are needed. Conservation interests in the Orange-Vaal River need to be defined and incorporated as far as possible into the planning and management of this important river system.

Remarks: The real abundance of this species has never been established partly because of its restricted habitat preferences and partly because it is difficult to catch even with suitable equipment. In spite of its fairly widespread distribution in the Orange-Vaal River system the rock catfish is an uncommon species and several authors have commented on its rarity (eg Marshall 1972; Skelton and Cambray 1981; Jackson et al 1983; Cambray 1984; Mulder 1986). Benade (in littera) recorded only six specimens of *Austroglanis sclateri* from approximately 12 tons of fish that was removed from a three kilometre stretch of the Vaal River near Barkly West during diamond mining operations. It is clear that the conservation status of this species should be investigated without delay.

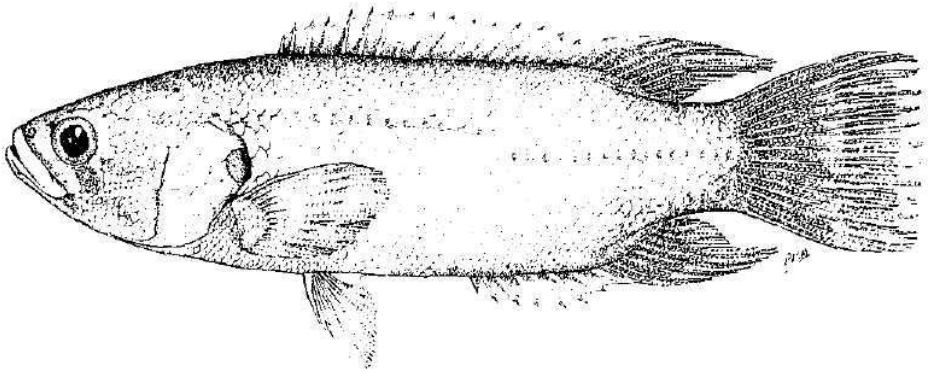
REFERENCES

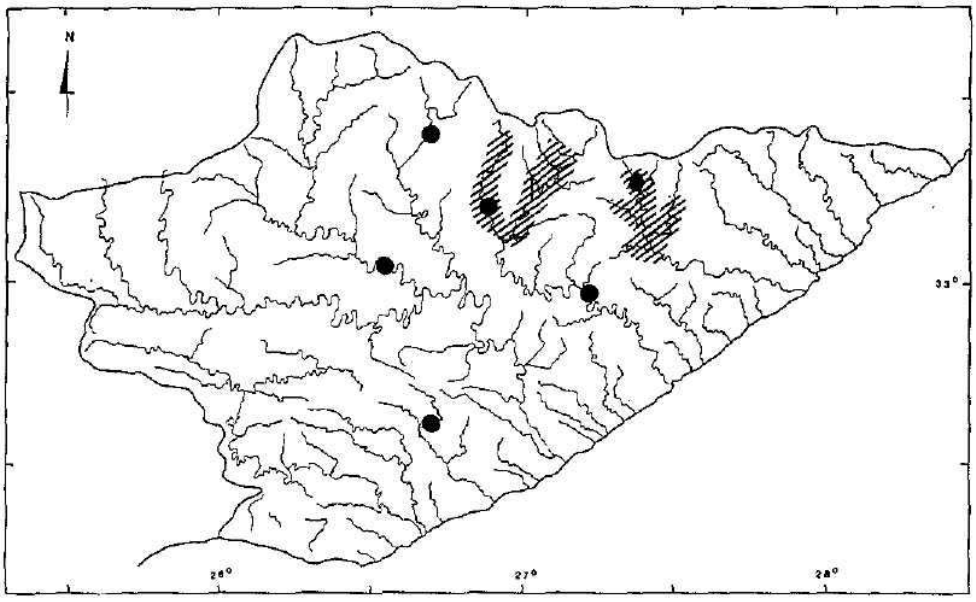
Barnard (1943); Cambray (1984); Cambray et al (1986); Gaigher et al (1980); Jackson et al (1983); Janse van Vuren (1978); Jacot-Guillarmod (1972); Jubb (1965, 1967a, 1972); Laurenson and Hocutt (1984); Marshall (1972); Mulder (1986); Skelton and Cambray (1981); Skelton et al (1984); Van Schoor (1972); Walmsley and Rogers (1986).

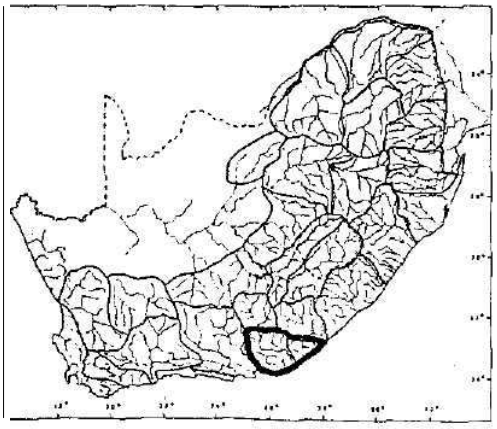
Correspondence: C Benade; J A Cambray; Dr K C D Hamman.

EASTERN PROVINCE ROCKY / OOS PROVINSIE-KURPER

FIGURE 15. The Eastern Province rocky, *Sandelia bainsii, t* 150 mm SL, with distribution in the south-east Cape Province and Ciskei.







Key

Distribution range from literature

Site record from literature or museum collection

EASTERN PROVINCE ROCKY / OOS PROVINSIE-KURPER **VULNERABLE**

Sandelia bainsii Gastelnau 1861

Family: Anabantidae

SUMMARY

Status: Vulnerable. The species has declined throughout its restricted range as a result of large scale habitat alteration and the introduction of alien fish predators.

Research: Fair - good. Mayekiso (1986) studied the biology of the species from the Tyume River. Distribution surveys have been made in certain rivers where the species occurs.

SPECIES DATA

Identification: A relatively large (maximum size 245 mm SL) and elongate anabantid. The head is pointed and the eye is placed forward over the large terminal mouth. The dorsal and anal fins each have a long series of spines and the caudal fin is frequently tasselled. Dorsal and ventral scales are distinctly smaller than mid-lateral scales. Colour is olive-grey or greenish-yellow with blackish edge to median fins, one or two indistinct dark bars radiate over the cheek from behind the eye. Males assume a pale green or lemon colouration during the breeding season (Mayekiso 1986).

Distribution: Known only from four river systems in the eastern Cape and Ciskei: the Kowie River; the Koonap and Kat River tributaries of the Great Fish River system; the Keiskamma River system and Buffalo River system (Jubb 1965, 1967a). An earlier report by Barnard (1943) mentions that *S bainsii* occurs in the Nahoon River but museum specimens from this locality have not been traced and the report is unconfirmed.

Habitat and ecology: *Sandelia bainsii* is found in quiet rocky habitats of larger streams. Mayekiso (1986) found that it favoured shallow marginal habitats where water flow is relatively slow. The species was frequently encountered just below weirs and Mayekiso (1986) suggested that this indicated a preference for clear water and silt free substrates. Depending on the system 5 *bainsii* occurs together with several other fish species including minnows *(Barbus trevelyani, B anoplus, B pallidvs)* the small clupeid *Gilchristella aestuaria,* freshwater mullet *(Myxus capensis)*, the goby *Glossogobius callidus,* the moggel *(Labeo umbratus),* as well as *Tilapia sparrmanii* and eels *(Anguilla* species). The rocky is a predator on invertebrates especially ephemeropteran nymphs, crabs and also on small fishes.

Breeding biology: *Sandelia bainsii* breeds in summer (October to February) and is a multiple spawner, laying demersal eggs. As far as has been determined the species is not a nest or brood guarder (Mayekiso 1986). Maturity is reached in the second year. Fecundity varies from less than 1 000 in a fish of about 70 mm SL to more than 7 000 in specimens of about 120 mm SL (Mayekiso 1986). The rocky is easily maintained in larger aquaria and unconfirmed reports of breeding in captivity have been received.

Remarks: The Eastern Province rocky *Sandelia bainsii* is fairly well known from general studies on systematics (Barnard 1943; Jubb 1965, 1967), anatomy (Cambray 1978), chemical tolerance (Hofmeyer 1966) and its biology and ecology (Mayekiso 1986). There are also several general accounts of the species in the literature such as Cambray (1981); Harrison (1952c); Jubb (1971).

CONSERVATION

Threats: There has been a general habitat deterioration throughout the range of *S bainsii* due to such factors as water abstraction (particularly during drought periods); agricultural, urban and industrial pollution (Hart 1982); and sedimentation as a result of soil erosion (Gaigher 1979; Mayekiso 1986). In addition there has been competition and predation by alien fishes such as bass *(Micropterus* species), trout *(Parasalmo mykiss)* and the sharptooth catfish *(Clarias gariepinus)* (Mayekiso 1986).

Conservation attention given: Mayekiso (1986) completed an autecological study of 5 *bainsii* in the Tyume River of the Keiskamma River system. Ad hoc distribution surveys of certain rivers where the species is known to occur have been made by the CDNEC. At least one locale where 5 *bainsii* occurs is on the Bloukrans River in a small nature reserve being established by the Diaz Divisional Council.

Conservation recommendations: A detailed survey of all rivers where the species is known or recorded from is required to determine the conservation status. River management strategies need to be developed to minimize the impact of agricultural and urban activities. Studies on the impact of alien fish species on 5 *bainsii* are required. Sanctuaries for 5 *bainsii* should be established. Captive breeding techniques for this species need to be developed and where necessary the restocking of natural waters should be made.

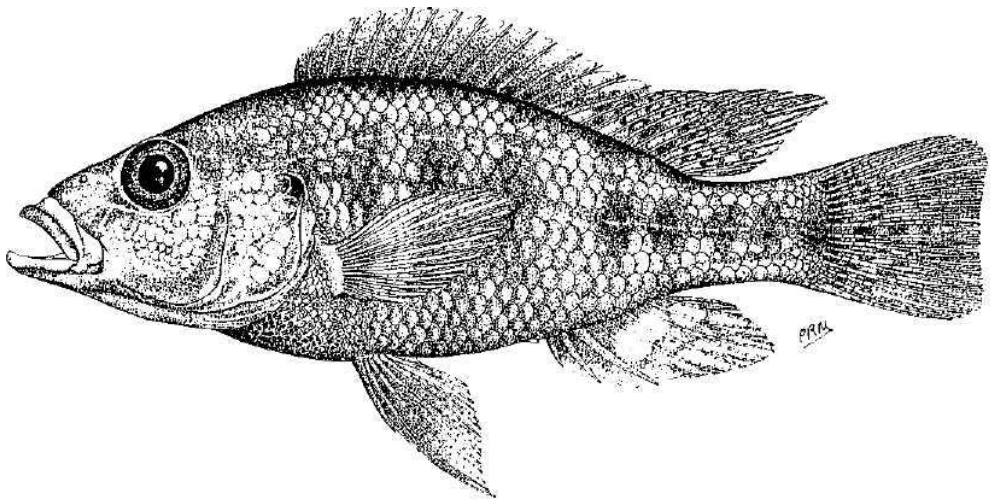
REFERENCES:

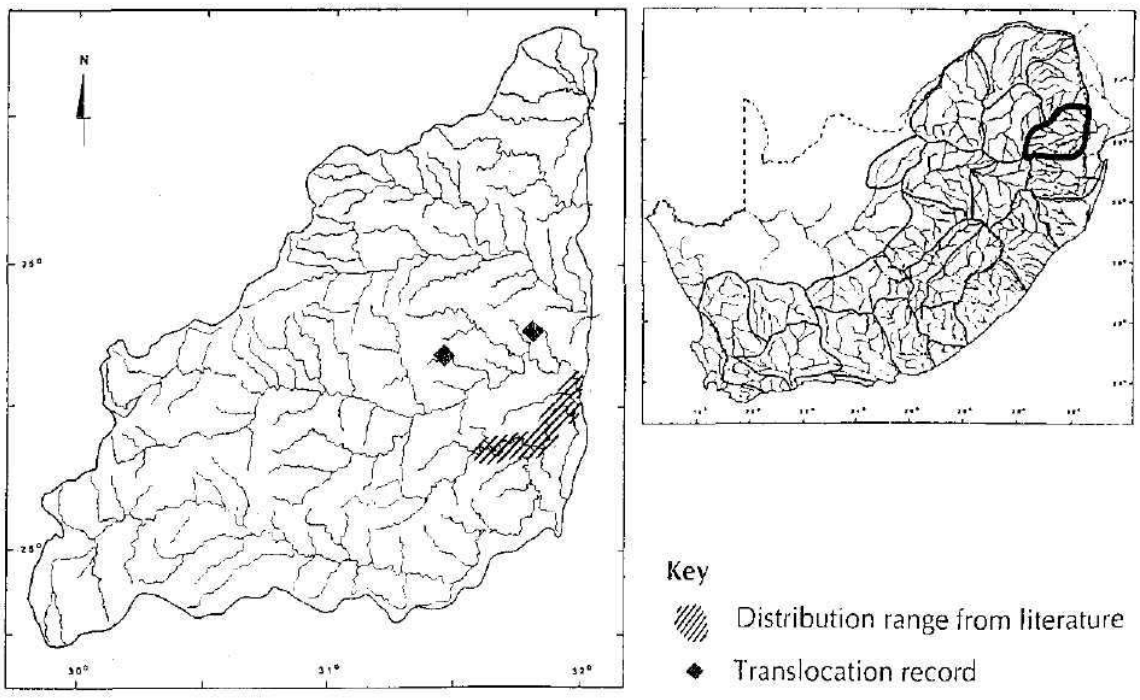
Barnard (1943); Bok (1983); Cambray (1978, 1981); Gaigher (1979); Harrison (1952c); Hart (1982); Hofmeyer (1966); Jackson (1982); Jubb (1965, 1967a, 1971); Mayekiso (1986); Visser (1969).

Correspondence: Dr A H Bok, J A Cambray, Dr K C D Hamman, M Mayekiso, S C Thome.

ORANGE-FRINGED LARGEMOUTH / ORANJERAHD-GROOTBEK

FIGURE 16. The orange-fringed largemouth, *Astatotilapia brevis* ± 150 ram SL, with distribution in the Incomati River system' eastern Transvaal.





ORANGE-FRINGED LARGEMOUTH / ORANJERAND-GROOTBEK **RARE**

Astatotilapia brevis (Jubb 1968)

Family: Cichlidae

SUMMARY

Status: Rare. The natural distribution of this species is restricted to a tributary of the Incomati River system which is exploited for agricultural use.

Research: Fair - good. An assessment study of the conservation status of the species was made by Kleynhans (1982, 1984).

SPECIES DATA

Identification: The orange-fringed largemouth is a relatively slender bodied cichlid reaching 150 mm SL. The mouth and upper jaw bones are comparatively short (maxillary does not reach to below the orbit) and are set with small unicuspid teeth. Its colour is olive-brown above, silvery-cream below with eight or nine variable dark vertical bars most intense along mid-line and above the upper lateral line. In adults the lappets and outer margin of the dorsal fin are bright orange, and there are series of orange spots on the membranes of the spinous and soft dorsal fin. The truncate caudal fin has orange outer extremities. The anal fin of males has six or seven large bright orange-vermillion ocelli.

Distribution: This species occurs naturally in the Lomati and Komati Rivers of the Incomati River system, south-eastern Transvaal (Jubb 1968b; Gaigher 1969; Kleynhans 1982, 1984). The species has been translocated to impoundments on tributaries of the Crocodile River (Incomati system) in the Kruger National Park (Pienaar 1978b). It has also been recorded from coastal lakes between the mouths of the Limpopo and Incomati Rivers in Mozambique (Gaigher 1969; Jubb 1968b).

Habitat and ecology: It favours pools, impounded waters and quiet river stretches with sandy substrates and good marginal vegetation (Gaigher 1969; Kleynhans 1982, 1984). In the Komati River relatively low population densities exists (4,4% relative density, Kleynhans 1982, 1984) but in a dam on the Lomati this rises to 21,7%. U de V Pienaar (personal communication) reports that the translocated populations in Kruger Park dams are flourishing from an original stocking of about 100 individuals in 1975. Cohabiting fish species include at least 19 species in the families Mormyridae, Characidae, Cyprinidae, Schilbeidae, Clariidae, Cichlidae and Gobiidae. *Astatotilapia brevis* is a predator on invertebrates and fishes (Jubb 1968b; Kleynhans 1982).

Breeding biology: It is a mouth brooding species which carries in the region of 80 eggs per brood. Fecundity varies from about 90 to 145. Brooding fishes have been collected in May (Kleynhans 1982) but the species is likely to breed throughout the warmer months of the year. Pienaar (1978a,b) reports that this species breeds successfully in small dams.

Remarks: The current generic placement is tentative (Greenwood 1979) and further investigations into the systematics and taxonomy of the species

are being carried out.

CONSERVATION

Threats: Water abstraction, siltation and agricultural pollution present major threats in the limited natural range of this species. Impoundments and weirs are beneficial to this species (Gaigher 1969; Pienaar 1978a,b; Kleynhans 1982, 1984).

Conservation attention given: The Transvaal Nature Conservation Division has conducted surveys and ecological studies of the species (Kleynhans 1982, 1984). Successful translocations from the Lomati and Komati Rivers to the Stolsnek, Newu, Mpondo and Berg-en-dal Dams in the Kruger National Park were made in 1975 (Pienaar 1978a,b). The construction of additional dams within the natural range of this species will favour the species.

Conservation recommendations: Kleynhans (1982, 1984) recommended that the habitat and status of *Astatotilapia brevis* should be monitored at regular intervals of not more than two years.

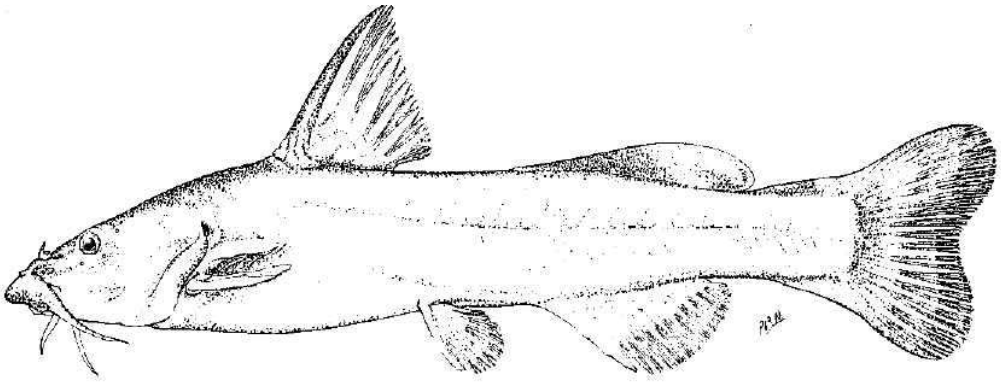
REFERENCES:

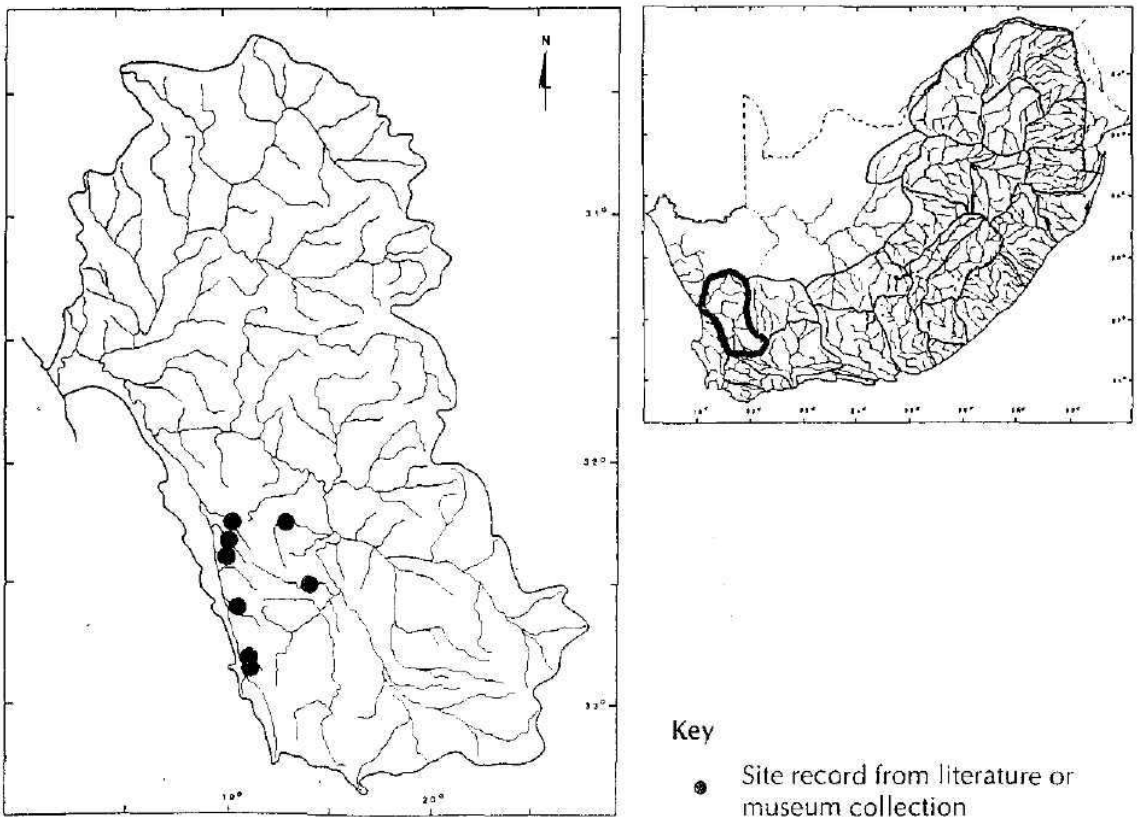
Gaigher (1969); Greenwood (1979); Jubb (1968b); Kleynhans (1982, 1984); Pienaar (1978a,b).

Correspondence: Dr C J Kleynhans; Dr U de V Pienaar.

CLAHWILLIAM ROCK-CATFISH / CLARWILLIAM-KUPRABER

FIGURE 17. The Clanwilliam rock-catfish, *Austroglanis gilli,* 94 mm SL, with distribution in the Olifants River system, western Cape Province.





CLANWILLIAM ROCK-CATFISH / CkANWILLIAM-KLXPBABER RARE

Austroglanis gilli (Barnard 1943)

Family: Bagridae

SUMMARY

Status: Rare. This species is endemic to the Olifants River system where it is uncommon and threatened by alien fishes and habitat deterioration.

Research: Fair. Distribution and population status surveys of the Olifants River system have been made since 1977 by the CDNEC.

SPECIES DATA

Identification: This is a relatively small (reaches 127 mm SL) plain greyish catfish. The short based dorsal fin has a strong spine, and the pectoral fins each have a strong serrated spine. There is a well developed humeral process on either side of the pectoral girdle. The caudal fin is emarginate. The mouth is terminal with fleshy lips and there are three pairs of simple circumoral barbels.

Distribution: At the present time *A gilli* is known only from certain Cedarberg tributaries of the Olifants River system, western Cape (Jubb 1965, 1967a; Gaigher et al 1980). Formerly the species was recorded also from the Olifants mainstream (Barnard 1943).

Habitat and ecology: The habitat of *A gilli* is perennial streams and rivers bedded with loose rounded rocks, pebbles and coarse clean sand (Barnard 1943, personal observation). It occurs in both pools and shallow riffles. Associated fishes include the redfin minnows *Barbus calidus* and *Barbus phlegethon,* the small galaxias *Galaxias zebratus,* juveniles of *B capensis* and *B serra* as well as the related catlet *Austroglanis barnardi. Austroglanis gilli* is primarily a benthic invertebrate feeder.

Breeding biology: No data available. Specimens have been kept with limited success in aquariums (Barnard 1943; K C D Hamman personal communication).

Remarks: Skelton (1981) and Skelton et al (1984) consider the taxonomy and systematics of the *Austroglanis* species.

CONSERVATION

Threats: Introduced alien predators *(Micropterus dolomieu, M salmoides)* and habitat destruction through sedimentation, water abstraction and stream channelization are the major threats and causes of the decline of this species (Gaigher et al 1980).

Conservation attention given: The species will benefit from the general conservation strategy adopted for the Olifants River system by the CDNEC (Scott 1982; see also Clanwilliam yellowfish sheet). Several distribution surveys have been carried out by the CDNEC since 1977.

Conservation recommendations: Continued development and application of a

conservation plan for the Olifants River system is necessary. Informing riparian land owners of the value, the threats to, and ways of conserving the fish fauna, is recommended. Where possible sanctuary areas should be established for *Austroglanis gilli* and other threatened species in the system. The biology and ecology of *A gilli* should be studied in relation to other threatened species and the impact of alien fishes. Captive breeding methods should be developed and, if necessary, natural habitats restocked.

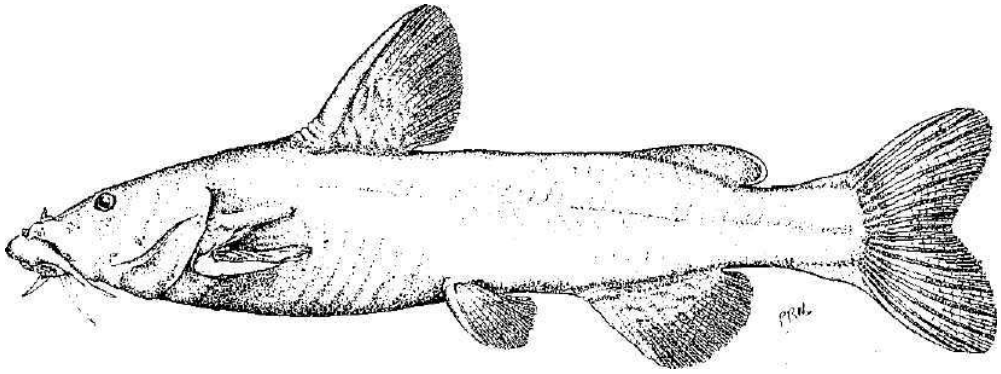
REFERENCES:

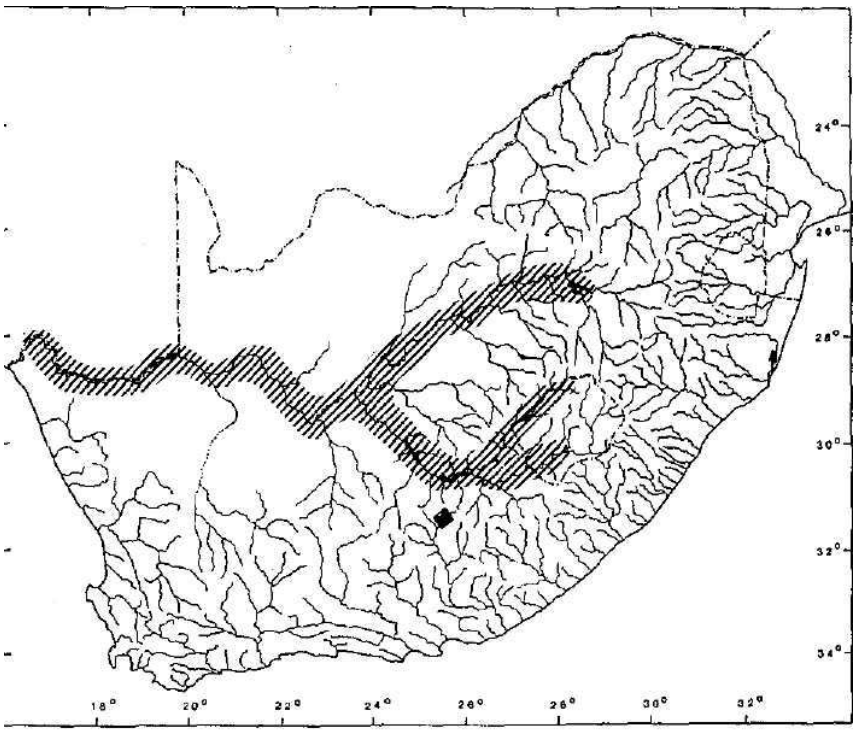
Barnard (1943); Gaigher (1973a); Gaigher et al (1980); Jubb (1965, 1967a); Skelton (1977, 1981); Skelton et al (1984); Scott (1982); Scott and Hamman (1984); Van Rensburg (1966).

Correspondence: Dr K C D Hamman; S C Thorne.

ROCK-CATFISH / KLIPBABER

FIGURE 18. The rock-catfish, *Austroglanis sclateri,* ± 150 mm SL, with distribution in the Orange River system, South Africa, Lesotho and South West Africa/Namibia.





Key

Distribution range from literature

Translocation record

INCOMATI ROCK CATLET / INCOMATI-SUIERBEKKIE **VULNERABLE**

Chiloglanis bifurcus Jubb and Le Roux 1969

Family: Mochokidae

SUMMARY

Status: Vulnerable. The Incomati rock catlet occurs within a narrow range in a system that is subject to increasing manipulation and exploitation.

Research: Good. Kleynhans (1982, 1984) investigated the conservation status of this species.

SPECIES DATA

Identification: A small depressed catlet (maximum size 68 mm SL). The disc-shaped mouth of these catlets is a distinctive feature. Up to eight widely spaced mandibular teeth and relatively short mandibular barbels are characteristic. The dorsal spine is not serrated. The caudal fin is forked with large rounded lobes.

Distribution: The species is endemic to the Incomati River system (Jubb and Le Roux 1969; Gaigher 1969; Kleynhans 1982, 1984). Within the system it is restricted to altitudes between 900 m and 1 200 m in the Crocodile River tributary and certain of its subtributaries (Elands, Ngodwana, Gladdespruit, Stadspruit) (Kleynhans 1984).

Habitat and ecology: Occurs in rocky rapids and cascades of permanent rivers. In these habitats in the Crocodile River, Kleynhans (1982, 1984) recorded that current speed varied from 0,35 to 1,16 m sec^{-1}, stream depth was 0,3 to 0,5 m and river width five to eight metres. It was found at relatively low population densities together with several other fish species including *Anguilla mossambica, Barbus argenteus, B pallidvs, Amphilius uranoscopus, A natalensis* and *Chiloglanis pretoriae.* The ■ast named species was by fa/ the r;.o.;t numerically abundant in the habitat (relative density of 85,7%). *Chiloglanis bifurcus* feeds on benthic invertebrates including ephemeropteran simuliid and trichopteran larvae and small gastropods.

Breeding biology: A partial spawner with total fecundity of between 250 and 300 ova. It breeds in summer from October to February, The precise spawning habitat has not been identified but this is likely to be in the rocks of the preferred habitat.

Remarks: Although Gaigher (1969) reported *C bifurcus* from the Komati branch of the Incomati system the more recent surveys by Kleynhans (1982, 1984) and monitoring surveys during 1986 have not encountered the species there. It is possible that Gaigher's (1969) specimens were misidentified.

CONSERVATION

Threats: The main threats to this species are environmental changes which are taking place due to increasing utilization of the water resources by agriculture and industry. For a specialized rheophilic species like *C bifurcus* the trend of increasing regulation of water supply is of

major concern. The recent construction of the Braam Raubenheimer Dam in the Crocodile River is particularly relevant in this regard. Pollution from industrial sources (a large paper mill sited adjacent to the Elands River) threatens part of the population.

Conservation attention givent The biology and distribution of this species was studied in detail by Transvaal Conservation authorities (Kleynhans 1982, 1984). This study proposed conservation measures to be taken as outlined below.

Conservation recommendations: The following recommendations were made by Kleynhans (1982, 1984): (i) the known range and habitat of the species to be monitored annually; (ii) part of range of species should be included in a proposed nature reserve; (iii) there should be liaison between Transvaal Nature Conservation authorities and the Department of Water Affairs in connection with a suitable drawdown arrangement for the Braam Raubenheimer (or Elandspruit) Dam (which is sited directly upstream of *Chiloglanis bifurcus* habitat).

Remarks: C J Kleynhans (personal communication) notes that the release of water from the Braam Raubenheimer Dam is primarily for, and is determined by, agricultural demands in the lowveld region. Nevertheless in spite of relatively low flows in the river due to storage, the numbers of *C bifurcus* below the dam had not been noticably affected in 1986.

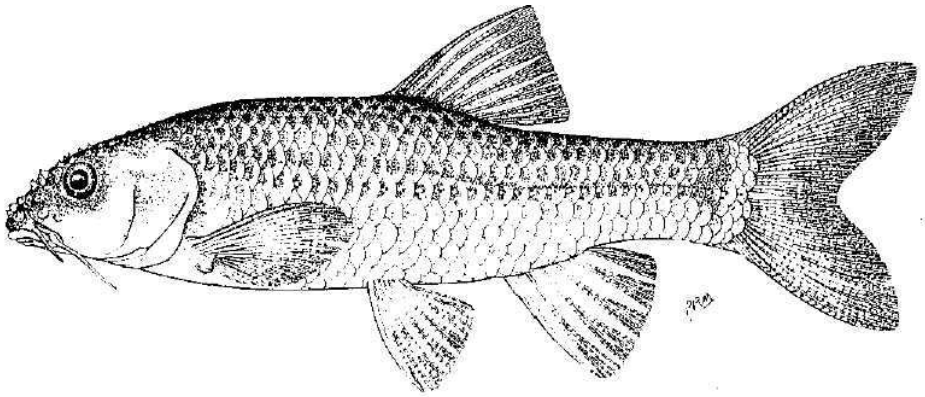
REFERENCES:

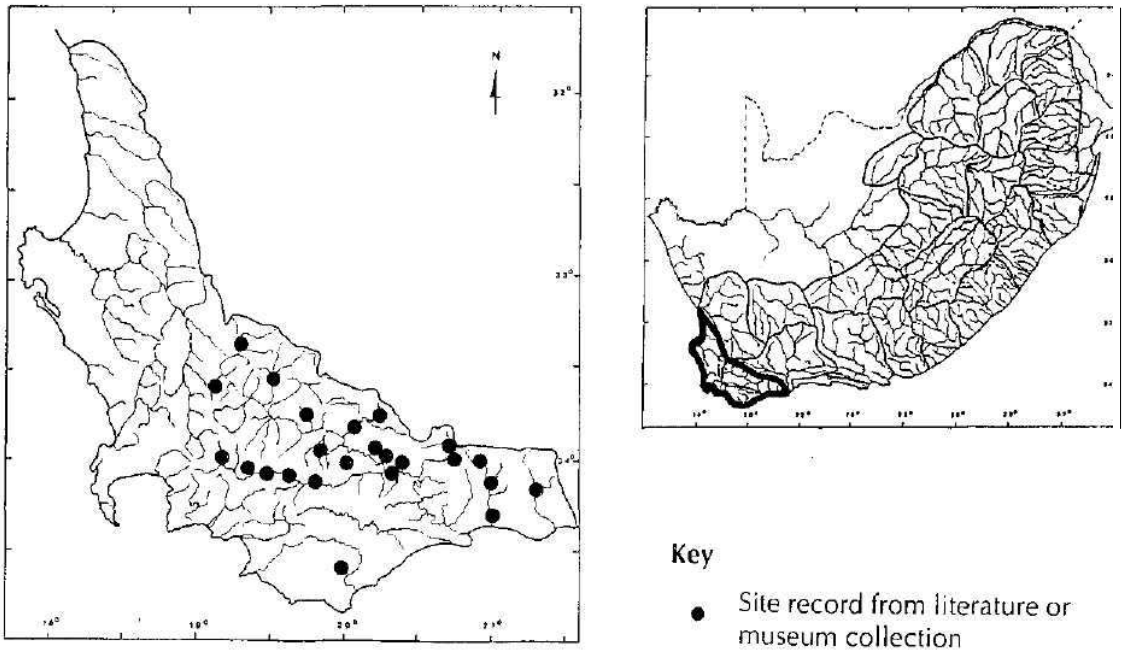
Gaigher (1969); Jubb and Le Roux (1969); Kleynhans {1982, 1984); Skelton (1977).

Correspondence: Dr C J Kleynhans.

BURCHELL'S REDFXN / BURCHELL SE ROOIVLERKIE

FIGURE 19. Burchell's redfin, *Barbus burchelli,* 80 mm SL, with distribution in the south-west Cape Province.





BURCHELL'S REDFIK / BURCHELL SE ROOIVLEHKIE RARE

Barbus burchelli Smith 1841

Family: Cyprinidae SUMMARY

Status: Rare. The species has been extirpated from much of its natural range. Further demands on freshwater supplies from south-western Cape rivers is likely to increase pressures on this species.

Research: Fair - good. Distribution and population status surveys have been made since 1977 by the CDNEC and certain aspects of the biology of the species have been studied (Cambray and Stuart 1985).

SPECIES DATA

Identification: A redfin cyprinid minnow that attains 136 mm SL. The mouth is subterminal with two pairs of well developed barbels. In summer during the breeding period males develop large conical tubercles on the head. The dorsal fin has a flexible unbranched ray. Juveniles have large irregular spots and a prominent mid-lateral series of connected blotches. In adults the fins are bright red basally. The intestine in this species is relatively elongate and involuted.

Distribution: Burchell's redfin is endemic to the Bree River and the adjacent Nuwejaars, Duiwenhoks and Kaffirkuils Rivers (Barnard 1943; Jubb 1965, 1967a; Cambray and Stuart 1985). An isolated population occurs in the Grashoek River, a tributary of the Heuningnes River, west of the Bree River (S C Thome personal communication).

Habitat and ecology: Occurs in a wide variety of habitats but prefers clear rocky pools of flowing streams. The Grashoek River is a lowland nonperennial system with turbid water, a predominantly sandy-gravel substratum and marginal beds of *Phragmites* reeds. The habitat of this species in two study sites on the Reisers and Cogmanskloof Rivers was illustrated and described by Cambray and Stuart (1985). It is absent from the mainstream and lower reaches of larger tributaries where introduced bass *(Micropterus* species) occur. It is most frequently found together with *Galaxias zebratus* and *Sandelia capensis* (Cambray and Stuart 1985). *Barbus burchelli* are primarily benthic feeders on detritus, diatoms, algae and ostracods, copepods and chironomid larvae.

Breeding biology: Cambray and Stuart (1985) provide the following information on the breeding biology of this species. Spawning occurs during early to mid-summer (September to February) with the peak during December and January. Fecundity based on the largest ova class in the ovaries only varies between ± 500 and 7 500 ova. Sections of the population appear to breed at different times and the different ova sizes present in individual fishes suggest that fractional spawning is normal. There are indications that males are territorial for breeding purposes. Sex ratio varies per size class with slightly more males in smaller size classes (less than 70 mm FL) and more females at larger size classes (greater than 70 mm FL) giving an overall ratio of one male to 1,4 or 1,5 females. No captive breeding has been reported but the species has been maintained in aquaria and outside ponds without difficulty (S C Thorne personal communication).

Remarks: Further studies on the biology of this species are being made (KC D Hamman and S C Thome personal communication).

CONSERVATION

Threats: Habitat destruction by man and the effects of introduced alien fishes are the main threats to this species. Apart from the mountain catchment zone intensive agriculture is common throughout the catchments of the range of the species. Extensive abstraction of water is taking place and there is a potential for pollution from insecticides, fertilizers and domestic and industrial sources. Habitat destruction from stream canalization, invasive plants, sedimentation and erosion from flood damage has been observed or recently recorded in the range of this species (Gaigher et al 1980; Cambray and Stuart 1985; Hamman et al 1982). Introduced alien fish species, especially bass *(Micropterus* species and trout *{Parasalmo mykiss* and *Salmo trutta)* have had a negative impact on this species (Gaigher et al 1980; Cambray and Stuart 1985) and Burchell's redfin is absent from many locales where these aliens are established.

Conservation attention given: Distribution surveys have been conducted by the CDNEC and certain aspects of the biology of the species have been studied (Cambray and Stuart 1985). Protection of alien predatory fish species has been repealed from the Nature Conservation Ordinance (KCD Hamman personal communication).

Conservation recommendations: Sanctuary streams for this species should be established in the Bree River catchment area, as well as for the isolated populations in the Duiwenhoks, Kaffirkuils and the Grashoek Rivers. A captive breeding programme for restocking depleted populations where necessary should be developed. Education on the conservation of aquatic environments, resources and organisms is essential for the general public, especially riparian land owners.

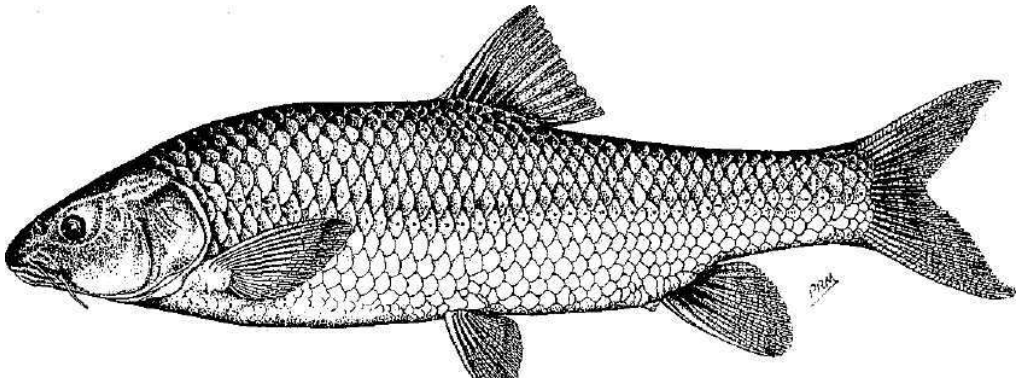
REFERENCES

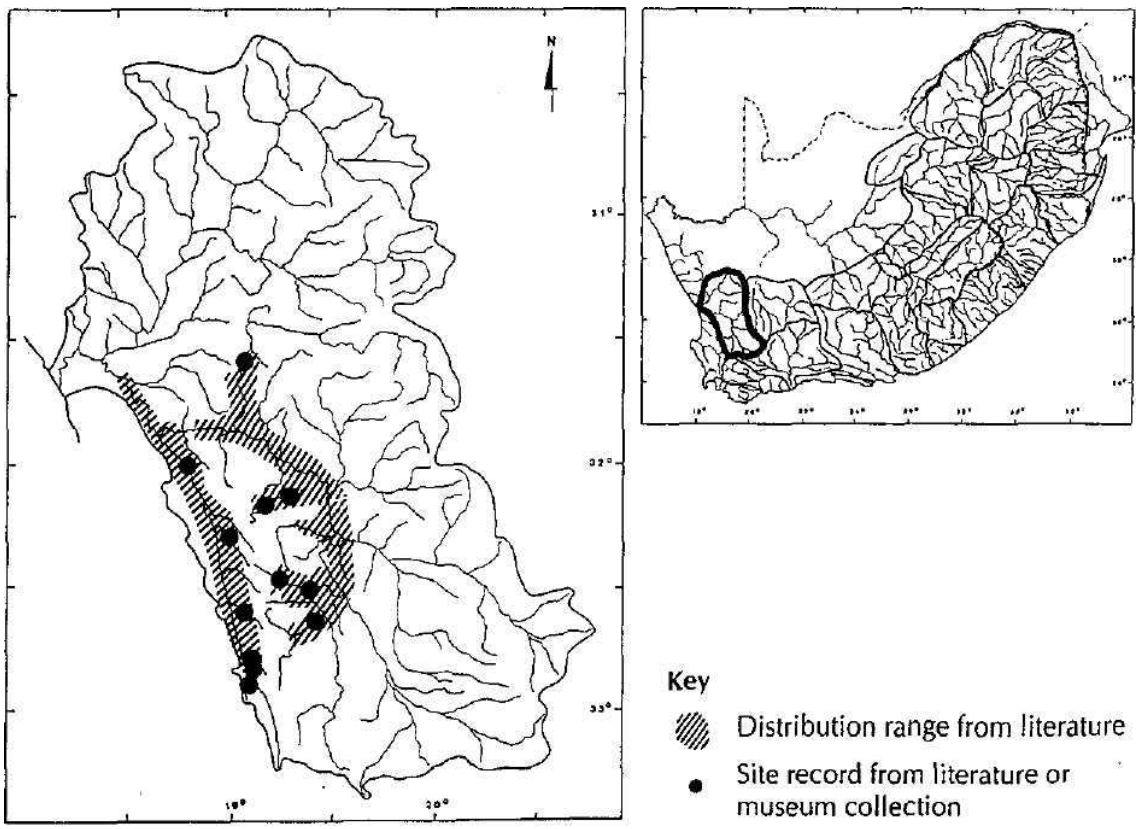
Barnard (1943); Cambray and Stuart (1985); Gaigher et al (1980); Hamman et al (1982); Harrison (1952a); Jubb (1965, 1967a).

Correspondence: Dr K C D Hamman; S C Thome.

CLANWILLIAM YELLOWISH / CLANWILLIAM-GEELVIS

FIGURE 20. The Clanwilliam yellowfish, *Barbus capensis,* 410 ram SL, with distribution in the Olifants River system, western Cape Province.





CLANWILUAM YELLOWFISH / CLAHWILLIAM-GEELVIS **RARE**

Barbus capensis Smith 1841

Family: Cyprinidae SUMMARY

Status: Rare. The stocks of this species have been declining in the Olifants River system for many years. Several threats to the species continue to operate in spite of positive conservation efforts.

Research: Fair - good. Surveys have been carried out to determine distribution and population status of the species. Artificial methods of propagation have been used for restocking the natural environment. Elementary studies on the biology of the species have been made by van Rensburg (1966) and Gaigher (1973a).

SPECIES DATA

Identification: A potentially large yellowfish species reaching 10,66 kg and 987 mm TL. Juveniles are silvery with dark blotches, adults are a rich golden-yellow or golden-olive in colour. The dorsal fin has a flexible leading unbranched ray and nine branched rays. The origin of the pelvic fins are below or behind the origin of the dorsal fin. The scales are longitudinally striated and relatively small (40 to 45 in lateral line series). The mouth is subterminal and the lips variable, sometimes enlarged and fleshy. There are two pairs of barbels.

Distribution: The species is endemic to the mainstream and certain tributaries of the Olifants River system, western Cape Province (Barnard 1943; Jubb 1965, 1967a; Gaigher et al 1980).

Habitat and ecology: Juveniles inhabit pools and sheltered backwaters and marginal areas of the mainstreams. In this system the water is usually clear and fresh with the substratum either well-worn loose rocks or clean white sand. In places the mainstream forms deep channels between palmiet *(Prionium serratum)* islands. The Clanwilliam yellowfish coexists with several fish species including other large indigenous cyprinids *Labeo seeberi* and *Barbus serra,* small indigenous species such as *B calidus, B phlegethon, Austroglanis gilli* and *Galaxias zebratus* as well as introduced species such as *Tilapia sparrmanii* and *Micropterus dolomieu.* The yellowfish is omnivorous (Van Rensburg 1966), feeding largely on algae and aquatic invertebrates including insect larvae, gastropods and crabs. Large specimens also feed on frogs and small fishes.

Breeding biology: Successful artificial breeding techniques of stripping ripe fish of milt and roe have been applied (Anonymous 1982). van Rensburg (1966) studied the gonad development of *B capensis* and found that the species breeds in summer from October through December and January. Young fish were found near the head of the mainstream in November and December (van Rensburg 1966). There is no firm evidence of large-scale upstream migration taking place for spawning although the distribution of fry and juveniles of the species indicates that spawning sites are to be found towards the upper reaches of the mainstream and in tributaries (van Rensburg 1966; Gaigher 1973a,b).

CONSERVATION

Threatst The main threats to the Clanwilliam yellowfish are habitat deterioration primarily as a result of sedimentation and siltation and water abstraction. Weirs and larger dams have obstructed the free movement of the large cyprinids and have regulated the river flow. Predation and competition from introduced fishes (especially *Micropterus dolomieu)* is a major threat to the indigenous fauna of this system. The existence of several towns and extensive agricultural development presents a potential threat of pollution.

Conservation attention given: A hatchery has been established on the banks of the Olifants River to breed the Clanwilliam yellowfish for reintroduction to natural waters. Artificial breeding techniques have been developed and a restocking programme initiated (Scott 1982). A conservation strategy for the Olifants River system has been drawn up (R C D Hamman personal communication) which includes the allocation of category 1 status for the system (this restricts the introduction of alien species). The Clanwilliam yellowfish and other indigenous species are protected and can no longer be caught without a special permit. Special angling contests have been organized to reduce the numbers of black bass in the system. Conservation education has been actively promoted by means of popular publications and reports in the press, radio and television* Several surveys to determine distribution and conservation status of fishes have been carried out on the Olifants River system.

Conservation recommendations: Further breeding and stocking of this species in the Olifants system is necessary. Studies on the biology and ecology of the Clanwilliam yellowfish should be made, especially with regard to life history requirements. Monitoring of natural populations should be continued as well as further efforts to inform the public on the conservation of the system.

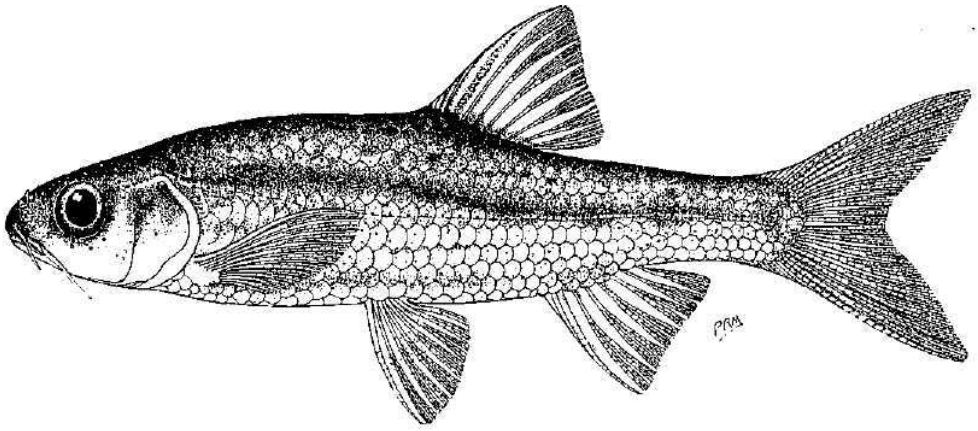
REFERENCES

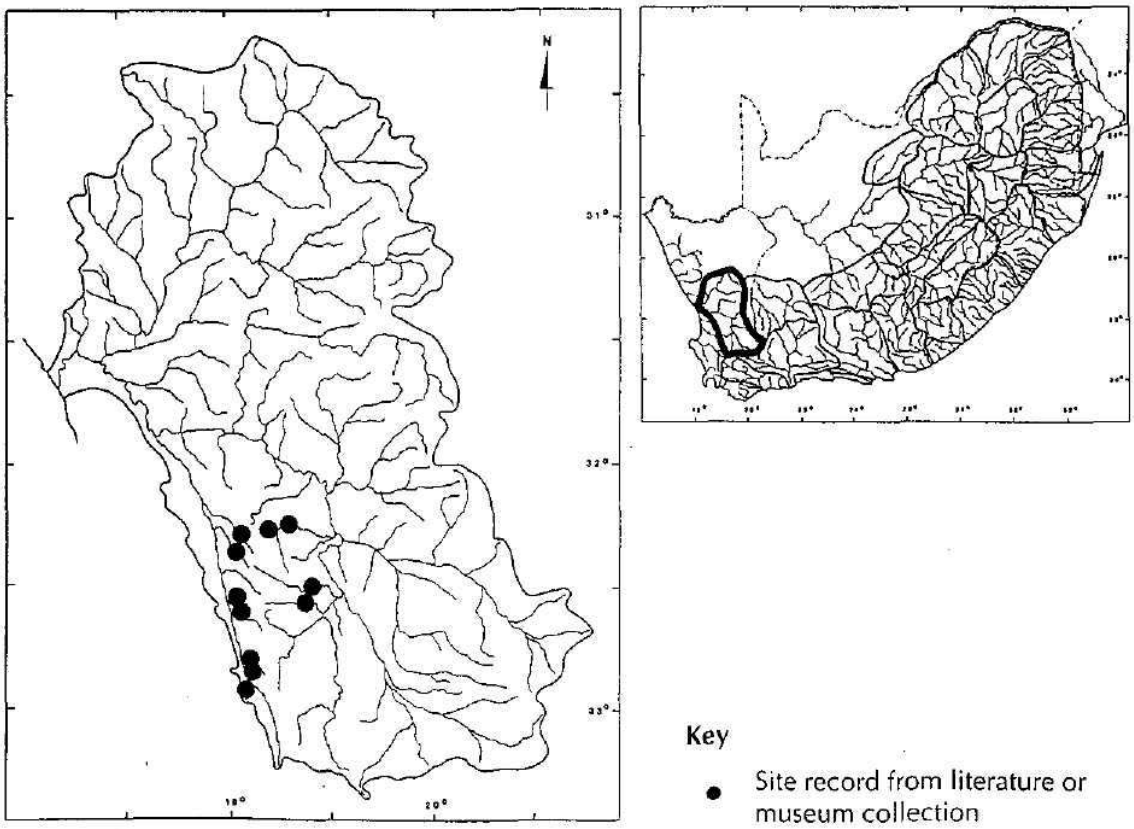
Anonymous (1982); Barnard (1943); Gaigher (1973a,b); Gaigher et al (1980); Jubb (1965, 1967a); Scott (1982); van Rensburg (1966).

Correspondence: Dr K C D Hamman; S C Thome.

CLANWILLIAM REDFIN / CLANWILLIAM-ROOIVLERKIE

FIGURE 21. The Clanwilliam redfin, *Barbus calidus,* 65 mm SL, with distribution in the Olifants River system, western Cape Province.





CLANWILLIAM REDFIN / CLANWILLIAM-ROOIVLERKIE **RARE**

Barbus calidus Barnard 1938

Family: Cyp rinidae

SUMMARY

Status: Rare. Introduced predatory fish have eliminated the Clanwilliam redfin from much of its former range in the Olifants River system.

Research: Fair. Surveys to determine the distribution and conservation status of Olifants River fishes have been carried out since 1977.

SPECIES DATA

Identification: A fusiform minnow species which reaches 82 mm SL. It has a bony serrated dorsal spine, the dorsal fin is placed behind the pelvics, and the anal fin has six branched rays. The mouth is large and terminal and there are two pairs of well developed barbels. The colour is silvery with dark brownish-black blotches and a dark interrupted lateral band. In adults the basal portion of the fins are bright red.

Distribution: The Clanwilliam redfin is endemic to the Olifants River system, western Cape. Populations are now restricted to the more remote reaches of Cedarberg tributaries only (Gaigher 1973a,b; Jubb 1965, 1967a; van Rensburg 1966; Skelton et al in preparation). Formerly the species was widely distributed in tributaries and the Olifants River mainstream (Barnard 1943; Harrison 1952a).

Habitat and ecology: It generally favours large pools in cool clear flowing water. The pools frequently have a bedrock substratum or include large boulders with loose rocks and sandy substrata. *Barbus calidus* feeds primarily on aquatic and allochthonous insects. Cohabiting fish species include *Galaxias zebratus,* the fiery redfin *B phlegethon,* juveniles of the large cyprinids *B serra, B capensis, Labeo seeberi,* and the two catlets *Austroglanis gilli* and *A barnardi.*

Breeding biology: Breeds during the summer months. Adult males have been observed (P H Skelton personal observation; S C Thome personal communication) to aggregate in breeding schools of about 30 to 50 individuals that maintain station over a particular site against vertical rock faces in flowing water. Individual females join the school of males for spawning. Specimens have been kept in aquaria for several years but captive breeding has not been reported,

---

CONSERVATION

Threats: Introduced alien fishes *(Micropterus dolomieu* and *M salmoides)* have eliminated this species from much of its former range. Surviving populations are found only beyond the reach of these predator species. Habitat destruction through factors such as water abstraction for agricultural purposes, stream canalization by bulldozing, the detrimental effects of invasive alien riparian plants and pollution from cultivated lands and towns also may have contributed to the decline of the species.

Conservation attention given: The Olifants River system has been accorded high conservation priority by the CDNEC (see Clanwilliam yellowfish sheet above). Further introduction or stocking of alien predator fish species is prohibited. Distribution surveys have been carried out by the CDNEC (Gaigher et al 1980; Skelton et al in preparation).

Conservation recommendations: The conservation programme instituted for the Olifants River system (see Clanwilliam Yellowfish data sheet above) must be continued and extended. The biology and ecology of the species should be studied with the aim of providing data to establish more specific conservation strategies. Where necessary artificial breeding programmes should be undertaken and the species restocked in suitable sites within its former range. The development of sanctuary streams for indigenous fish communities in the Olifants River system is required urgently.

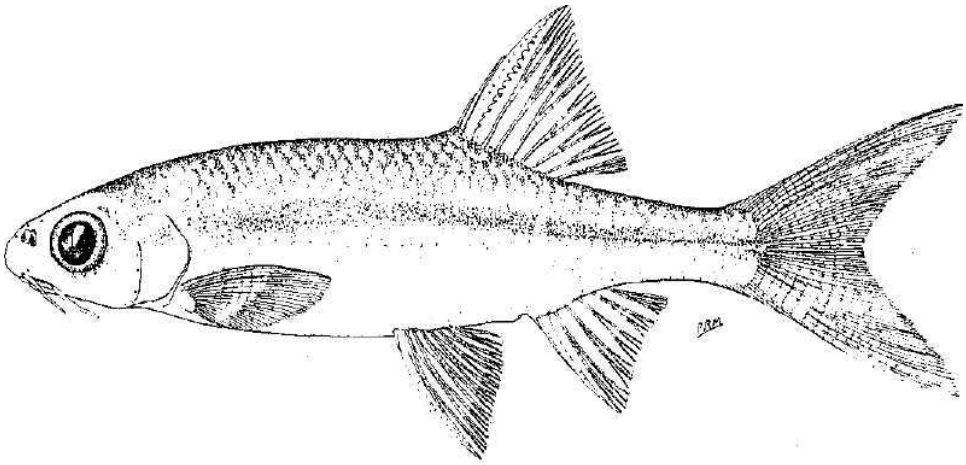
REFERENCES

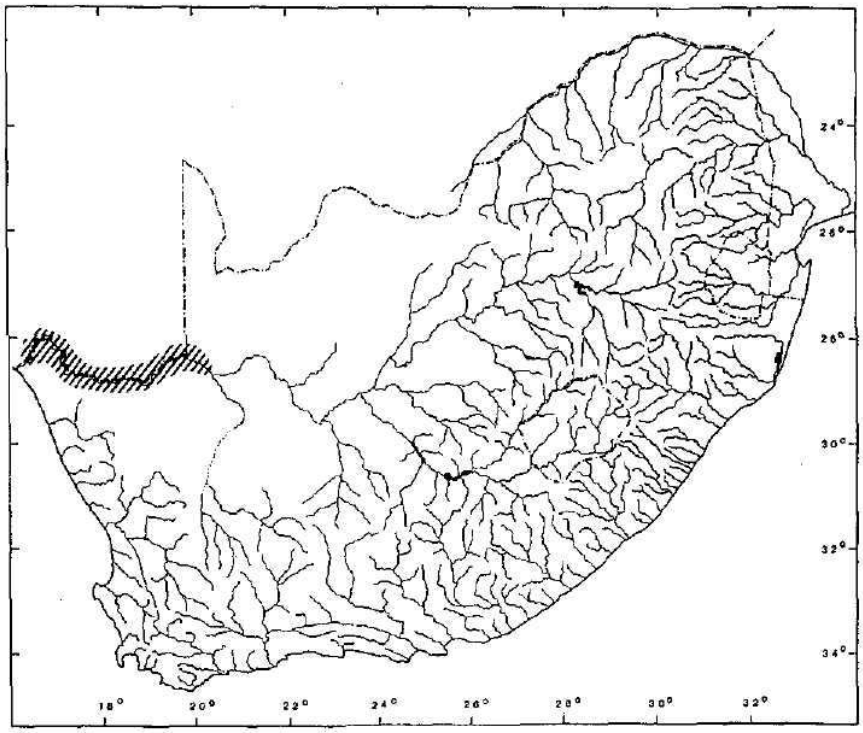
Barnard (1943); Gaigher (1973a,b); Gaigher et al (1980); Harrison (1952a); Jubb (1965,1967a); Skelton (1977, 1980); Van Rensburg (1966),

Correspondence: Prof I G Gaigher; Dr K C D Hamman; S C Thome.

NAM&QUA BARB / HAMAKWA-GHXELIEMIEirrJIE

FIGURE 22. The Namaqua barb, *Barbus hospes,* + 55 mm SL, with distribution in the lower Orange River, South Africa and South West Africa/Namibia.





Key

Distribution range from literature

NAMAQUA BARB / NAMAKWA-GHIELIEMIENTJXE **RARE (SAFE?)**

Barbus hospes Barnard 1938

Family: Cyprinidae SUMMARY

Status: Rare, possibly safe. This species is restricted to the Orange River below Aughrabies Falls. Increasing exploitation of the Orange River water constitutes a growing threat.

Research: Fair - good. Several comprehensive surveys of the lower Orange have been made since 1980. Cambray (1984) presents some preliminary biological information of the species.

SPECIES DATA

Identification: A small cyprinid species (attains + 65 mm SL) with an unusual body-form. The mouth is ventral and there are two pairs of well developed barbels of equal size. The dorsal fin has a serrated spine and is placed behind the pelvics. The caudal peduncle is relatively narrow and the caudal fin is deeply forked with long pointed lobes. The scales are small and difficult to see. The colour is silvery-white without any dark markings.

Distribution: It is endemic to the Orange River below Aughrabies Falls. The species occurs along the entire course of the lower Orange River (Skelton and Cambray 1981; Cambray 1984) as well as in the lower reaches of the northern Fish River tributary in South West Africa/Namibia (AMG records).

Habitat and ecology: The species favours fairly deep, open flowing habitats over sand or rocks (Skelton and Cambray 1981; Cambray 1984) and it has been collected in rapids. The lower Orange River is a wide (up to 300 to 400 m), turbid water body with muddy, sandy or rocky substrates. Cambray (1984) provides physical and chemical profiles as well as the average daily flow characteristics of the middle and lower Orange River. The main cohabiting fish species are *Barbus aeneus, Labeo capensis,* and *Mesobola brevianalis* with several other species also being present, including the introduced *Oreochromis mossambicus* (Skelton and Cambray 1981; Cambray 1984; Skelton 1986c).

Breeding biology: *Barbus hospes* reaches maturity in the first year and Cambray (1984) found a 0,55:1 male to female ratio of adults in the population. There were indications that breeding occurs as early as September and extends to March (late summer). Length frequency distributions of specimens indicates that a double spawning may occur within a summer season. Cambray (1984) collected juveniles at all his stations suggesting that localized breeding occurs along the entire length of the lower Orange.

Remarks: An interesting outcome of Cambray's (1984) work is that regulation of flow of the lower Orange River appears to favour the biology of *B hospes.*

CONSERVATION

Threats: The entire Orange-Vaal River system is subject to heavy manipulation, regulation and utilization of its water supply (Cambray et al 1986; Walmsley and Rogers 1986). Exploitation will increase markedly in future years with the development of major schemes such as the Lesotho Highlands Water Scheme (Hansmann 1986). The abstraction of water from the middle and lower Orange for urban, industrial and agricultural development including supplies for South West Africa/Namibia is expected to increase rapidly. The development of riparian urban, industrial and agricultural facilities creates a growing pollution threat. High sediment loads and siltation are characteristic of the Orange River system, but it is not known how detrimental these are to this species.

Conservation attention given: Distribution surveys of the middle and lower Orange have been reported by Skelton and Cambray (1981) and Cambray (1984). Cambray (1984) made a preliminary study of certain aspects of the biology of the species (see above). This species is protected under the Nature Conservation Ordinance.

Conservation recommendations: Studies are required on the biology and ecology of the Namaqua barb especially with respect to the changed environmental conditions of the lower Orange River. The status of this species should be monitored regularly.

Remarks: Cambray (1984) suggested that this species be removed from the list of threatened species but also that its biology and conservation status should be studied and monitored. It has nevertheless been included on the recommendation of officials of the CDNEC (K C D Haroman and C Benade in littera) because of the escalating threats to the system as a whole and the species' general vulnerability in view of its limited distribution and specific habitat preferences.

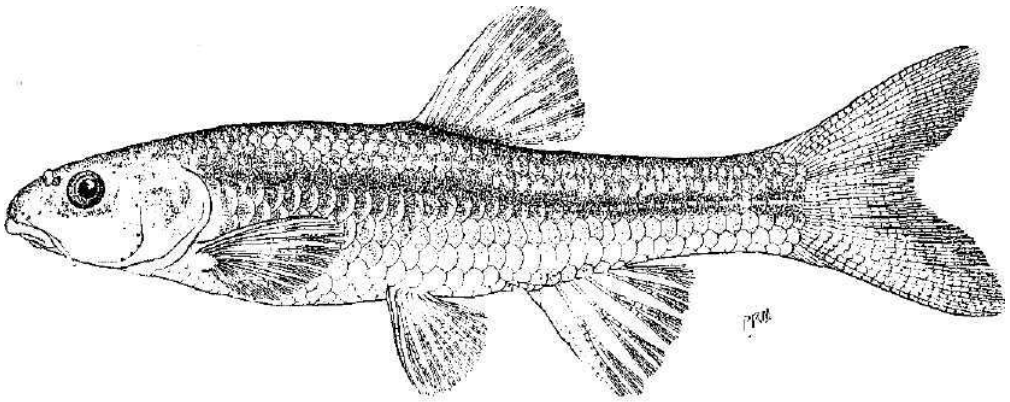
REFERENCES

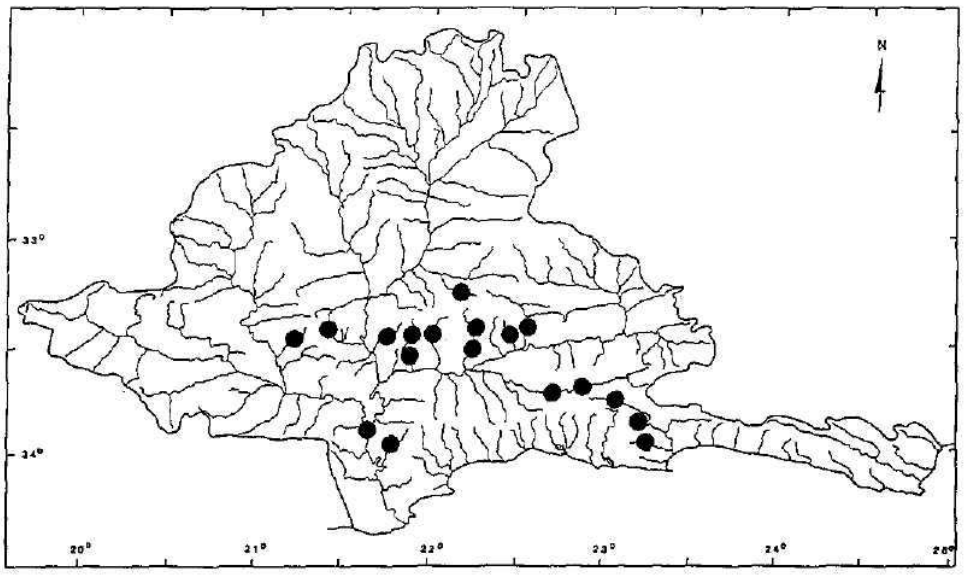
Barnard (1943); Cambray (1984); Cambray et al (1986); Gaigher et al (1980); Hansmann (1986); Jubb (1965, 1967a); Skelton (1977, 1986c); Skelton and Cambray (1981); Walmsley and Rogers (1986).

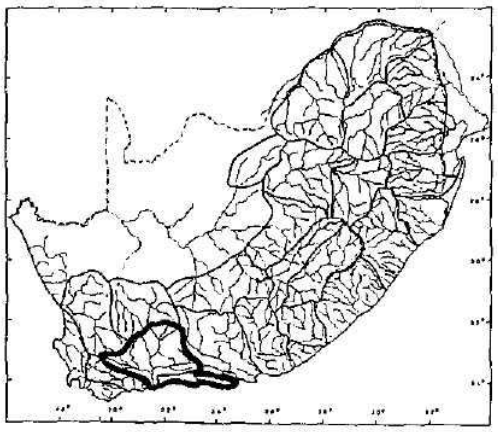
Correspondence: C Benade; J A Cambray; Dr K C D Hamman.

SLENDER REDFIN / **SLANK** ROOXVLERKIE

FIGURE 23. The slender redfin, *Barbus tenuis*, 60 rnm SL, with distribution in the Gourits and Keurbooms River systems, southern Cape Province.







Key

● Site record from literature or museum collection

SLENDER REDFIN / SLAHK ROQIVLERKIE RARE

Barbus tenuis Barnard 1938

Family: Cyprinidae

SUMMARY

Status: Rare. Populations of this species have declined as a result of habitat destruction and introduced predatory fishes.

Research: Fair. Distribution and conservation status surveys have been made by the CDNEC since 1977.

SPECIES DATA

Identification: This is a slender redfin minnow (maximum size 80 mm SL) with a single pair of relatively short barbels. Adult specimens have bright red patches at the bases of the fins. The body markings consist of an indefinite mid-lateral band on either side and a mid-predorsal stripe. Moderately large scales also serve to distinguish the species from a sympatric redfin *(Barbus asper)*. Internal diagnostic features include two rows only of pharyngeal teeth on each bone, and a relatively short and simply involuted intestine.

Distribution: Occurs in tributaries of the Gourits and Keurbooms River systems, southern Cape province (Barnard 1943; Jubb 1965, 1967a; Skelton 1977, 1980; Gaigher et al 1980).

Habitat and ecology: *Barbus tenuis* inhabits pools of mountain streams. Preferred habitats have clear, flowing water with rock and gravel or clean coarse sandy substrates. Useful information on the Keurbooms River system is provided by Duvenage and Morant (1984). In certain tributaries of the Gourits system *B tenuis* occurs together with another redfin species *B asper.* In the Keurbooms River system *B tenuis* is found together with the redfin *B afer* and several other indigenous fish species including *Galaxias zebratus, Sandelia capensis* and *Anguilla mossambica.*

Breeding biology: Unknown except that breeding occurs in summer and males develop conical tubercles on the head (Skelton 1980).

CONSERVATION

Threats: The major threat to this species in the Gourits River system is probably habitat destruction through water abstraction and stream canalization. Other threats include introduced fishes, especially bass *(Micropterus* species) as well as trout *(Parasalmo mykiss)* and translocated species such as *Tilapia sparrmanii* and *Barbus aeneus** Many tributaries of both these river systems have been affected by invasive riparian plants such as wattle *(Acacia mearnsii)* or blackwood *(A melanoxylon). Barbus tenuis* and other indigenous species were adversely affected by extensive flood damage in 1981 (Hamman et al 1982). The possible construction of large dams on the Keurbooms River (Duvenage and Morant 1984) is a potential future threat to the slender redfin through loss of habitat.

Conservation attention given: Surveys to determine distribution and conservation status have been carried out since 1977 by the CDNEC. Specific protection for this species is provided by the Cape Nature Conservation Ordinance.

Conservation recommendations: Suitable sanctuaries to conserve this species should be established. Studies on the biology and ecology of the species are needed to provide an effective conservation strategy. These studies should include the effect of various alien species. Captive or artificial spawning techniques for this and other redfin minnow species should be developed. Land owners within the catchment areas where the species exists should be informed about the conservation of threatened fauna and environments.

Remarks: Many of the mountain streams feeding the Gourits system have been adversely influenced by man because most of the drainage area is in a rain-shadow where surface water is scarce. Available supplies are fully utilized for agriculture and domestic supply. Weirs are common and smaller streams are frequently completely diverted into reservoirs. Heavy overgrazing by stock results in sedimentation and excessive runoff during floods (Hamman et al 1982).

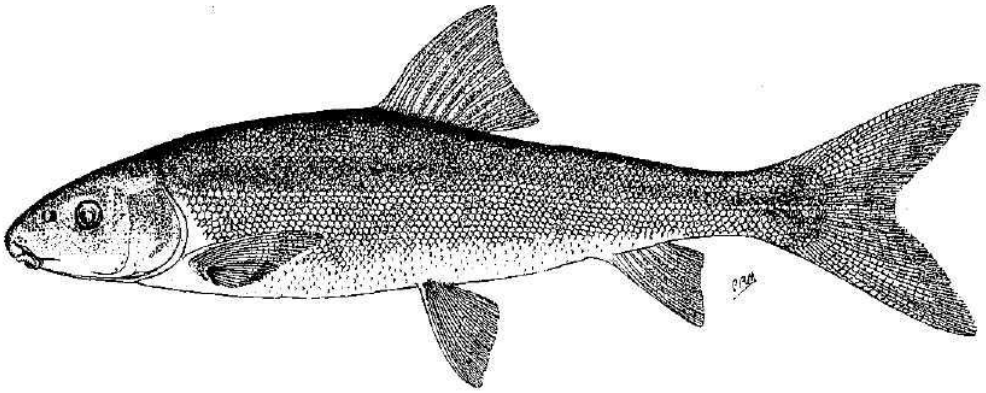
REFERENCES

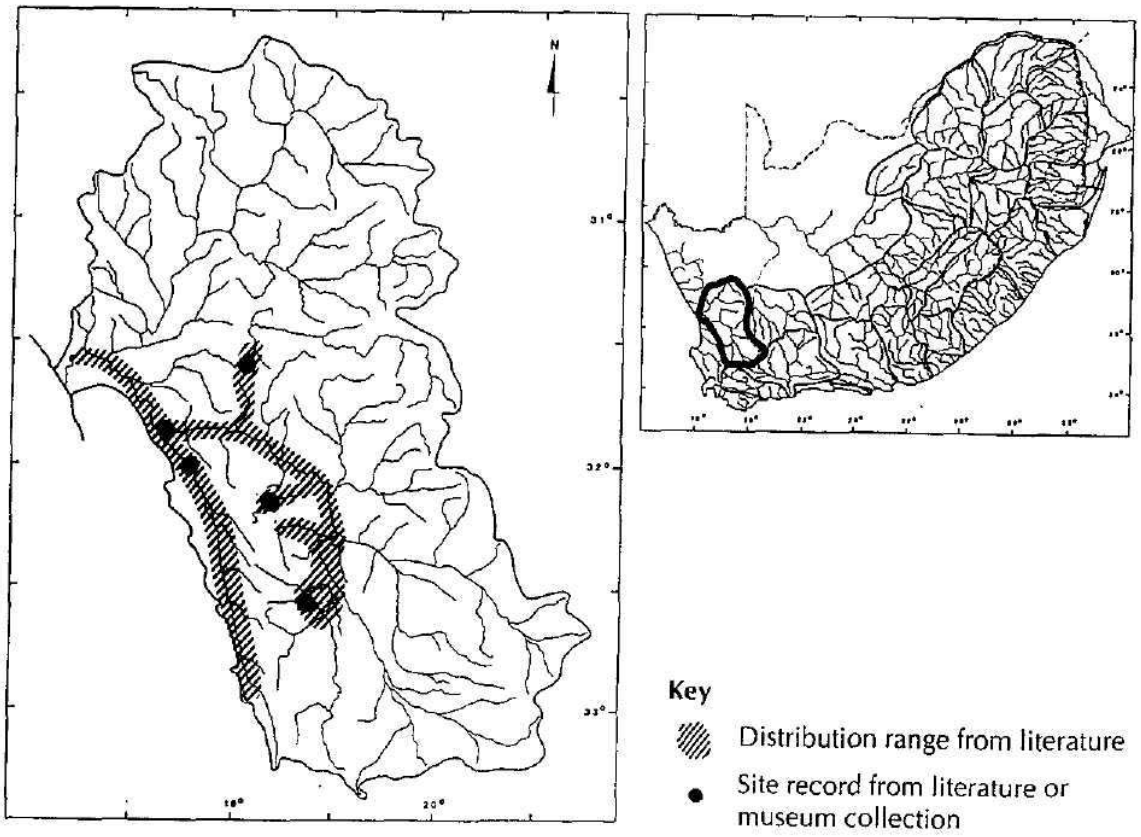
Barnard (1943); Duvenage and Morant (1984); Gaigher et al (1980); Hamman et al (1982); Harrison (1952a); Jubb (1965, 1967a); Skelton (1976, 1977, 1980).

Correspondence: Dr K C D Hamman; S C Thome.

CLASWILLIAM SANDFISH / CLANWILLIAM-SANDVIS

FIGURE 24. The Clanwilliam sandfish, *Labeo seeberi,* 145 mm SL with distribution in the Olifants River system, western Cape Province.





CLAHWILLIAM SMDFISH / CLAHWXLLIAM-SAHDVIS RARE

Labeo seeberi Gilchrist and Thompson 1911

Family: Cyprinidae SUMMARY

Status: Rare. Man-made changes to the habitat threaten this naturally restricted species.

Research: Fair. Surveys by the CDNEC have exposed the threatened status of the species.

SPECIES DATA

Identification: A relatively large (up to 550 mm FL) and slender cyprinid with extremely small scales (82 to 90 in lateral line series). Also identified by its inferior mouth and well developed papillate lips with a single pair of small barbels on either side. Colour is greyish-blue or silvery-brown with silvery-white belly.

Distribution: Endemic to the Olifants River system, western Cape. Recent distribution surveys show that the adults of *L seeberi* are confined to the main Olifants River and the Doring River (Skelton et al in preparation). In the Olifants mainstream the species is extremely scarce above the Bulshoek Dam.

Habitat and ecology: Large pools with a sandy substratum appear to be the favoured habitat of adults. Juveniles are found in the smaller pools and rocky runs of tributaries. Cohabiting fish species are the Clanwilliam yellowfish *(Barbus capensis)* and the sawfin *(Barbus serra)*. Introduced bass *(Micropterus dolomieu* and *M salmoides)* and banded tilapia *(Tilapia sparrmanii)* are also present in the lower reaches of the Olifants mainstream and the Doring River. *Labeo seeberi* feeds on algae, diatoms and microscopic Crustacea (van Rensburg 1966).

Breeding biology: This has not been intensively studied. Based on circumstantial and casual observations, a high fecundity and upstream migration and congregation are components of the biology of this species. Gaigher (1973a) reports a peak of ripe fishes in September suggesting a spring-' early summer breeding season. Barnard (1943) reports a juvenile being kept in an aquarium for up to four years without substantial increase in size being recorded. Captive or artificial breeding is untested.

CONSERVATION

Threats: Habitat destruction through water abstraction and sedimentation, as well as the obstruction of passage by weir and impoundment construction appear to be the major factors in the decline of this species. Predation by introduced fishes (especially *M dolomieu)* also may be partly responsible for the decline.

Conservation attention given: A conservation programme for the fishes of the Olifants River system has been initiated by the CDNEC (see Clanwilliam Yellowfish Data sheet). Surveys of the Olifants River system have been made by the CDNEC since 1979 (Skelton et al in preparation).

Conservation recoimnendations: A comprehensive conservation strategy for the fish fauna of the Olifants River system should include steps to improve the habitat and facilitate the migrations of the larger cyprinid species where necessary. A captive breeding programme of *Labeo seeberi* should be initiated for stocking of natural waters, A study of the biology and ecology of *L seeberi* is needed to determine major limiting factors including movements and migrations.

Remarks: A large decline in numbers of this species is evident based on the results of recent surveys and earlier reports (eg Barnard 1943; van Rensburg 1966; Gaigher 1973b). Local farmers report that they have not observed mass migrations or congregations of *L seeberi* for many years (K C D Hamman and S C Thome personal communication). New legislation that provides protection for *L seeberi* and other threatened fish species in the Cape is being drafted and introduced (K CD Hamman personal communication).

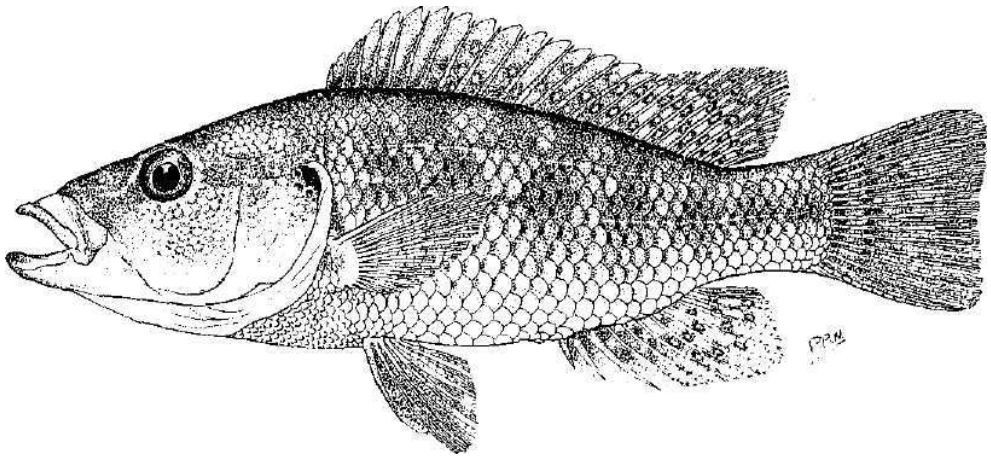
REFERENCES

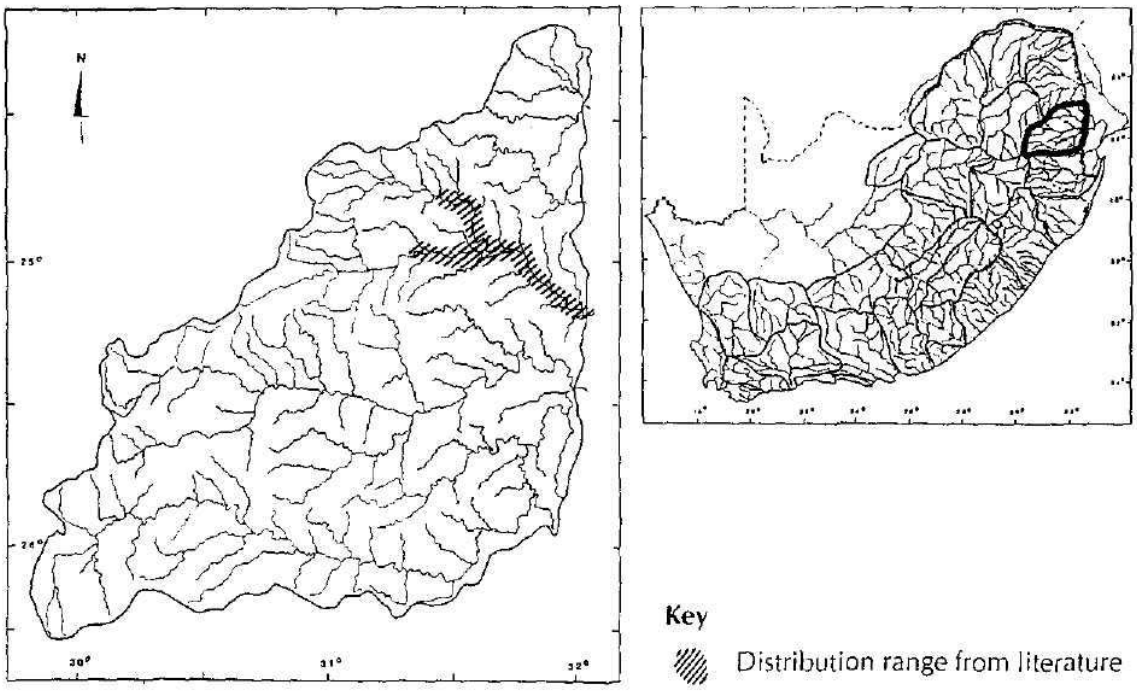
Barnard (1943); Gaigher (1973a,b); Harrison (1973); Jubb (1965, 1967a); Scott and Hamman (1984); van Rensburg (1966).

Correspondence: Dr K C D Hamman; S C Thorne.

LOWVELD LARGEMOUTH / LAEVELD-GROOTBEK

FIGURE 25. The lowveld largemouth, *Serranochromis meridianus,* 103 mm SL, with distribution in the Sabi-Sand tributary of the Incomati River system, eastern Transvaal.





LOWVELD LARGEMOUTH / LAEVELD-GROOTBEK **RARE**

Serranochromis meridianus Jubb 1967

Family: Cichlidae

SUMMARY

Status: Rare. This species occurs in low numbers within the Sabie-Sand tributaries of the Incomati River system. Habitat deterioration in these systems threatens the species. Successful translocations to impoundments in the Kruger National Park have been made.

Research: Fair - good. A conservation assessment of the species was made by Kleynhans (1982, 1984). Aspects of its breeding biology have been reported by Pott and Le Roux (1968).

SPECIES DATA

Identification: A predatory cichlid reaching 300 mm SL with a large protractile mouth. The jaws are set with small unicuspid teeth. Colour varies but is usually olive-brown to silvery or golden-yellow, scales with reddish centres, and there are seven or eight dark vertical bars and two or three horizontal bars on the body. The dorsal and caudal fins have black spots and the anal fin has distinct orange-red or dark brick-red spots, the dorsal fin is edged with orange. Breeding males are more brightly coloured, predominantly yellow.

Distribution: This species occurs in the Sabie and Sand River tributaries of the Incomati River system in the Transvaal lowveld (Jubb 1967b). It has also been recorded from coastal pans between the Limpopo and Incomati Rivers (Gaigher 1969) and from Mgobezeleni Lake in Maputaland (Bruton and Appleton 1975). The species has been translocated to impoundments on tributaries of the Sabie River in the Kruger National Park (Pienaar 1978a).

Habitat and ecology: *Serranochromis meridianus* thrives in small dams and impoundments. Pienaar (1978a) reports that from an initial stocking of 13 specimens in Mtshawu Dam (November 1972) "thousands" were present two years later. In the Sabie-Sand system the habitat preference is large open pools with well vegetated banks *(Phragmites)* (Kleynhans 1982, 1984). Low population densities are reported in the Sand River by Kleynhans (1982, 1984) where 5 *meridianus* represented only 1,1 to 1,6% of the total fish collected in the four surveys (19 specimens out of 2 521 in four collections). Cohabiting fish species include mormyrids, characins including tigerfish *(Hydrocynus forskahlii),* minnows and yellowfish *(Barbus* species), labeos and other cyprinids, catfishes *{Eutropius depressirostris, Clarias gariepinus* and *Synodontis zambezensis)* and tilapiine cichlids *(Oreochromis mossambicus, Tilapia rendalli)*.

Breeding biology: Pott and Le Roux (1968) described the breeding behaviour of specimens in aquariums. The male prepares a nest by clearing the substrate of debris. Eggs are laid in batches of about 30 and fertilized in the nest with the total brood estimated at about 150 eggs. The female collects and broods the fertilized eggs in her mouth.

CONSERVATION

Threats: Detrimental environmental changes within the Sabie drainage that threaten the existence of this species include pollution from mining, domestic and agricultural sources, sedimentation, water abstraction and invasive aquatic and riparian plants (Kleynhans 1982, 1984; Joubert 1986).

Conservation attention given: The natural range of this species (Sabie River) occurs partly within the boundaries of the Sabie-Sand Private Nature Reserve and the Kruger National Park (KNP). The species has been successfully translocated to a number of large dams in tributaries of the Sabie River originating within the KNP (eg Mestel, Mtshawu, Nyamundwa, Skukuza and Nhlanganzwane Dams), as well as dams beyond the KNP eg in the Manyeleti Game Reserve (B C W Van der Waal personal communication). A dam in the Sabie-Sand Private Nature Reserve that was stocked with the species subsequently dried out in 1983. Research into the status and conservation of *Serranochromis meridianus* in the Transvaal was reported on by Kleynhans (1982, 1984). Steps to conserve the Sabie River within the KNP are being considered and liaison between interested parties concerned with the rivers of the eastern Transvaal lowveld has been initiated (Joubert 1986).

Conservation recommendations: A strategy for the integrated management and development of the Sabie catchment should be drawn up by all controlling bodies and riparian owners. The need for silt traps and low weirs with built-in fish passes to protect and conserve the habitat of all the rivers in the KNP including the Sabie and Sand Rivers is recognized by the KNP authorities.

Remarks: Although the species is relatively safe in terms of extinction its continued presence in the Red Data Book serves to highlight the deterioration of the natural habitat of the species.

REFERENCES

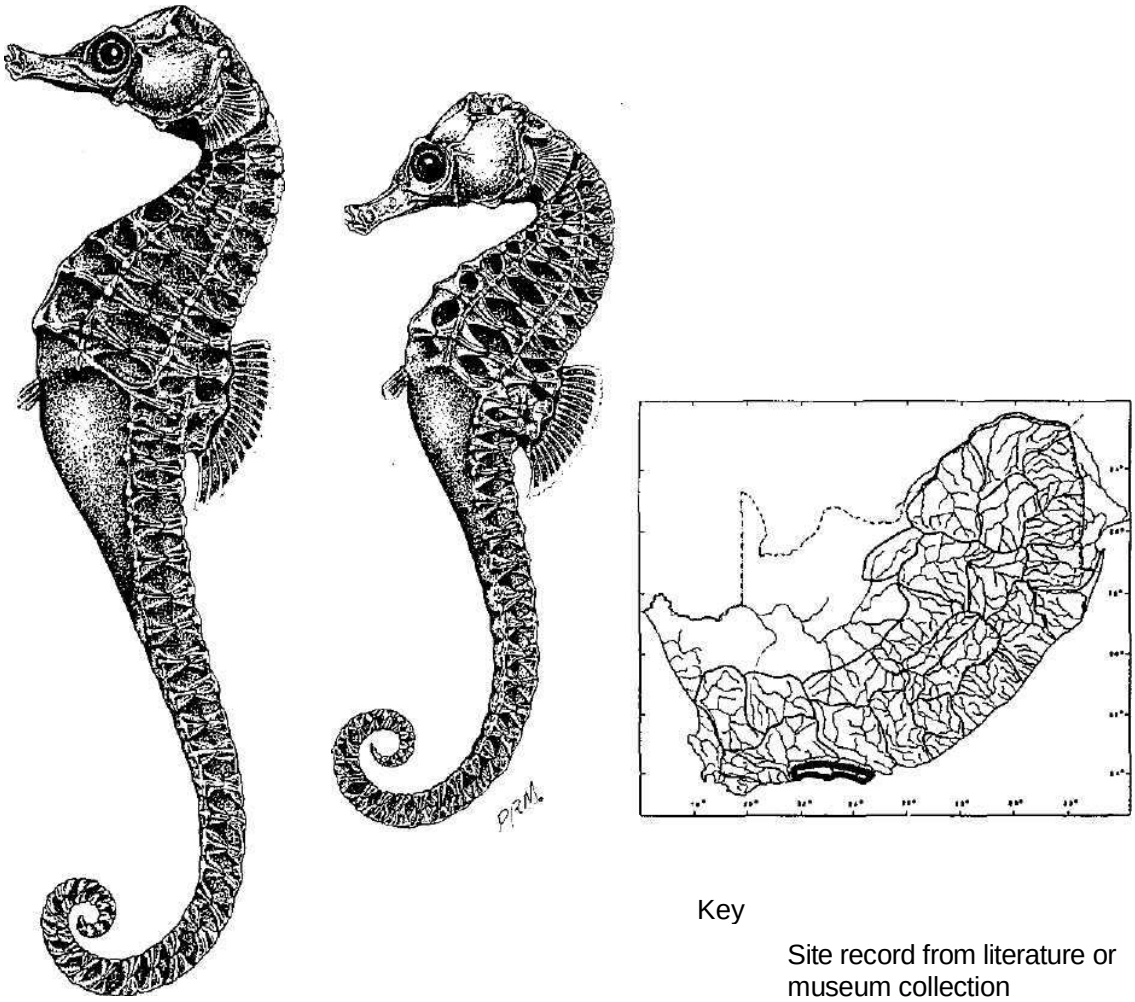
Bruton and Appleton (1975); Gaigher (1969); Joubert (1986); Jubb (1967b); Kleynhans (1982, 1984); Noble (1974); Pienaar (1978a); Pott and Le Roux (1968).

Correspondence: M Coke; R S Crass; Dr C J Kleynhans; Dr U de V Pienaar; Dr B C W Van der Waal.

KNYSNA SEAHORSE / KNYSNA-SEEPERDJIE

FIGURE 26. Two specimens of the Knysna seahorse, *Hippocampus capensis*, 81 mm and 61 mm from tip of crown to outer curve of tail' with distribution in southern Cape Province.

'



KNYSNA SEAHORSE / KNYSNA-SEEPERDJIE **VULNERABLE**

Hippocampus capensis Boulenger 1900

Family: Syngnathidae

SUMMARY

Status: Vulnerable. The Knysna seahorse is known only from a few southern Cape estuarine systems which are all much used by man for various activities.

Research: Poor - fair. Detailed reports on the estuaries where *H capensis* is found have been published in recent years (Whitfield et al 1983; Duvenage and Morant 1984; Grindley 1985). There are no reports, however, on specific biological and ecological studies of this species.

SPECIES DATA

Identification: Seahorses in general are distinctive and highly modified fishes with the head held at right angles to the trunk, the body and the prehensile tail is enclosed in bony rings. The Knysna seahorse rarely exceeds 70 mm TL. A low coronet and body rings with low spinules are only present in juveniles, and are obsolete in adults. A relatively short snout, more than twice in head length, is characteristic of this species (Dawson 1986).

Distribution: Recorded from the Knysna estuary, Keurbooms estuary, Klein-brak estuary and Swartvlei estuary (Heydorn and Tinley 1980; Kok 1981; Whitfield et al 1983; Grindley 1985).

Habitat and ecology: Collected in muddy, well vegetated backwater creeks. Comprehensive assessments of the most important systems where the Knysna seahorse occurs have been made by Whitfield et al (1983) (Swartvlei), Duvenage and Morant (1984) (Keurbooms) and Grindley (1985) (Knysna).

Breeding biology: The male is a pouch brooder and gravid specimens are found over the summer months (Smith 1981). This species has been kept and bred in aquariums at the Port Elizabeth Oceanarium, but details of the breeding biology are not reported.

Remarks: An unexplained sudden mortality of seahorses occurred in Swart-vlei on the 18 November 1985 (Whitfield in littera). R Thomson collected 35 dead specimens along the shore adjacent to eelgrass *(Zostera capensis)* beds approximately three kilometres from the estuary mouth. Specimens were also gathered up to five kilometres from the mouth.

CONSERVATION

Threats: Human settlement and associated industrial, domestic and recreational activities (especially power boating) threaten the ecology of southern Cape estuaries (Heydorn and Tinley 1980). The land around the Knysna Lagoon and estuary is largely privately owned and various construc-tional developments have impinged on the water area (Grindley 1985). Recreational use of the estuary is extensive. Although a general pollution potential is present, Grindley (1985) reported that the Knysna

estuary was relatively unpolluted. A number of proposed developments threaten the long-term natural integrity of the Keurbooms system (Duvenage and Morant 1984). The main potential threat is the possibility of a large dam being built on the Keurbooms River. Recreational and pollution threats are also present. Township development and increasing recreational pressures are expected in the Swartvlei estuary but, as pointed out by Whitfield (in littera), any environmentally sensitive developments within the Wilderness National Lake Areas has to be approved by the National Parks Board. In all sites collecting for aquarium trade also poses threats to this species (Skelton 1977; Smith 1981). The present conservation status of all four estuaries where the Knysna seahorse is recorded from is fair (Heydorn 1986).

Conservation attention given: The Knysna seahorse is protected by law (the Sea Fisheries Act of 1973) in the Knysna estuary (Smith 1981). Ecological surveys with conservation recommendations have been made in the southern Cape estuaries where the species occurs, as part of the ECRU investigations (Whitfield et al 1983; Duvenage and Morant 1984; Grindley 1985). The Wilderness Lakes are now a "National Lakes Area" under the auspices of the National Parks Board (Botha 1984).

Conservation recommendations: Detailed studies of the ecology, environ mental sensitivity and status of this species are required. Suitable sanctuary zones within the estuaries should be provided where human access or activity is prohibited or strictly regulated. The aquarium trade should be monitored and controlled with respect to this species. Compre hensive protective legislation should be provided to protect the species throughout its natural range. V

Remarks: Kok (1981) raises the interesting, but as far as is known unsub-stantiated, possibility that the Knysna seahorse may have been introduced by man to estuaries adjacent to the Knysna estuary.

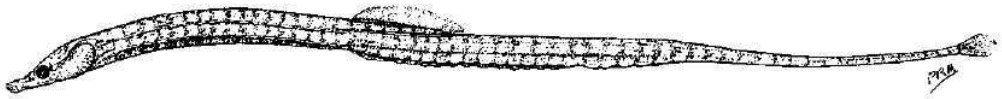
REFERENCES

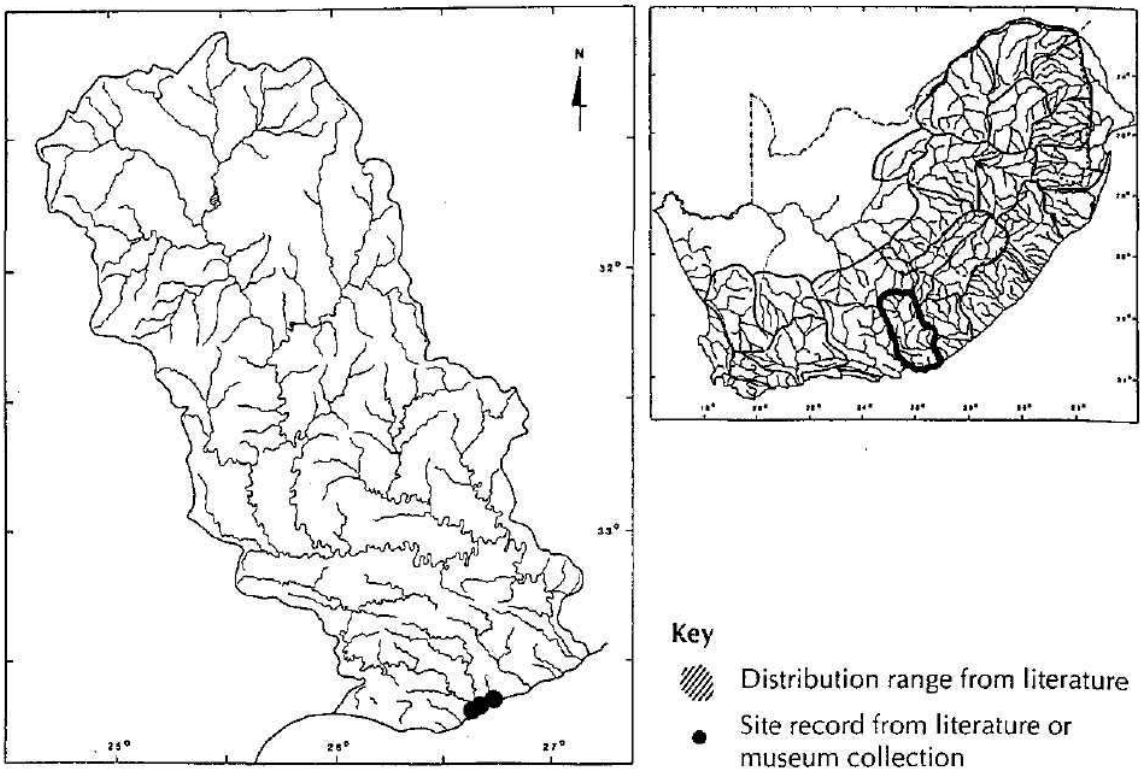
Botha (1984); Dawson (1986); Duvenage and Morant (1984); Grindley (1985); Heydorn (1986); Kok (1981); Smith (1935, 1963, 1965); Smith and Smith (1966); Smith M (1981); Whitfield et al (1983).

Correspondence: Dr P C Heemstra; Dr H M Kok; Prof M M Smith; Dr A K Whitfield.

RIVER PIPEFISH / RIVIER-PYPVIS

FIGURE 27. The river pipefish, *Syngnathus watermayeri,* 100 mm SL, with distribution in the south-east Cape Province.





RIVER PIPEFISH / RIVIER-PYPVIS **INDETERMINATE - VULNERABLE**

Syngnathus watermayeri Smith 1963

Family: Syngnathidae

SUMMARY

Status: Indeterminate - Vulnerable. The species is only known from three locales in the eastern Cape.

Research: Poor. This species is only known from museum specimens.

SPECIES DATA

Identification: A pipefish reaching up to 13 cm long with (16 to 18) + (37 to 40) rings. The head length about 10 times in standard length, snout one third of the head length. The opercle has a short basal ridge. The pectoral fin is small with seven rays. The origin of the dorsal fin is opposite the anus. Dorsal fin rays 28 to 32; three anal fin rays.

Distribution: Originally described from the Bushmans and Kasouga Rivers (=estuaries?) in the eastern Cape (Smith 1963). Dawson (1986) also records it from the Kariega River situated between the previous two locales.

Habitat and ecology: Although Smith (1963) records the species from "Kasouga and Bushman's Rivers" there is no evidence that this refers specifically to the freshwater reaches above the ebb and flow points and not to the estuaries themselves. The estuaries of these river systems are all elongated and riverine in physical appearance. The systems are often referred to as "rivers" right up to their mouths. Another pipefish, *Syngnathus acus,* is recorded by Day et al (1981) from the Bushmans River (=estuary) and unidentified pipefish have been collected on occasions from the Kariega River estuary (R S Stobbs personal communication) where they are most often found in Zostera beds.

Breeding biology: Unknown.

CONSERVATION

Threats: Specific studies on threats to the species have not been made and the real extent to which factors mentioned here threaten the species, if at all, are not known. The building of weirs and dams on the Bushmans and Kariega Rivers together with extensive water extraction for domestic and agricultural uses has undoubtedly reduced the freshwater inflow to the estuaries. The construction of road bridges across the Bushmans and Kariega estuaries has altered the natural flow and affected sedimentation patterns within the Bushmans and Kariega estuaries (Farquharson 1970b). Township development on the banks of the estuaries has taken place and there has been a rapid increase in recreational activities such as sailing, power boating and fishing. The present conservation status of the Bushmans, Kariega and Kasouga estuaries is fair (Heydorn 1986).

Conservation attention given: No specific attention has been given to this species. There are established trust bodies concerned with conservation management of the Bushmans and Kariega Rivers. Ecological studies on

the Bushmans estuary have been made by the Department of Zoology, University of Port Elizabeth. A research programme to determine the influence of freshwater input on estuarine ecology is being carried out by the Institute for Freshwater Studies, Rhodes University and incorporates the Kariega estuary.

Conservation recommendations: An investigation should be made to establish the status and conservation of the river pipefish (see Remarks).

Remarks: The common name "River Pipefish" for this species may be misleading as there is no firm evidence that the specimens were derived from the freshwater reaches of the Bushman and Kasouga Rivers. G W Begg (personal communication) considers *Syngnathus* species (pipefishes) to be threatened generally in Natal due to the rapidly changing conditions in estuaries there, especially the progressive sanding up with loss of submergent macrophyte beds *(Zostera).*

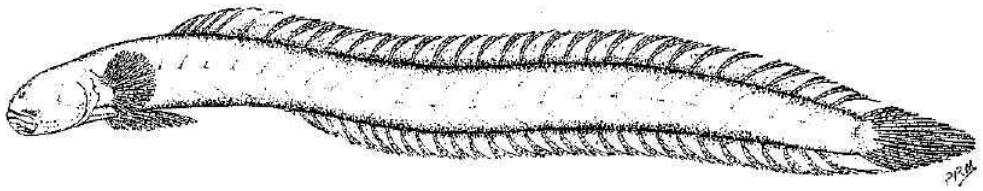
REFERENCES

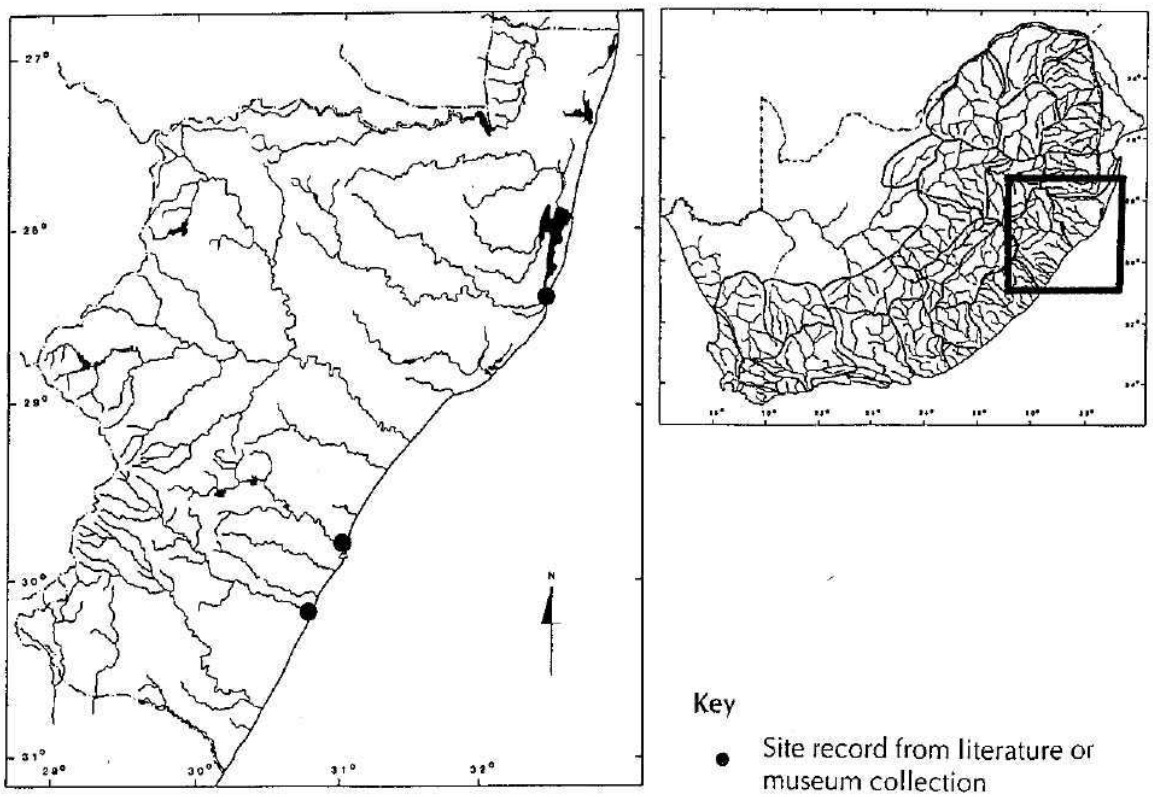
Dawson (1986); Day et al (1981); Farquharson (1970b); Heydorn (1986); Smith (1963, 1965).

Correspondence: Dr G W Begg; Dr P H Heemstra; Dr G Read; Mr R S Stobbs.

BEARDED EELGOBY / BEBAARDE PALINGDIKKOP

FIGURE 28. The bearded eelgoby, *Taenioides jacksoni,* 140 mm SL, with distribution in Natal.





BEARDED EELGOBY / BEBAARDE PALINGDIKKOP **VULNERABLE**

Taenioides jacksoni Smith 1943

Family: Gobiidae SUMMARY

Status: Vulnerable. The species is uncommon in collections. The rapid deterioration of estuaries in Natal especially through sedimentation raises concern for the survival of the species.

Research: poor - fair. No specific study of the biology of this species has been made but some data on the habitat of the species is available from surveys of estuaries in Natal by Begg (1978, 1984a,b).

SPECIES DATA

Identification: A gobioid species (attains 132 mm SL) with a naked elongated body with the pelvic fins united. The dorsal and anal fins are long and confluent with the caudal fin and are enveloped in thick skin. The eyes are very small and vestigial, the head has scattered tiny flaps.

Distribution: Recorded from the St Lucia estuary (Smith 1965) and by Begg (1984a,b) from the Mgeni and Mkomazi estuaries.

Habitat and ecology: Burrows in soft anaerobic sediments (mud) under saline conditions. The following details on the habitat where the species was collected by Begg (1984a,b) have been provided by G W Begg (personal communication): depth 15 to 220 cms; dissolved oxygen 3,9 to 7,5 mg ■**; salinity 0 to 28%-; temperature 21 to 27"C; Secchi two to 25 cms; substratum from muddy sand to pure mud or silt or sludge, usually pure mud; vegetation usually *Phragmites* reeds but also grasses *(Sporobolus* species), lagoonal and estuarine trees. Broad detailed descriptions of the St Lucia, the Mgeni and Mkomazi estuaries are given in Begg (1978, 1984a). All three known locales are open estuaries and Begg (1984b) considers both the Mgeni and the Mkomazi to be in "fair" environmental condition although in both much man-induced habitat change has taken place.

Breeding biology: Unknown.

Remarks: Whitfield (1980) records only *Taenioides esquivel* from St Lucia estuary but as this is the type locality of *T jacksoni,* either Whitfield (1980) made an incorrect identification or both species occur there.

CONSERVATION

Threats: The major threat to this species is the smothering of favoured substrate (soft anaerobic mud) through coarse sand deposits (Begg 1978, 1984a,b). Various other threats to the habitat such as pollution or physical alterations, and extensive recreational usage of the estuaries where the species is known to occur, has been recorded by Begg (1978, 1984a,b). Heydorn (1986) gives the conservation status of St Lucia estuary as good, and Mgeni and Mkomazi as fair. Sedimentation is particularly severe in the Mkomazi estuary and localized industrial pollution also occurs.

Conservation attention given: Studies by Begg (1978, 1984a,b) provide a sound basis for the conservation of Natal's estuaries where the bearded eelgoby and other rare and threatened estuarine fish species occur.

Conservation recommendations: Begg (1984b) recommends the formulation of a comprehensive nation-wide policy to conserve estuaries and lagoons.

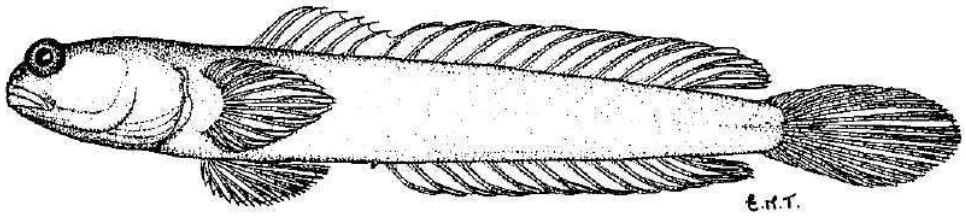
REFERENCES:

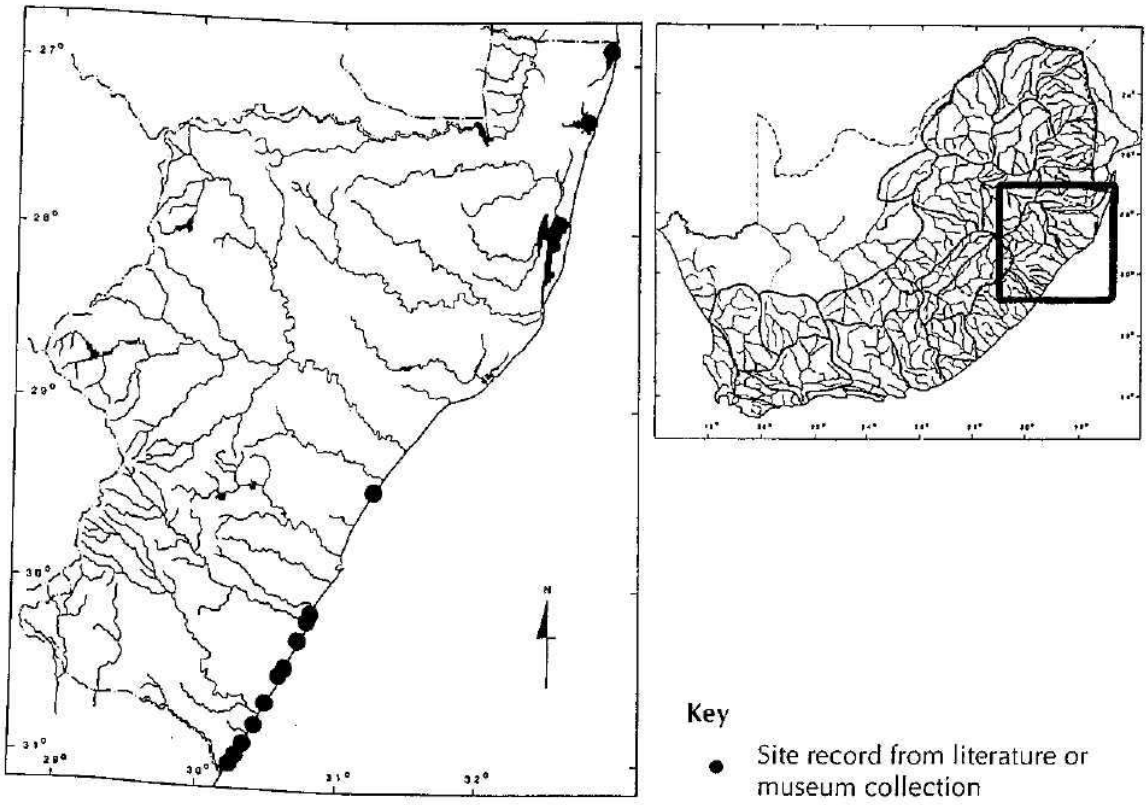
Begg (1978, 1984a,a); Heydorn (1986); Hoese (1986a); Smith (1943, 1965); Whitfield (1980).

Correspondence: Dr GW Begg; Dr P C Heemstra.

BURROWING GOBY / GRAWENDE DIKKOP

29. The burrowing goby, *Croilia mossambica, t* 48 mm SL, with distribution in Natal.





BURROWING GOBY / GRAWENDE DIKKOP RARE (SAFE?)

Croilia mossambica Smith 1955

Family: Gobiidae

SUMMARY

Status: Rare - Safe. Recent surveys by Begg (1984a,b) have shown this species to be more widespread than previously thought. The species is, however, relatively uncommon in the known locales.

Research: Good. Surveys of the Natal estuaries have been carried out by Begg (1984a,b). The biology of the species was studied and reported on by Blaber and Whitfield (1977).

SPECIES DATA

Identification: A small (attains 60 mm SL) elongate, scaleless gobiid with large antero-dorsal eyes and steeply sloping snout. The mouth is large with the lower jaw projecting. In life the body is semitransparent with a dark spot at the base of the caudal fin. The caudal fin is pointed.

Distribution: Estuaries and coastal lakes from Lake Poelela (Mozambique) in the north to Sandlundlu estuary (31°2^{t}30"S, 30°13'30^{n}E) in the south (Blaber and Whitfield 1977; Bruton and Kok 1980; Begg 1984a,b). In addition to locales given in Skelton (1977) *C mossambica* is reported by Begg (1984a,b) from the following locales: Mhlali, uMgababa, Mkomazi, Mahlongwa, Mnamfu, Kwa-Makosi, Mtentweni, Mhlangeni, Mbizana, Mpenjati, Sandlundlu.

Habitat and ecology: Blaber and Whitfield (1977) record the habitat of *C mossambica* in Lake Sibaya. It burrows (to a depth of nine centimetres) in clean and undisturbed fine to medium grained sand at depths from 3,5 to 16 m with a recorded maximum of 27 m. Apart from a suitable substratum the essential habitat requirements are undisturbed environments with little water movement. The food of the species is surface dwelling benthic invertebrates. In Lake Sibaya the population density varies from one fish 10 nr^{2} to one fish 70 nr^{2}. Begg (1984a) reports that *C mossambica* is frequently encountered together with the sandprawn *Callianassa kraussi,* and suspects this fish occupies the burrows of sandprawns.

Breeding biology: *C mossambica* is a summer breeder with a protracted spawning period (Blaber and Whitfield 1977). Males are territorial and about 50 adhesive eggs are laid. Young and juveniles possibly inhabit weed beds. Blaber and Whitfield's (1977) study included the captive breeding of the species.

Remarks: Until the collections made by Begg (1984a,b), who used a beam trawl for the purpose, the burrowing habits of this species acted against its presence in collections. Future studies may show the species to be more abundant than presently considered (G W Begg personal communication).

CONSERVATION

Threats: Sedimentation is a serious threat to the estuaries of Natal (Begs 1984a,b) but this factor may favour the status of *C mossambica.* Other man-made environmental perturbations such as pollution and sand extraction (eg Mpenjati lagoon) are threats to this species. Artificial breaching of the sandbar at the mouth of lagoons is probably deleterious for this species as are motorboat and other recreational activities which result in water currents and shift the substratum. The majority of known locales are presently in fair conservation status with only the Mhlangeni in a poor state (Heydorn 1986). The conservation status of the uMgababa and Mahlongwa estuaries is good (Heydorn 1986).

Conservation attention given: Apart from the mentioned studies on the biology and ecology of this species (Blaber and Whitfield 1977; Begg 1984a,b) no specific conservation attention has been applied.

Conservation proposals: Broad and specific recommendations for the conservation of estuaries including those from which *C mossambica* is known have been made by Begg (1978, 1984a,b). These recommendations are essential for the conservation of this and other estuarine fish species included in this Red Data Book.

Remarks: The Mpenjati lagoon is the focal point of a resort development run by the Natal Parks Board. It is expected that this will intensify the recreational use of the lagoon that could be deleterious to the burrowing goby.

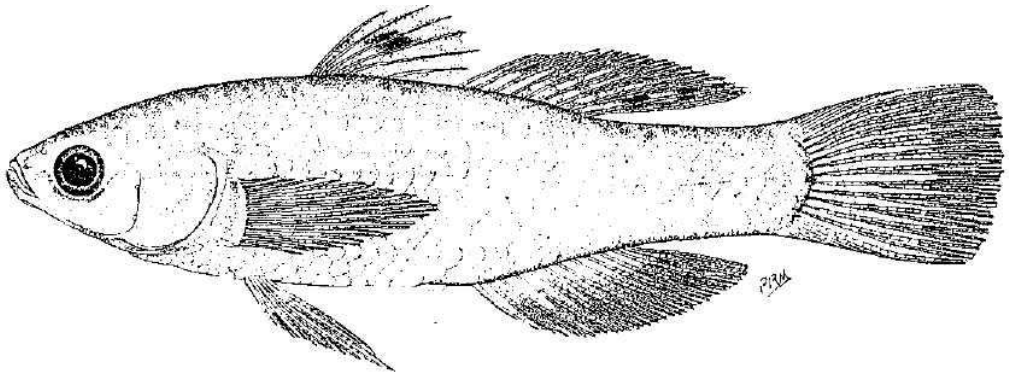
REFERENCES:

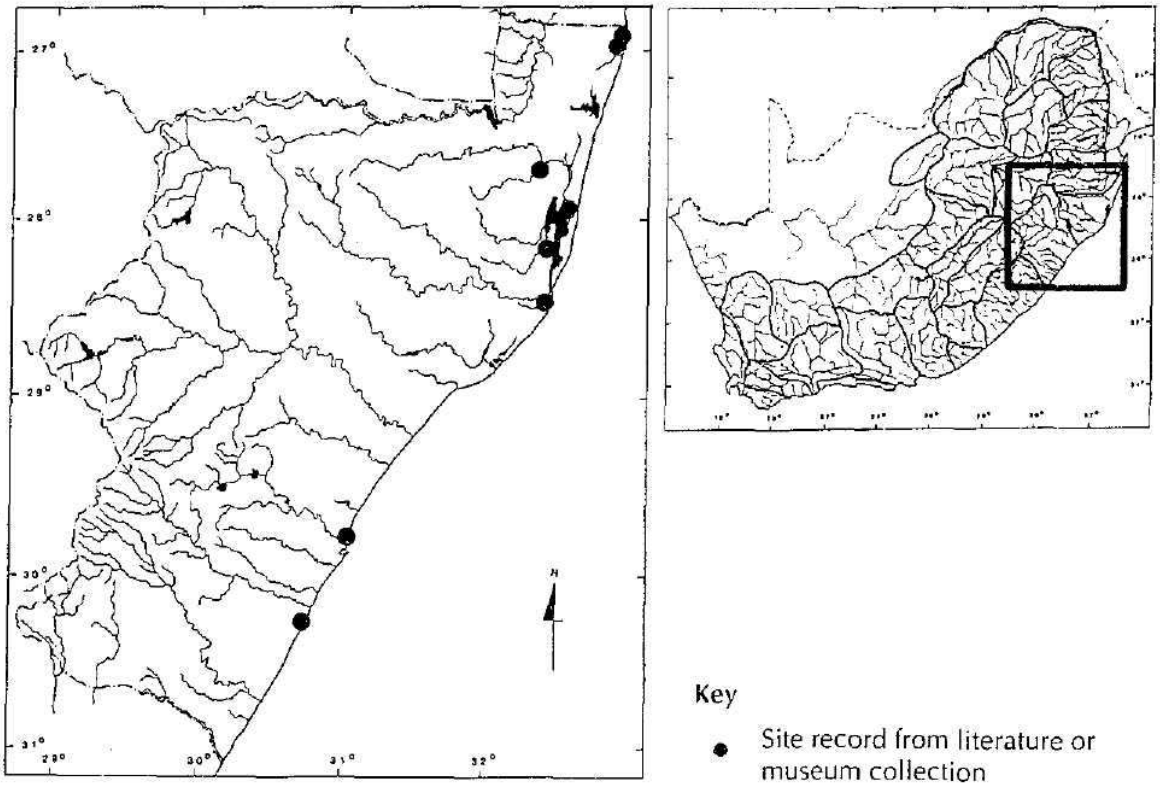
Begg (1978, 1984a,b); Blaber and Whitfield (1977); Bruton and Kok (1980); Heydorn (1986); Skelton (1977); Smith (1955).

Correspondence: Dr G W Begg; M Coke; Dr P C Heemstra.

GOLDEH SLEEPER / GOUE SLAPER

FIGURE 30. The golden sleeper, *Hypseleotris dayi,* 50 mm SL, with distribution in Natal.





GOLDEN SLEEPER / GOUE SLAPER RARE

Hypseleotris dayi Smith 1950

Family: Eleotridae SUMMARY

Status: Rare. Known only from a few estuarine systems in Natal, several of which are being threatened by human activities (Begg 1978, 1984a,b).

Research: Poor. The species is only known from a few ad hoc reports. No specific biological or ecological studies have been made on this species.

SPECIES DATA

Identification: Small fishes (maximum recorded size 50 mm SL) with scaled head and two dorsal fins. Mouth terminal with small villiform teeth. The caudal fin is truncate with 15 segmented rays. In life specimens are transparent ventrally, head and body with golden sheen, and a dark stripe through eye and body (Smith 1950; Crass 1968; Kyle in littera).

Distribution: Distributed in estuaries of Natal from the Kosi system in the north to the Mpambanyoni in the south. Specifically it has been recorded from a freshwater stream near Charters Creek, Lake St Lucia (Smith 1950), Msunduzi River a tributary of the Mkuze River (Jubb 1967a; Crass 1968; Bruton and Kok 1980), Empangeni (Hoese 1986b), Mgeni estuary (Edwards and Moll 1972), the Kosi system near Kosi mouth as well as in lakes Makhawulani, Mpungwini and Mtando Channel (Kyle in littera) and from a small stream that enters the Mpambanyoni estuary (Cooke in littera; RUSI records).

Habitat and ecology: Occurs in freshwater usually near the entrance of small streams into estuaries, and the reed margins of estuarine lakes and channels. The original habitats given by Smith (1950) were "a small estuary formed by a stream of practically fresh water" and "water of salinity greater than that of the sea". Kyle (in littera) has observed that in the Kosi system during periods of flood this species is much more common than in dry years. One reason is that they favour shallow vegetated marginal habitats, especially for breeding purposes, and such habitats are more abundant in wet periods. In captivity they feed readily on mosquito and chironomid larvae.

Breeding biology: They have been successfully kept in aquaria for as many as 15 years (D Pistor personal communication; Kyle in littera) but there are no reports of breeding in captivity. Both Pistor and Kyle have remarked on the attractiveness of male specimens of the species. Breeding appears to take place in the extreme shallow margins of waters following flooding (Kyle in littera).

Remarks: This poorly known species may not be uncommon where it occurs as it is easily overlooked. Kyle (in littera) reports "large" shoals in the Mthando Channel at Kosi. It has not been reported from St Lucia since the original specimens were collected there. Begg (1984a,b) did not find specimens at Mgeni in spite of a thorough study of that system.

CONSERVATION

Threats: The species has a restricted natural distribution. Plans to develop a harbour at Kosi Bay and increasing human interference and catchment related deterioration of Natal's estuaries (Begg 1978, 1984a,b) threaten the long-term survival of the species. With the exception of the Mpambanyoni estuary the known locales of this species have a fair or good conservation status at present (Heydorn 1986). The Mpambanyoni is threatened by industrial pollution, severe siltation and sugarcane encroachment (Heydorn 1986). Alien fish (swordtails *Xiphophorus helleri)* are present at this locale (Cooke in littera).

Conservation attention given: A survey of populations in the Kosi estuary has been carried out by R Kyle (KwaZulu Bureau of Natural Resources). At least parts of certain locales where this species is reported from are declared nature reserves that provide some measure of protection for the species (eg at Kosi, St Lucia and Mgeni).

Conservation recommendations; The conservation of estuaries in Natal has been considered in general by Begg (1978, 1984a,b). Studies on the biology and ecology, especially the breeding biology of this species are required. In certain cases the possibility of establishing sanctuary areas should be investigated.

Remarks: Kyle (in littera) considers that the population of *Hypseleotris day!* at Kosi is widespread and has a secure future. Much of the distribution range of the species at Kosi falls within the boundaries of forest and other reserves which are in the process of being reproclaimed and fenced.

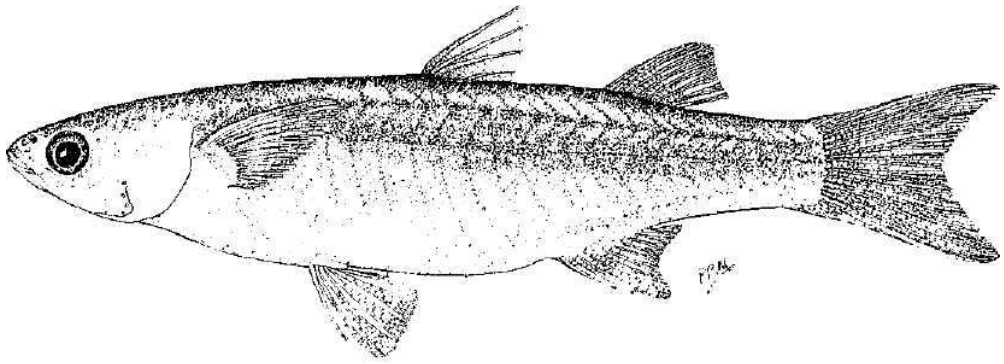
REFERENCES:

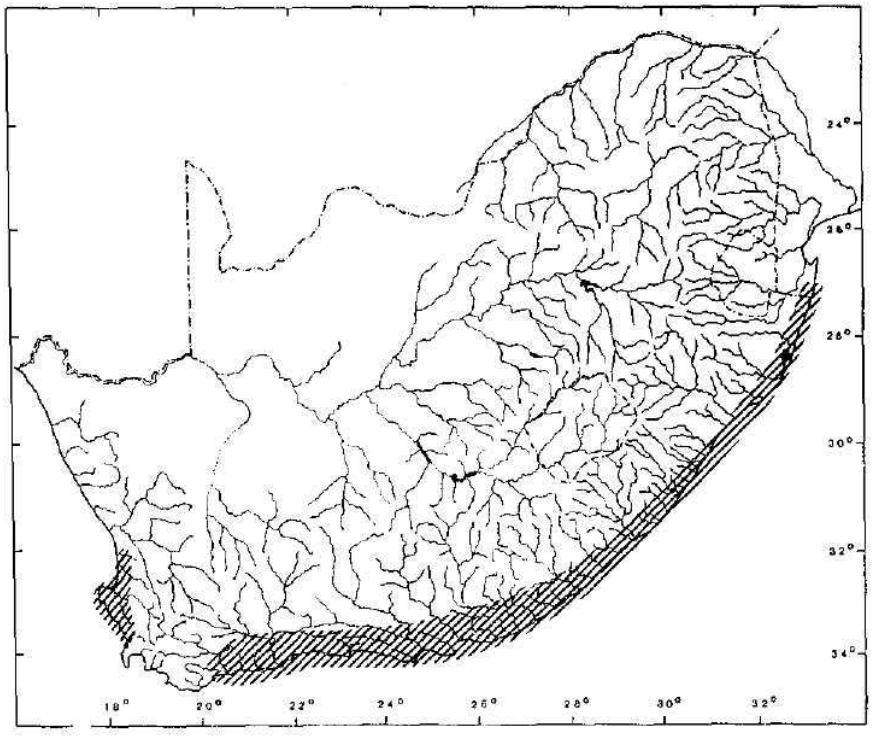
Begg (1978, 1984a,b); Bruton and Kok (1980); Crass 1968; Edwards and Moll (1972); Heydorn (1986); Hoese (1986b); Jubb (1967a); Kyle (1981); Smith (1950, 1965).

Correspondence: Dr G W Begg; M Coke; D Cooke; Dr R Kyle; D Pistor.

FRESHWATER MULLET / VARSWATER-HARDER

FIGURE 31. The freshwater mullet, *Myxus capensis,* 109 mm SL, with distribution in southern Africa.





Key

Distribution range from literature

FRESHWATER MULLET / VARSWATER-HARDER **RARE**

Myxus capensis (Valenciennes in C and V 1836)

Family: Mugilidae

SUMMARY

Status: Vulnerable. The extensive construction of dams and weirs in the rivers of the east coast of southern Africa have seriously interferred with the diadromous habits of this species.

Research: Good. The biology and life history of this species in relation to its conservation was studied by Bok (1983).

SPECIES DATA

Identification: A mullet species attaining 450 mm FL. Eyes without adipose lids. Anal fin origin is in advance of the origin of the second dorsal fin. The pectoral fins do not reach forward beyond the orbit. The teeth are yellowish in colour. Colour in life is silver-grey.

Distribution: Found in east coastal rivers and estuaries from Kosi Bay in the north (Blaber 1978a; Begg 1984a) to the Bree River southern Cape, in the south (Bok 1979, 1983). Inland penetration varies depending on the physiography of the system, the nature and condition of the environment and the development of artificial barriers (Bok 1979).

Habitat and ecology: The preferred habitat is large, deep pools of coastal rivers. The freshwater mullet is diadromous and known to penetrate in excess of 100 km in suitable systems like the Great Fish and the Gamtoos Rivers (Bok 1979; Bruton et al in press). This species is also found in the upper reaches of estuaries, especially of systems that receive a large amount of fresh water (Bok 1979, 1983). Kyle (in littera) found that numbers of this species in the Kosi estuary system depends inversely on the salinity. Breeding occurs in the sea areas adjacent to estuaries and juveniles enter rivers from the estuaries in late winter and early summer. Males remain in freshwater for up to four years and females up to seven before returning to the sea.

Breeding biology: Breeding occurs throughout the year with a peak in early summer. In the Kosi system Kyle (in littera) has found a clear annual run of gravid mature fish to the sea in mid-winter. Males mature after one year, females after two years. Fecundity varies from 140 000 ova in a female of 270 mm FL to 630 000 ova in a fish of 450 mm FL. There is no evidence that fish survive and return to freshwater after breeding (Bok 1984). A H Bok (personal communication) has succeeded in artificially breeding *Myxus capensis,*

CONSERVATION

Threats: Man-made obstructions across rivers in the form of weirs and dam walls that prevent the upstream migration of *M capensis* is probably the main threat to the species (Bok 1984). Habitat deterioration due to water extraction, sedimentation and pollution are ancillary threats to the species survival.

Conservation attention given: Bok (1983) completed a detailed study of the biology and ecology of *Myxus capensis* in the eastern Cape. During the course of this work specimens were translocated to sites above barriers and into other systems.

Conservation recommendations: Bok (1983, 1984) made the following recommendations for the conservation of this mullet species: a) the construction of fish ladders on existing and future artificial barriers of rivers when feasible; b) weirs to be located and constructed in places suitable to incorporate fish ladders into the design; c) attention to be given to the artificial breeding techniques for production of stock for restocking depleted populations.

Remarks: In the Kosi system Kyle (in littera) has found that up to 10% of fish migrating to the sea are caught in the fish traps set by local inhabitants*

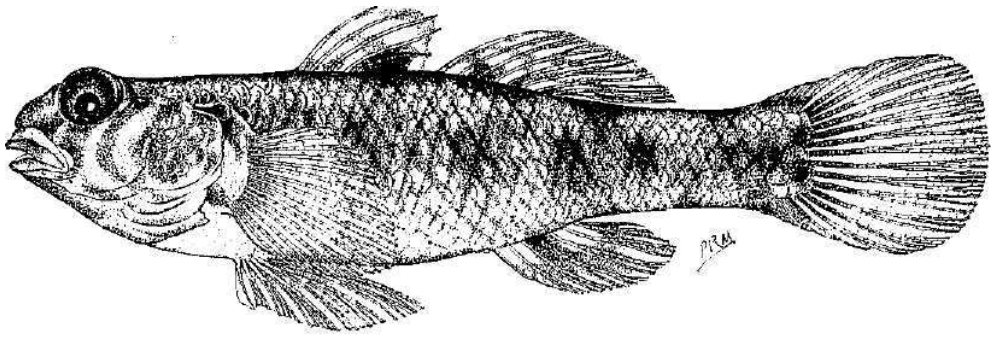
REFERENCES

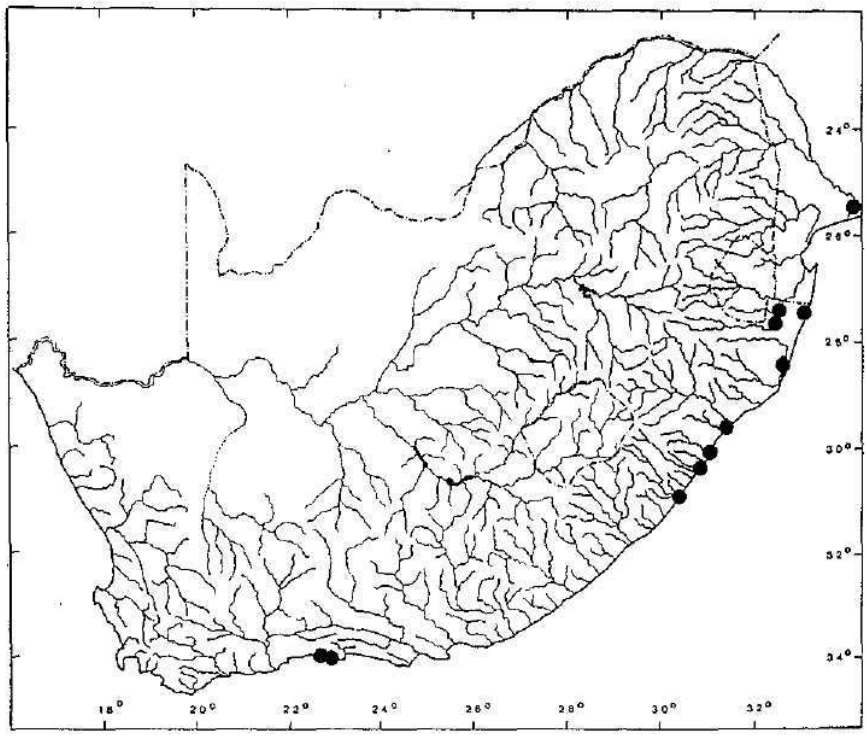
Begg (1978, 1984a); Blaber (1978a); Bok (1979, 1980, 1983, 1984); Bruton et al (in press).

Correspondence: Dr A H Bok; Dr R Kyle.

CHECKED GOBY / BLOKKIES-DIKKQP

FIGURE 32. The checked goby, *Redigobius dewaali,* 28 mm SL, with distribution in southern Africa.





Key

● Site record from literature or museum collection

CHECKED GOBY / BLOKKIES-DIKKOP **RARE**

Redigobius dewaali (Weber 1897)

Family: Gobiidae

SUMMARY

Status: Rare. This species is uncommon and restricted to a few locales in South Africa.

Research: Poor - fair. Aspects of the biology and ecology of this species from the Pongolo floodplain have been studied by P la Hausse (in preparation). Various distribution surveys have improved recent knowledge on the distribution of the species.

SPECIES DATA

Identification: A small (attains 42 mm SL) relatively compressed, deep bodied goby. Mouth large, reaching to below the eye (female) or beyond the eye to preopercle (males). Scales ctenoid, 25 to 29 in lateral series. Dorsal fin with a large blue (black in preserved specimens) spot, body olive with oblique dark bars in front and diffuse spots in rear, three to four spots along anal base and two dark spots at base of caudal.

Distribution: Recorded from lower Limpopo River in Mozambique (AMG records) south to Knysna estuary (Grindley 1985). The species is reported only from the following intermediate locales: Pongolo River floodplain (Kok and Blaber 1977; Bruton and Kok 1980; Merron et al 1985; la Hausse in press, in preparation); the Kosi system (Kyle in littera); Lake St Lucia (Kok and Blaber 1977); Nonoti and uMgababa lagoons (estuaries) (Begg 1984a,b); Durban Bay (Smith 1950); and Swartvlei (Whitfield et al 1983). The checked goby was originally described from the Mgeni and Illovo (Lovu) Rivers (Weber 1897).

Habitat and ecology: The environment and ecology of the Pongolo River floodplain has been described in detail by Kok (1980) and Heeg and Breen (1982). The checked goby is found in a wide variety of pans which are seasonal or perennial, floodplain and non-floodplain and in the river (la Hausse in preparation). In general the species appears to prefer quiet, clear, well vegetated fresh or slightly saline waters. The Nonoti estuary is a small, shallow, well vegetated system which was classified as a lagoon and supports a relatively small fish community of seven species (Begg 1978, 1984a,b). The following details of the habitat where the checked goby was collected in the Nonoti are (Begg in littera): depth of 65 to 170 cms, dissolved oxygen 3,4 to 8,1 mg $^{-1}$, salinity 1-2%-, temperature 21 to 29,9°, secchi 40 to 95 cms, substrate mud or mud-sand, vegetation floating *Eichhornia crassipes* or lagoonal trees. The uMgababa estuary is also a relatively small system in the lagoon category ie normally closed and irregularly open. It is well vegetated with *Zostera* and a variety of submerged macrophytes. Twenty-eight species have been recorded and *Redigobius dewaali* is rare, Begg (1984a) only collected one specimen in seven survey visits during 1980 and 1981, This specimen was taken at a depth of 85 cm, dissolved oxygen of 5,8 mg ~*, freshwater, temperature 17,9°, secchi 75 cm, substrate sand- muddy, vegetation of *Phragmites* reeds. On the Pongolo floodplain *R dewaali* is often found in association with another goby *Glossogobius callidus* (la Hausse in preparation).

Breeding biology: Fecundity varies from 350 to 1 100 ova per female with maturity being reached in specimens above 22,8 mm SL (females) and 23,9 mm SL (males) (la Hausse in preparation). The available data indicates that the species breeds mainly in summer with the timing possibly related to flooding. Uniform egg size indicates that the species is a total spawner.

Remarks: The extensive hiatus in the distribution of *R dewaali* from uMgababa to Swartvlei is interesting. *Redigobivs dewaali* has not been collected in the estuaries near East London during a study programme on estuarine gobies conducted by G Bell-Cross and G Brett of the East London Museum (G Bell-Cross in littera). Kok and Blaber (1977) described a junior synonym of this species and referred to it as the blue-spot goby.

CONSERVATION

Threats: Environmental degradation and deterioration through many causes poses a general threat to the existence of *R dewaali* and other flood-plain or estuarine species. Heeg and Breen (1982) detailed changes in the habitat brought about by impoundment and agricultural development oh the Pongolo floodplain system. Begg (1978, 1984a,b) provides an assessment of the severe impacts of urban, agricultural, industrial and transport sources on Natal estuaries. The major problem affecting these estuaries is siltation, largely from catchment soil erosion. River water abstraction resulting in decreased freshwater input to the estuaries and lagoons may be a particular threat to this species. Other threats are agricultural encroachment onto floodplains, breaching of river mouths, destruction of bank-binding vegetation, industrial waste pollution, and a variety of direct and indirect physical threats to the systems. The threats to the Knysna estuary are mainly related to urban and industrial development, transportation and human utilization (Grindley 1985). The conservation status of the known locales of this species vary from poor (Nonoti) to good (uMgababa) (Heydorn 1986).

Conservation attention given: la Hausse (in preparation) has made a preliminary study of the biology of this species on the Pongolo River floodplain. Extensive study and recommendations on the conservation of systems where the species has been recorded from have been made by Begg (1978, 1984a,b), Grindley (1985), Heeg and Breen (1982) and Whitfield et al (1983). Additional data and suggestions for conservation of these areas are available from several works such as Bruton (1980a), Day (1981) and Taylor (1982c). Integrated conservation programmes are advocated for all the riverine floodplain, coastal lagoon or estuarine locales. Parts of certain known locales fall within existing conservation areas, eg Lake Nyamithi in the Ndumu Game Reserve, and nature reserves at Kosi Bay and Lake St Lucia.

Conservation recommendations: Further studies on the biology and ecology of this species are required. Suitable sanctuary locales should be selected for conservation on the basis of critical life history and environmental requirements. The uMgababa is considered to be the most important lagoon for conservation on the south coast of Natal (Heydorn 1986).

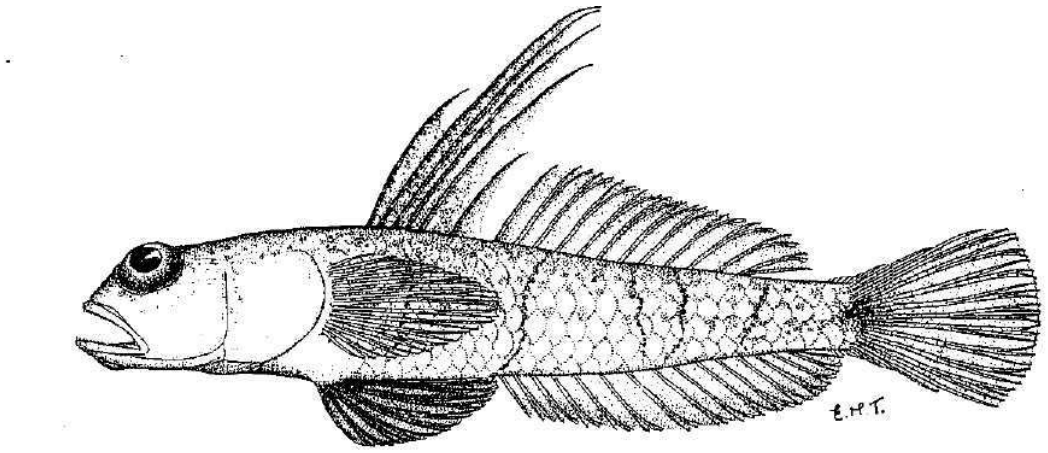
REFERENCES

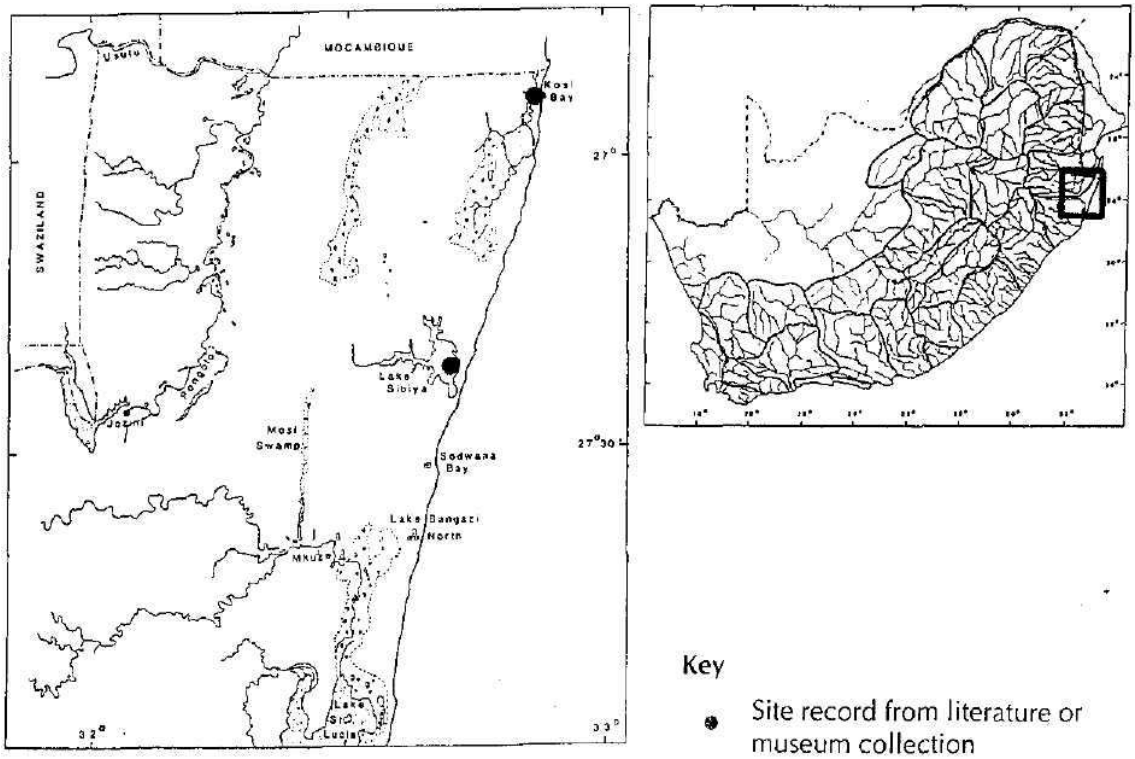
Begg (1978, 1984a,b); Bruton (1980a); Bruton and Kok (1980); Davies (H49); Day (1981); Grindley (1985); Heeg et al (1980); Heeg and Breen (1982); Hoese (1986a); Kok (1980); Kok and Blaber (1977); la Hausse (in press); Merron et al (1985); Smith (1950); Taylor (1982c); Weber (1897); White et al (1984); Whitfield et al (1983).

Correspondence: Dr G W Begg; G Bell-Cross; M Coke; Dr R Kyle; P la Hausse de Lalouviere.

SIBAYI GOBY / SIBAII-DIKKOF

FIGURE 33. The Sibayi goby, *Silhouettea sibayi,* 30 mm SL, with distribution in northern Natal.





SIBAYI GOBY / SIBAYI-DIKKOP **RARE**

Silhouettea sibayi Farquharson 1970

Family: Gobiidae

SUMMARY

Status: Rare. The species is endemic to the Kosi system and Lake Sibaya in KwaZulu where it is not common (Bruton 1979a; Hoese 1986a).

Research: Poor. The biology of this species has not been studied although general SCUBA diver observations on the distribution and habitat of the species in Lake Sibaya are known (Bruton 1979a).

SPECIES DATA

Identification: A small, cryptic goby (maximum size 40 mm SL) with naked chest (prepelvic area) and large eyes; three to five subvertical lines of small spots on the side of the body. Dorsal fin of males with two to four tall and filamentous spines, dorsal fin rays fewer than anal fin rays.

Distribution: Recorded from Lake Sibaya and the Kosi system in Maputaland (Bruton 1979a, 1980a; Hoese 1986a). Known from a single specimen only in Kosi (Rusi 17519).

Habitat and ecology: Of benthic habits, and occurs on sandy slopes from shallows to about 20 m. Has been observed in open habitat and areas with macrophyte cover. Associated species include *Oreochromis mossambicus, Pseudocrenilabrus philander, Tilapia sparrmanii, T rendalli, Clarias gariepinus* and the gobies *Croilia mossambica* and *Glossogobius giuris.* The sibayi goby buries itself in sand leaving only the eyes uncovered. The long dorsal fin is erected above the sand either for intraspecific communication or as a lure to attract prey (Bruton 1979a).

Breeding biology: This has not been studied. Bruton (1979a) reports that juveniles were observed in plant beds by SCUBA divers.

Remarks: An alternative common name for this species is the barebreast goby (kaalbors-dikkop) (Hoese 1986a).

CONSERVATION

Threats: No immediate threats are recorded. Bruton (1979b) discussed the conservation of Lake Sibaya and indicated that the rapidly expanding rural population of KwaZulu as well as the general development of the area will undoubtedly lead to greater impact by man on the Lake ecosystem. A similar and possibly greater threat faces the Kosi system which has been (or is being) considered for harbour development. Begg (1978) lists the following environmental problems associated with the Kosi system: i) deforestation of the area; ii) DDT pollution; iii) sand encroachment of the tidal basin; and iv) bank erosion from the passage of boats. None of these are considered serious threats and Begg (1978) concluded that the Kosi system is in satisfactory environmental condition.

Conservation attention given: No specific attention has been given to the Sibayi goby but there has been extensive ecological research and conservation attention given to the Kosi system and Lake Sibaya (see Begg 1978; Bruton 1979b and Bruton and Cooper 1980 for details). Bruton (1980b) in particular addressed the conservation of Maputaland which included Kosi and Lake Sibaya and showed that both are included partly within existing conservation areas (Bruton 1980b, Figure 7), Kyle (in littera) reports that the KwaZulu Bureau for Natural Resources is erecting a fence around a portion of Lake Sibaya as a "Tribal Nature Reserve" for conservation purposes.

Conservation recommendations: Conservation proposals on the coastal lakes of KwaZulu made by Bruton (1980b) and the KwaZulu Bureau for Natural Resources (DNCK 1981) aim at long-term management and sustainable use of the Kosi and Sibaya systems. Lake Sibaya and parts of the Kosi system would fall into the ordinary environmental reserve category which are defined as valuable resource areas with small human populations, restricted public access and controlled removal of fauna and flora. The DNCK proposal identifies three pertinent areas: i) Kosi Bay natural resource area north of Kosi where the people are permitted to stay under certain development and habitatulization restrictions; ii) Kosi Bay Wilderness area which includes the actual water bodies and shores of the system - limited recreational and local Thonga use is accepted; and iii) the Lake Sibaya area with three utilization zones: a general recreation zone where sailing is permitted; a general resource zone where fishing is encouraged; and a game reserve zone managed as a reserve with restricted tourist access. These proposals are being implemented and should ensure reasonable security for this species. It is also recommended that a specific autecological and biological investigation of the species be carried out.

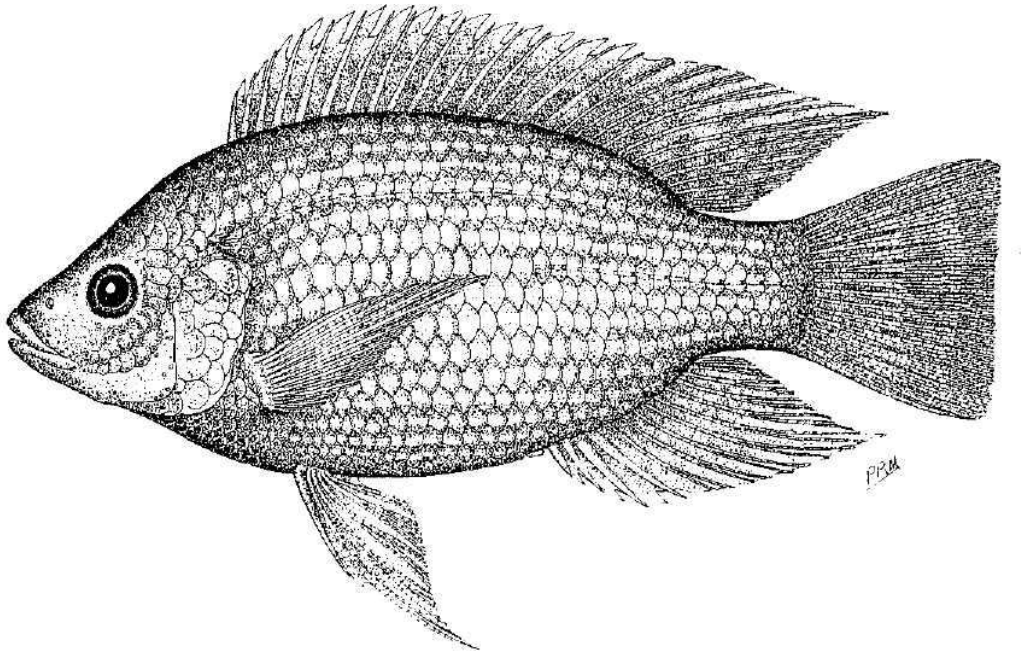
REFERENCES:

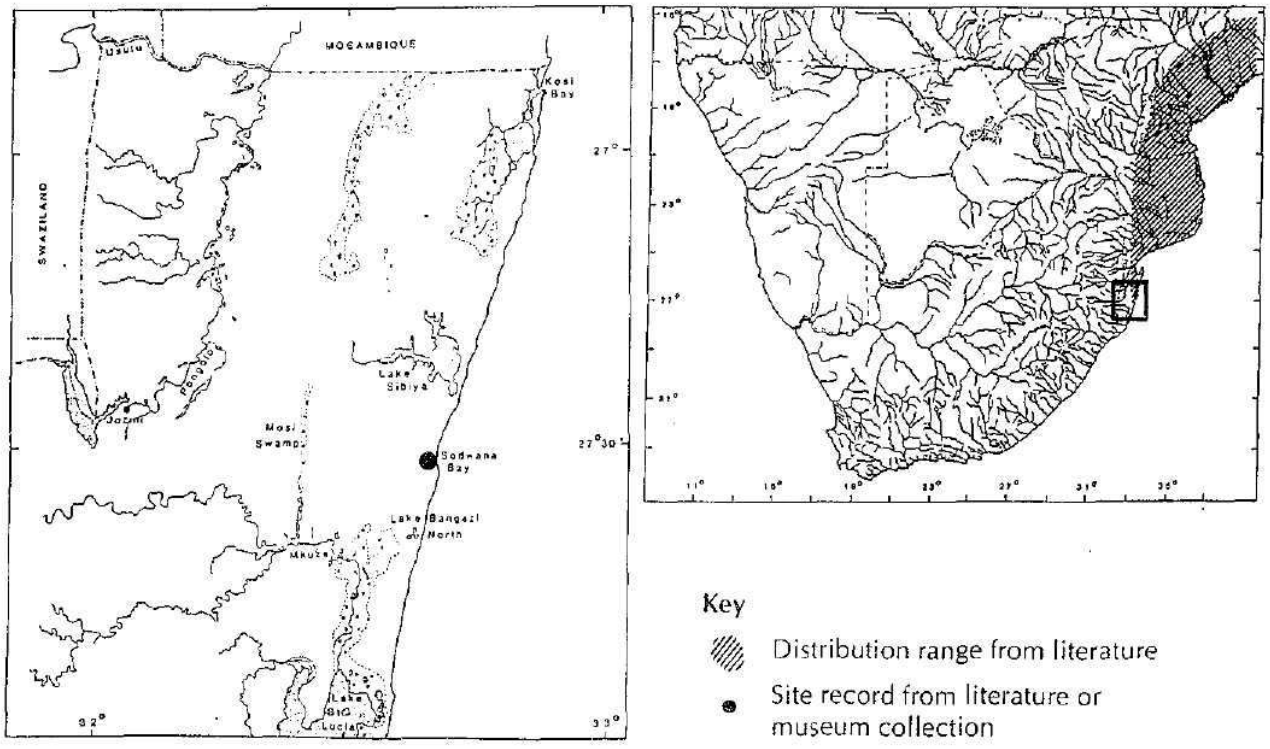
Begg (1978); Bruton (1979a,b; 1980a,b); Bruton and Cooper (1980); Division of Nature Conservation, KwaZulu (1981); Farquharson (1970); Hoese (1986a).

Correspondence: Prof M N Bruton; M Coke; Dr P C Heemstra; Dr R Kyle.

BLACK TILAPIA / SMART TILAPXA

FIGURE 34. The black tilapia, *Oreochromis placidus,* 245 mm SL, with distribution in southern Africa and north-east Natal.





BLACK TILAPIA / SWART TXLAPXA **VULNERABLE**

Oreochromis placidus (Trewavas 1941)

Family: Cichlidae

SUMMARY

Status: Vulnerable (possibly endangered) in South Africa. Known only from a single system in South Africa. Human recreational activities in the area pose a general threat to the system.

Research: Poor. No specific biological study of *0 placidus* has been made. The general ecology of Mgobezeleni Lake system has been investigated by Begg (1978) and Bruton (1980c).

SPECIES DATA

Identification: A species of the genus *Oreochromis* with (usually) four anal fin spines (see Trewavas 1983). Attains 355 mm TL. The teeth are unicuspid in large males and the head is relatively short (32 to 36% SL). There are 16 to 20 short gill rakers on the lower part of the anterior arch. There are XVI to XVIII dorsal fin spines. The colour of juveniles is a light silver-grey with three lateral spots and faint vertical bars, breeding males are a dark grey-black with red dorsal lappets (Bell-Cross 1976).

Distribution: Lower sections of east coastal rivers from Lukuledi River, Tanzania, to the Mgobezeleni Lake system in Maputaland (Bruton 1975, 1980a; Trewavas 1983). The subspecies *0 placidus placidus* occurs from the lower Zambezi southwards to Mgobezeleni (Trewavas 1983), In Maputaland this species is also known from Lake Shazibe and the mangrove swamp at Sodwana (Bruton 1980a).

Habitat and ecology: It prefers quiet pools with marginal vegetation (Bell- Cross 1976). In the Mgobezeleni system it was collected from a 1,4 m deep shaded pool on the southern edge of a mangrove swamp (Bruton 1975) as well as in 30 cm deep rapids but the latter did not appear to be suitable habitat for the species. *Oreochromis placidus* is most frequently found together with *O mossambicus.* The ecology of the Mgobezeleni has been investigated by Begg (1978) and Bruton (1980c).

Breeding biology: Details of the breeding biology are not known but the species is probably a mouth-brooder (Bell-Cross 1976),

Remarks: In Zimbabwe this species was translocated from the lower Lundi River to the Kyle Dam (Jubb 1967a) and probably also to other waters. Trewavas (1983) suggests that its temperature and salinity tolerances are probably narrower than those of *O mossambicus.*

CONSERVATION

Threats: In South Africa the main threat to this species is the potential interference with the relatively small Mgobezeleni Lake system by man. The Lake itself is in close proximity to the estuary and Begg (1978) states that the environment in the estuary is highly disturbed. The destruction of the mangrove community by the badly designed culvert bridge

at the head of the estuary was described by Bruton and Appleton (1975). This bridge was subsequently modified with beneficial results to the previously damaged sections of the system. The Sodwana Bay area is used extensively for recreation (Begg 1978) and resort facilities have been established there. Further development of this resort is likely, which might affect the freshwater resources of the Mgobezeleni Lake itself. The present conservation status of Mgobezeleni estuary is good (Heydorn 1986).

Conservation attention given: The ecology of the Mgobezeleni system has been reported by Bruton and Appleton (1975); Begg (1978) and Bruton (1980c). Bruton (1980b,c) recommended that the entire Mgobezeleni Lake system be incorporated into a "Maputaland National Park" under the St Lucia Conservation Area and managed as a Nature Reserve for resource based recreation. A low level causeway bridge was replaced by a new bridge in 1977 in order to re-establish a tidal regime in the lower portions of this system. Additional fish records from the Mgobezeleni Lake are given by Bourquin (1986).

Conservation recommendations: A specific study on the biology and autecology of the black tilapia at Mgobezeleni should be made. A conservation plan for the Mgobezeleni Lake system is required.

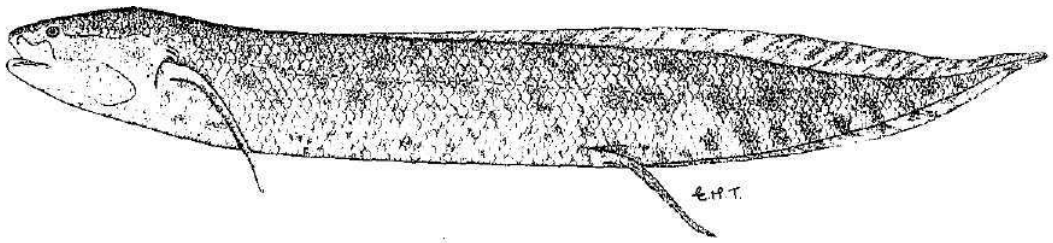
REFERENCES

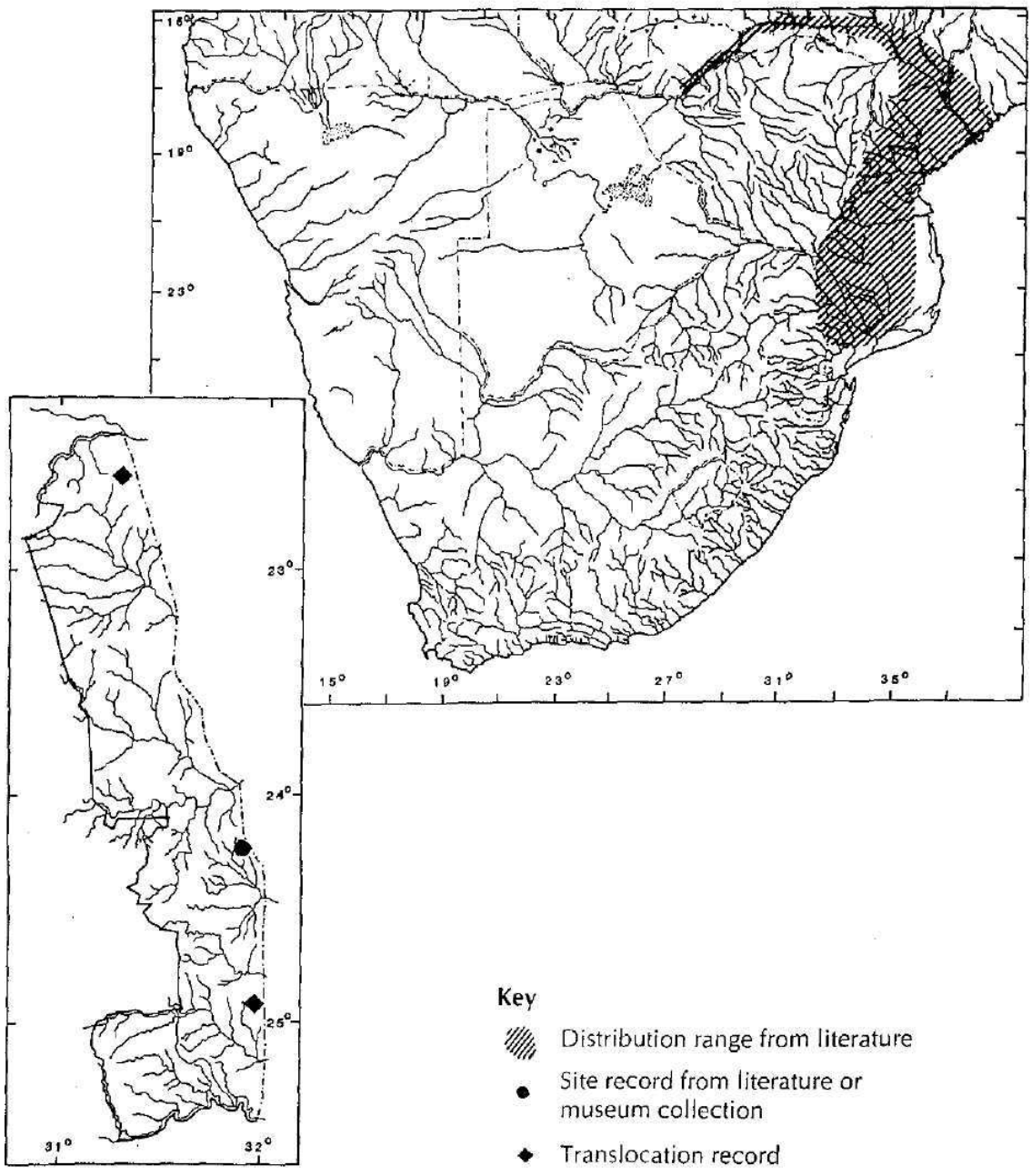
Begg (1978); Bell-Cross (1976); Bourquin (1986); Bruton (1975, 1980a,b,c); Bruton and Appleton (1975); Jubb (1967a); Trewavas (1983).

Correspondence: M Coke; Dr R Kyle,

LUNGFISH / LONGVIS

FIGURE 35. The lungfish, *Protopterus annectens brieni,* ± 200 nrni SL, with distribution in southern Africa and the Kruger National Park.





LUNGFISH / LONGVIS VULNERABLE

Protopterus annectens brieni Poll 1961

Family: Protopteridae

SUMMARY

Status: Vulnerable in South Africa. The lungfish was discovered recently in a single pan along the eastern boundary of the Kruger National Park (Pienaar 1981a,b).

Research: Poor. The species has not been studied in South Africa but various aspects of its biology and ecology are reported in the literature and have been summarized by Jubb (1967a) and Bell-Cross (1976).

SPECIES DATA

Identification: The lungfish has a distinctively tapered, elongated body with soft, partially embedded scales and filamentous pectoral and pelvic fins. The head is rounded with small eyes and short restricted gill openings. Maximum size reached is 90 to 100 cm but such specimens are rare. Young are characterized by feathery external gills. The usual colour is pale to dark greyish-olive-brown with irregular dark brown spots.

Distribution: In South Africa the lungfish has been recorded only from one pan in the Pumbe sandveld on the eastern boundary of the Kruger National Park (Pienaar 1981a,b). Beyond South Africa it occurs in swampy areas, floodplains and pans of Mozambique along the middle and lower Zambezi, Pungwe, Buzi, Save and Limpopo Rivers and possibly as far south as Lake Chualo on the Incomati River system (Gaigher 1969; Jubb 1967a; Pienaar 1981a). Further north *P annectens brieni* occurs along the Luapula and Luabala Rivers of the Zaire River system in Zaire (Poll 1961).

Habitat and ecology: *Protopterus annectens* inhabits swamps, flood-plains and seasonal pans. These habitats are characterized by having abundant aquatic vegetation, and often a muddy substratum. Marked seasonal fluctuations of the water body is also a feature of the lungfish habitat. The Pumbe Pan where the lungfish was found in South Africa is a shallow (less than one metre deep) temporary rain pan which dries up completely each year (Pienaar 1978a). The pan is also inhabited by the spotted killifish *Nothobranchius orthonotus.* The lungfish survives the dry season by aestivating in a coccoon formed in the bottom muds of the pan as it dries out (Johnels and Svensson 1954; Jubb 1967a).

Breeding biology: Nests are built in shallow water among dense (chiefly grassy) vegetation (Johnels and Svensson 1954). Entrance pathways are formed to the breeding chamber where large numbers of eggs are laid on the naked substrate. The larvae are tended and guarded by the male fish who remains in the nest and generates a gentle water current through it.

Breeding occurs during the summer (rainy) season and fractional spawning is characteristic. Johnels and Svensson (1954) made their observations on *Protopterus annectens annectens,* and the details of breeding of *P annectens brieni* may be different.

CONSERVATION

Threats: The site where the lungfish was first discovered in South Africa is situated on the border between South Africa and Mozambique. The site is therefore prone to destruction from border traffic and patrols or road development (Pienaar 1981b). This species is exploited as a food resource by local inhabitants digging up the aestivating fishes when the habitat is dry (Jubb 1967a; Pienaar 1981b).

Conservation attention given: The site is known to the authorities of the Kruger National Park and is monitored as a site of special interest (Project Aqua site 19). Specimens of lungfish have been collected and translocated to a less vulnerable habitat (the Machai Pan) in the Nwambiya sandveld south of Pafuri in the Kruger National Park (Pienaar 1981b). An experimental translocation has also been made to the Rietpan near the eastern boundary of the Kruger National Park, north of the Sabie River (U de V Pienaar in littera).

Conservation recommendations: The original site should be monitored and safeguarded from destruction by border traffic. The outcome of the translocation programme should be monitored and if necessary further translocations should be attempted to other suitable habitats (eg pans in the Nwambiya sandveld and along the Limpopo floodplain). The biology and ecology of the species should be studied in the Kruger National Park. A captive breeding population should be established.

Remarks: This species is subject to harvesting for food by local inhabitants in Mocambique (Jubb 1967a). The South African population is at the extreme southern range of the distribution of lungfishes in Africa and special conservation attention is therefore warrented. Detailed taxonomic analysis of the South African population has not been carried out.

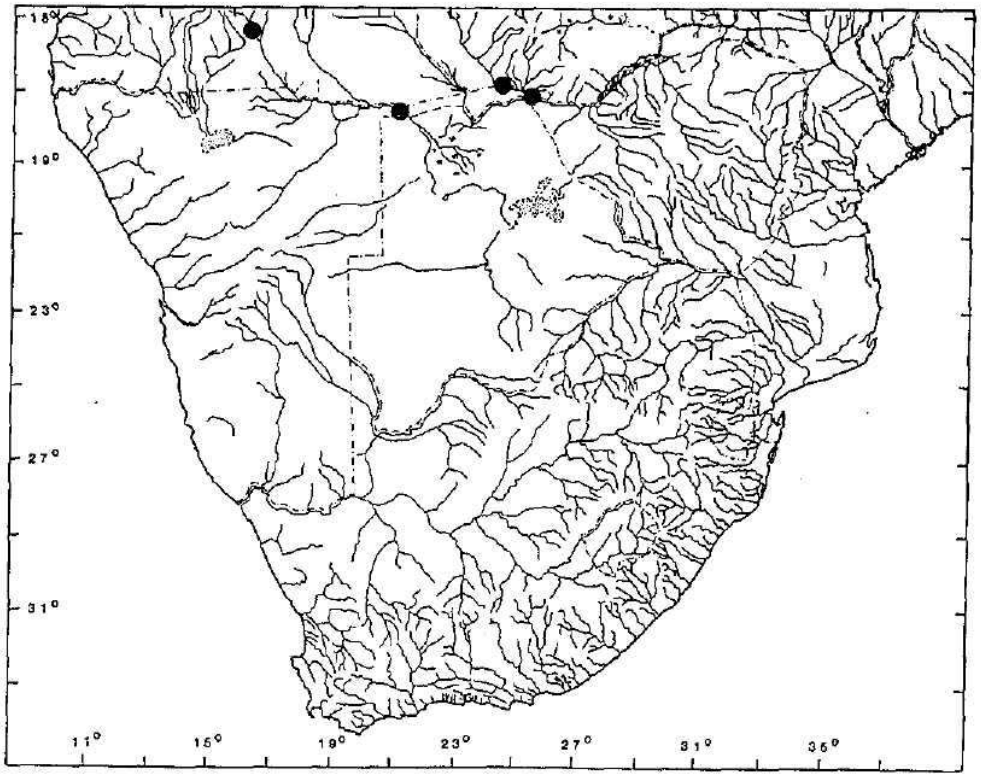
REFERENCES:

Bell-Cross (1976); Gaigher (1969); Johnels and Svensson (1954); Jubb (1967a); Pienaar (1978a, 1981a,b); Poll (1961).

Correspondence: Dr U de V Pienaar.

OCELLATED SPINYEEL / BONT-STEKELPALING

FIGURE 36. The ocellated spinyeel, *Afromastacembelus vanderwaali,* 69 mm SL, with distribution in the Okavango and Zambezi River systems in southern Africa.



Key

● Site record from literature or museum collection

OCELLATED SPIKYEEL / BONT-STEKELPALING RARE

Afromastacembelus vanderwaali (Skelton 1976)

Family: Mastacembelidae

SUMMARY

Status: Rare in South West Africa/Namibia. Restricted habitat preferences limit this species to few locales in the Zambezi and Okavango Rivers only.

Research: Poor. Known only from specimens collected during general distribution surveys.

SPECIES DATA

Identification: A relatively small eel-like fish (attains 153 mm SL) with a series of 22 to 26 independent spines along the back. Soft dorsal, caudal and anal fins are confluent. The head is elongate and the snout has a trilobed pointed fleshy appendage bearing the anterior nostrils. Colour dark brown with a linear series of brown and yellow ocellations along the soft dorsal and anal fins.

Distribution: Occurs in the Upper Zambezi and Okavango Rivers where it has been collected or reported from the following locales only: Upper Zambezi River - rapids at Katima Mulilo and Impalila (Van der Waal 1976; Van der Waal and Skelton 1984); Okavango River - rapids at Popa and at Caiundo, in Angola (Skelton 1976; Skelton and Merron 1984; Skelton et al 1985).

Habitat and ecology: This species inhabits holes and crevices in rocks and rocky habitats in flowing water. It has also been taken once from the trailing fringes of papyrus plants in the Okavango River at a site close to Popa rapids (Skelton and Merron 1984). The distribution and habitat preference of the ocellated spinyeel is closely similar to that of *Clariallabes platyprosopos.*

Breeding biology: Not known. Skelton (1976) reported a ripe female in September and suggested that the species may breed during high water conditions which prevail in late summer in the Kavango and Caprivi areas. The species has been maintained in an aquarium for over a year but without breeding (B C W Van der Waal personal communication).

Remarks: Travers (1984) places this species in a new genus *Afromastacembelus.*

CONSERVATION

Threats: (See also data for *Clariallabes platyprosopos)*. At present there are no major threats to the habitats of these species in South West Africa/Namibia. Gravel exploitation near Katima Mulilo could affect the rocky rapid habitat there and pesticide pollution from catchment sources may have a deleterious effect on fish populations in future. A large water abstraction scheme is under construction in South West Africa/ Namibia (Anonymous 1983; Ravenscroft 1985) and in future this may have an adverse affect on water levels at Popa rapids, especially during natural

low water periods. Exploitation for the aquarium trade could present a threat to this species.

Conservation attention given: The situation regarding the status and conservation of this species has been brought to the attention of the conservation authorities in Kavango and Caprivi (Van der Waal 1976, personal communication). Applications for the commercial collection and exploitation for aquarium trade has been declined (B C W Van der Waal personal communication).

Conservation recommendations: All collecting for aquarium trade purposes must be strictly regulated. The biology and ecology, of the ocellated spinyeel should be studied. Careful control and monitoring of potentially destructive operations on restricted habitats like the rocky rapids are necessary. The exploitation of the water resources of the Zambezi and Okavango Rivers must be carefully managed to ensure minimum impact on sensitive habitats.

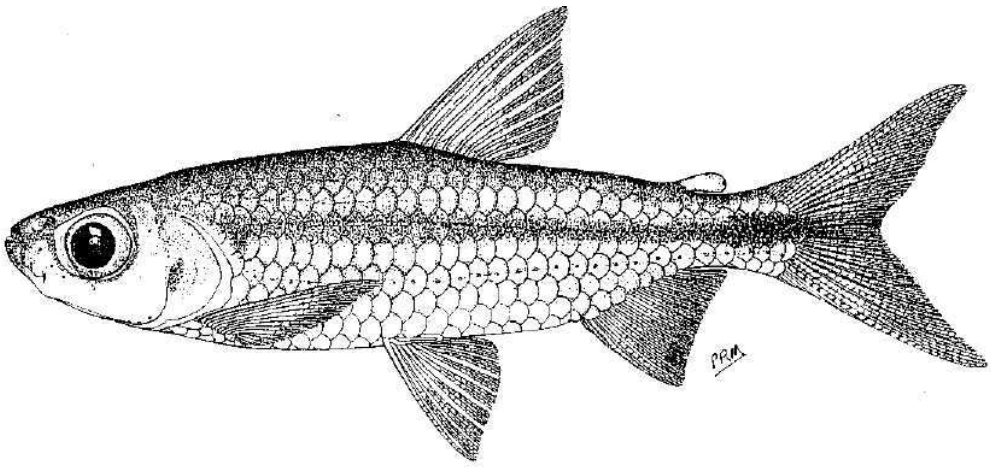
REFERENCES

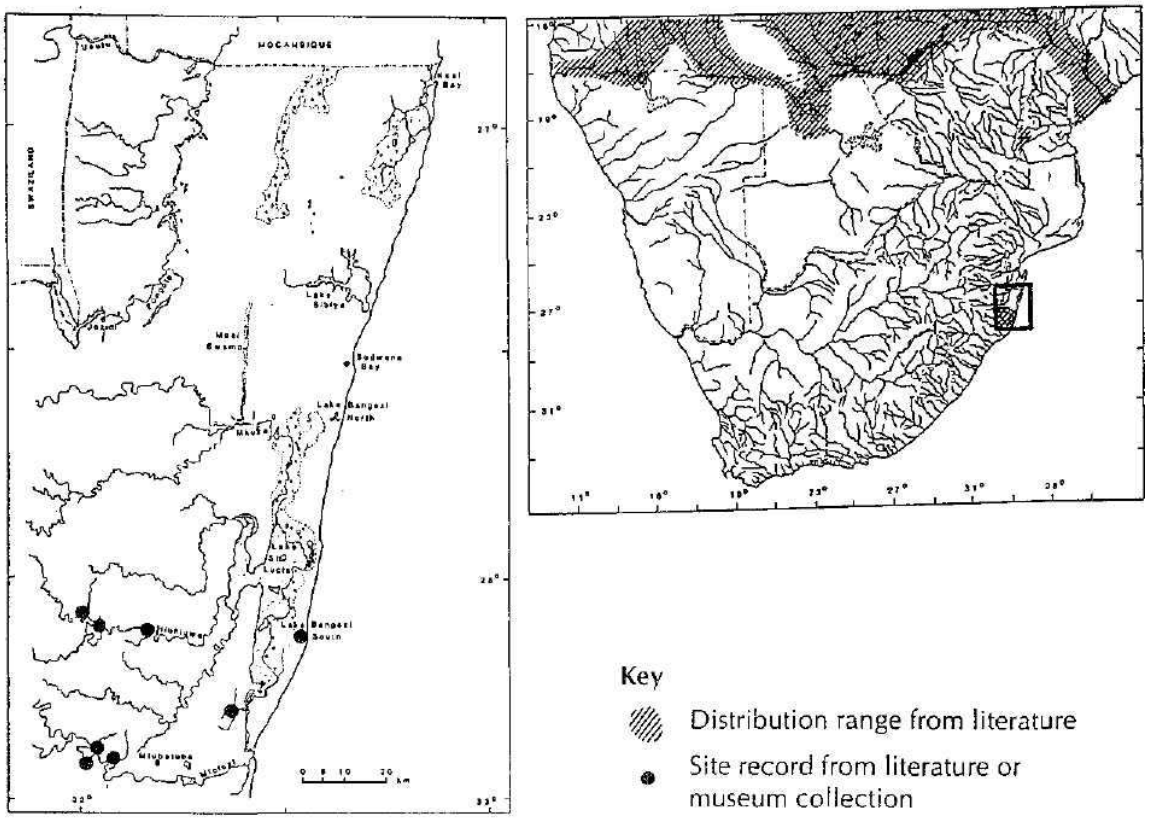
Anonymous (1983); Ravenscroft (1985); Skelton (1976); Skelton and Merron (1984); Skelton et al (1985); Travers (1984); Van der Waal (1976); Van der Waal and Skelton (1984).

Correspondence: Dr B C W Van der Waal.

STRIPED ROBBER / STREEP-ROWER

FIGURE 37. The striped robber, *Brycinus lateralis,* 81 mm SL, with distribution in southern Africa and north-east Natal.





STRIPED ROBBER / STREEP-ROWER **RARE**

Brycinus lateralis (Boulenger 1900)

Family: Characidae

SUMMARY

Status: Rare in South Africa. Known from a few locales in Natal and KwaZulu, in systems which are subject to increasing environmental pressures.

Research: Poor. In South Africa this species is only known from museum specimens.

SPECIES DATA

Identification: A moderate sized (up to 140 mm SL) characin with large eyes and terminal mouth. The teeth are large and tri- or multicusped and occur in two rows on the upper and lower jaws. The short-based dorsal fin (ii + 8 rays) is placed above the pelvic fins, the anal fin is long based (iii + 14-15 rays) and a small adipose fin is present. In life specimens are silvery with a prominent spindle-shaped black bar surrounded by yellow on the caudal peduncle and caudal fin.

Distribution: In South Africa specimens are known only from the following locales in Natal and KwaZulu, all of which are or have been connected with the Lake St Lucia drainage: Nzimane River, Hluhluwe Game Reserve (Bourquin et al 1971); Elcheleselwane (west of Lake St Lucia); Umpangazi Lake (Bangazi South) (eastern shores of Lake St Lucia) (Crass 1964); Amanzimnyana River (AMG/P 5185); Umfolozi River and its floodplain pans (Bourquin et al 1971; Bruton and Kok 1980; Pike 1965, 1979).

Beyond South Africa *B lateralis* occurs in the Buzi, the Zambezi, the Okavango and Cunene Rivers as well as the Luapula section of the Zaire River system (Poll 1933, 1967; Balon 1971; Bell-Cross 1976). Minshull (1985) records this species from the upper Save River in Zimbabwe but Bell-Cross (1976) suggests that the species may have been introduced to that system. A record from Swaziland by Clay (1976) is unsubstantiated and dubious.

Habitat and ecology: Found in well vegetated habitats of at least one or two metre depth, where there is little or no water current (Crass 1964; Bell-Cross 1976). In Natal the species has been collected from standing (lentic) and well vegetated water bodies such as the floodplain pans on the Mfolozi (Pike 1979).

Breeding biology: This is a shoaling species which moves upstream during rains (Bell-Cross 1976) possibly for spawning purposes. Females have high fecundity (as many as 12 000 ova per individual) (Bell-Cross 1976). Balon (1971) suggests that *B lateralis* may spawn on submerged macrophytes.

Remarks: The taxonomy and name of this species was recently revised by Paugy (1986).

CONSERVATION

Threats: The St Lucia catchments from which *Brycinus lateralis* is known, include parts of Natal and KwaZulu which are increasingly subject to environmental pressures from human population growth and land utilization. Siltation from land erosion is a prominent threat in these catchments (Nanni 1982). Water abstraction, dam construction and river regulation threatens the floodplain pan habitats on the Mfolozi drainage (Porter 1982). Pollution from mines and pesticides (Brooks and Gardner 1980; Porter 1982) has also been recorded.

Conservation attention given: No specific attention has been given to this species in South Africa. Several of the known locales of the species do occur within formally conserved areas such as the Hluhluwe and Mfolozi Game Reserves, as well as the Eastern Shores Nature Reserve. In the case of the Hluhluwe and Mfolozi Game Reserves the river systems are not entirely contained by the conserved areas and there is no guarantee of sanctuary for the species in these areas. The detailed study on the impact of Mfolozi dams (Porter 1982) is indirectly of conservation benefit to this species.

Conservation recommendations: The distribution, biology and ecology of *B lateralis* in South Africa should be investigated. It is clear that the conservation of this species is dependent on sound conservation practice in terms of land/catchment relationships. Therefore it is important that, for example, the recommendations on dam sites in the Mfolozi River and on the management of the Mfolozi floodplain, swamps and estuary complex by Porter (1982) are implemented.

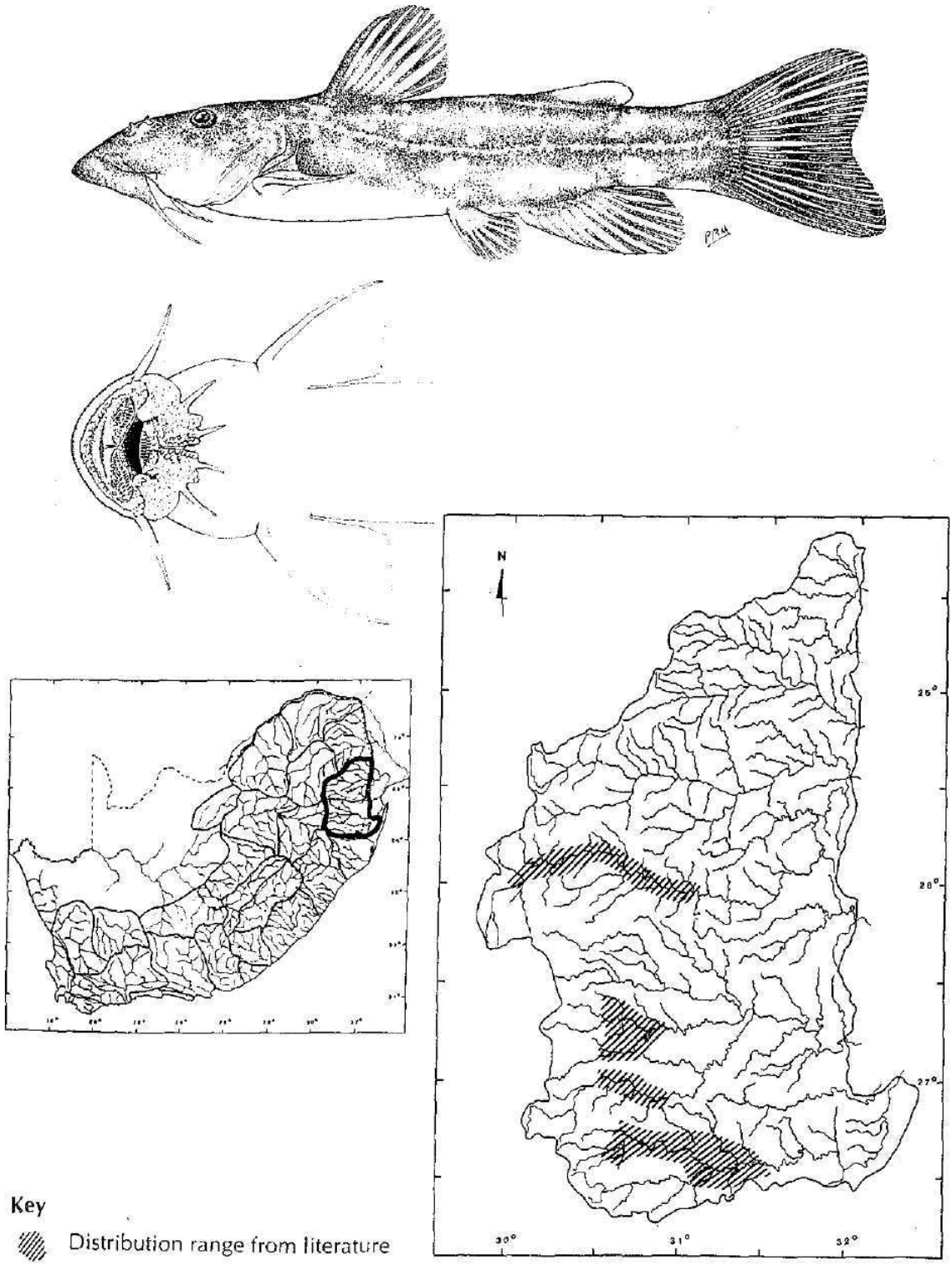
REFERENCES

Balon (1971); Bell-Cross (1976); Bourquin et al (1971); Brooks and Gardner (1980); Bruton and Kok (1980); Clay (1976); Crass (1964); Jubb (1967); Minshull (1985); Nanni (1982); Paugy (1986); Pike (1965, 1979); Poll (1933, 1967); Porter (1982).

Correspondence: M Coke; R H Taylor.

PONGOLA ROCK CATLET / PONGOLA-SUIERBEKKIE

FIGURE 38. The Pongola rock catlet, *Chiloglanis emarginatus,* 46 mm SL, with distribution in the Incomati and Pongola River system in South Africa and Swaziland.



PONGOLA ROCK CATLET / POHGOLA-SUIERBEKKIE **RARE**

Chiloglanis emarginatus Jubb and Le Roux 1969

Family: Mochokidae

SUMMARY

Status: Rare in South Africa. The species is restricted in distribution and threatened by stream regulation.

Research: Good, A study of the distribution and conservation of this species was made by Kleynhans (1982, 1984).

SPECIES DATA

Identification: A small (up to 65 mm TL) scaleless catlet with a broad emarginate caudal fin. The dorsal fin is short with a simple spine. The inferior mouth has a large oral disc and relatively well developed barbels. There are few (up to eight) widely spaced mandibular teeth.

Distribution: This catlet is known in South Africa from the Komati tributary of the Incomati River system and tributaries of the Pongola River system (Gaigher 1969; Jubb and Le Roux 1969; Kleynhans 1982, 1984; Pott 1969). Beyond the borders of South Africa *C emarginatus* occurs in Swaziland (Pongolo and Umbeluzi River systems), and Zimbabwe in the Pungwe and Zambezi River systems (Jubb and Le Roux 1969; Bell-Cross 1976).

Habitat and ecology: It inhabits shallow (usually less than 0,5 m) rocky river stretches (flats, stickles and runs) of escarpment streams, where the water is clear and cool and the current is moderately strong (up to 0,7 m s^{-1}). Epilithic aufwuchs and small stream invertebrates including aquatic insect larvae, ostracods and small molluscs form the major food items of the species. Associated fish species include various cyprinids such as minnows *(Barbus* species), yellowfish *(Barbus polylepis, B marequensis, Varicorhinus nelspruitensis)* and labeos, *(Labeo cylindricus* and *L molybdinus)*, the mountain catlet *Amphilius uranoscopus* and three *Chiloglanis* species as well as the eel *Anguilla mossambica,* the mormyrid *Marcusenius macrolepidotus* and the cichlid *Pseudocrenilabris philander* (Kleynhans 1982, 1984).

Breeding biology: A few aspects have been studied by Kleynhans (1982, 1984): maturity is attained in fishes larger than 40 mm SL; ova of two size classes are present in the ovaries of ripe females; functional fecundity (the ripe ova only) is about 114 to 141 eggs per female but total fecundity (all ova) is from 246 to 321 eggs per female. Ripe-running individuals were collected in November, and the species is therefore likely to be a summer breeder.

Remarks: This species has not been located by Kleynhans (1982, 1984, personal communication) in the Gladdespruit where it was reported to be present by Appleton (1974).

CONSERVATION

Threats: Impoundments such as the Fig Tree Dam on the Komati River and the Morgensen Dam on the Ngwempisi River (Pongola River system) have

flooded parts of suitable *C emarginatus* habitat. Other dams are planned for the streams where this species occurs and these are expected to have a deleterious impact on this species through habitat flooding, downstream effects on the flow and changes in water quality. The water demand for agriculture and industrial usage (especially for power generation by Highveld power stations) is likely to increase in future, with increasing impacts on the habitats of eastern Transvaal escarpment streams (Kleynhans 1982, 1984).

Conservation attention given: An investigation into the distribution and aspects of the biology and conservation of this species was made by Kleynhans (1982, 1984).

Conservation recommendations: Kleynhans (1982, 1984) has recommended that monitoring surveys of the known populations and habitat of this species are carried out every two years.

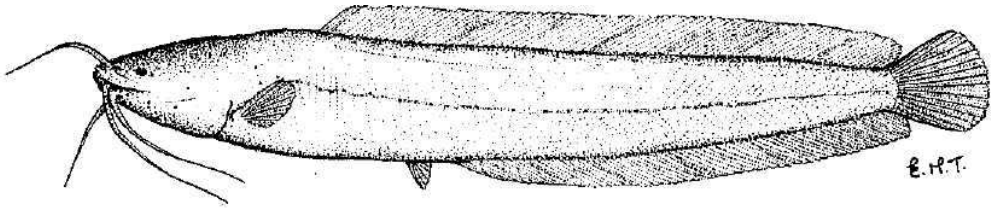
REFERENCES

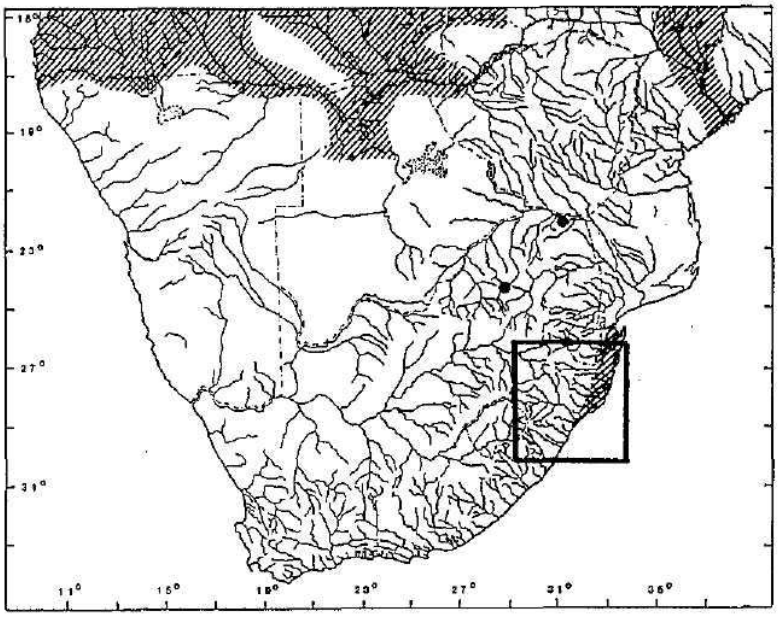
Appleton (1974); Bell-Cross (1976); Gaigher (1969); Jubb and Le Roux (1969); Kleynhans (1982, 1984); Pott (1969).

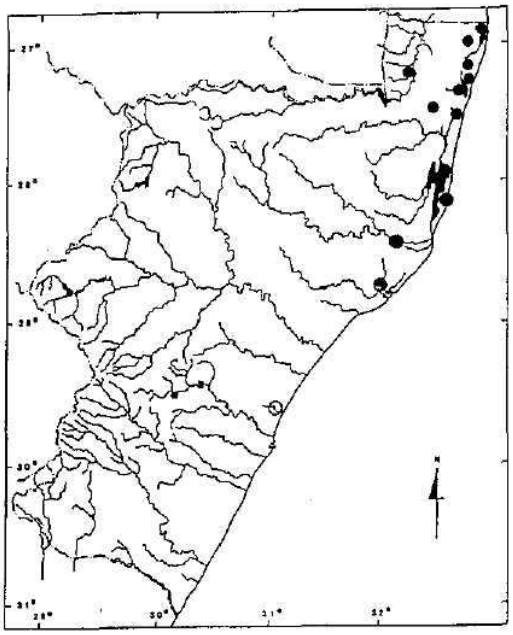
Correspondence: Dr C J Kleynhans.

SNAKE CATFISH / SLANG-BABER

FIGURE 39. The snake catfish, *Clarias theodorae,* ± 90 mm SL, with distribution in southern Africa, Natal and Transvaal.







Key

- Distribution range from literature
- Site record from literature or museum collection
- Historic record

SNAKE CATFISH / SLANG-BABER RARE

Clarias theodorae Weber 1897

Family: Clariidae SUMMARY

Statusi Rare in South Africa. Only a few locales are known where this tropical species reaches the southern limit of its distribution in South Africa.

Research: Poor. No specific study of the biology, ecology or conservation of this species is known.

SPECIES DATA

Identification: A relatively small, elongate clariid catfish (maximum size about 300 mm SL) with a short head (head length five to six times in SL). The nasal barbels are placed far forward on the snout. The pelvic fins are nearer to the tip of snout than to the base of the caudal fin. It is usually dark brown or black in colour with whitish spots around the lateral line tubules.

Distribution: In South Africa the snake catfish occurs in the Transvaal and Natal. In the Transvaal the species is known only from the Klein Nyl (Mogalakwena) and Nwanedi tributaries of the Limpopo (Hecht et al 1981, 1983). In Natal it is reported from Mzinyeni Pan (Pongola floodplain), Muzi (Mosi) swamps, KwaNgwanase airfield, a stream south of Lake Zilonde (Kosi system) (Kyle 1984), swamps at Mbibi and Manzengwenya, Vasa Pan, Lake Sibaya, Lake Bangazi-South (Bruton 1974; Bruton and Kok 1980; Bruton and Taylor 1979; Crass 1964), Mgobezeleni Lake (Bourquin 1986) and Hlabinyathi Pan near Sodwana (R H Taylor personal communication) as well as the Mfolozi River (Crass 1964) and the Mdloti River (Weber 1897). The most southern recent record is from the Enseleni stream which drains into Richards Bay (AMG 9587). Beyond South Africa *C theodorae* occurs in the Cunene, Okavango and Upper Zambezi systems, as well as the Zambian Zaire, Lake Mweru, the Kasai, Lake Tanganyika, Lake Malawi and the east coast of Mocambique as far north as the Rufiji River in Tanzania (Bell-Cross 1976; Jackson 1961; Poll 1933, 1967; Tweddle and Willoughby 1979).

Habitat and ecology: It inhabits shallow, densely vegetated or otherwise sheltered, marginal habitats of lakes, streams and rivers (Jackson 1961; Bell-Cross 1976; Hecht et al 1981). A favoured habitat in the Okavango is abandoned *Tilapia rendalli* nest cells. The snake catfish feeds on aquatic invertebrates, and allochthonous insects. It is often found together with small fishes such as minnows *(Barbus* species), *Aplocheilichthys* species, *Pseudocrenilabrus philander* and *Ctenopoma* species.

Breeding biology: This has not been studied in detail. Females of 126 mm and 148 mm TL reported with mature eggs (Crass 1964). Van der Waal (in littera) collected ripe adults of both sexes from the flooded margins of Lake Liambezi (Eastern Caprivi) during March 1974. In captivity these fish were observed to exhibit aggressive prespawning behaviour including chasing and fin display by the male, biting of the female's abdomen by the male, mutual mouth-biting interspersed with periods of relative inactivity

(when the fishes lay alongside each other, facing the same direction and the male gently rubbing back and forth along the female). The ripe male is characterized by swollen cheeks.

CONSERVATION

Threats: No specific threats have been identified but general habitat deterioration through siltation, pollution (agricultural) and urban and industrial development (eg at Richards Bay) may be affecting populations. In Natal, agricultural development (especially sugar cane) of catchment areas has probably reduced or altered the natural riverine swamp habitats favoured by the snake catfish. The species has not been recorded from its type locality (Mdloti River) since originally collected by Weber (1897). Begg (1978) states that natural vegetation in the upper catchment region of the system is poor through overgrazing. The river is extensively used for urban and agricultural purposes and Begg (1984a) and Blaber et al (1984) report that significant quantities of dieldrin were found in mullet taken from the Mdloti lagoon. In the Transvaal the habitat of the Klein Nyl River has deteriorated through agricultural development (C J Kleynhans personal communication).

Conservation attention given: No specific action has been taken to conserve the snake catfish although the Transvaal Nature Conservation authorities have noted the species for attention (Kleynhans 1985). Several locales where *C theodorae* occurs are contained within the boundaries of nature or game reserves, eg the Nwanedi Game Reserve (Venda), the Enseleni Nature Reserve and the St Lucia Reserve.

Conservation recommendations: An investigation of the conservation status, distribution and biology of this species should be carried out in both the Transvaal and Natal.

Remarks: *C theodorae* is fairly common in suitable marginal habitats in the St Lucia area (R H Taylor personal communication).

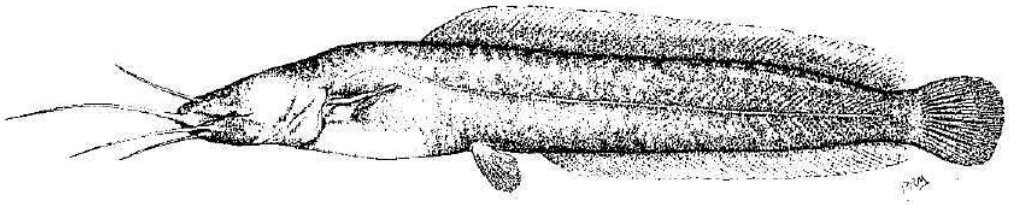
REFERENCES

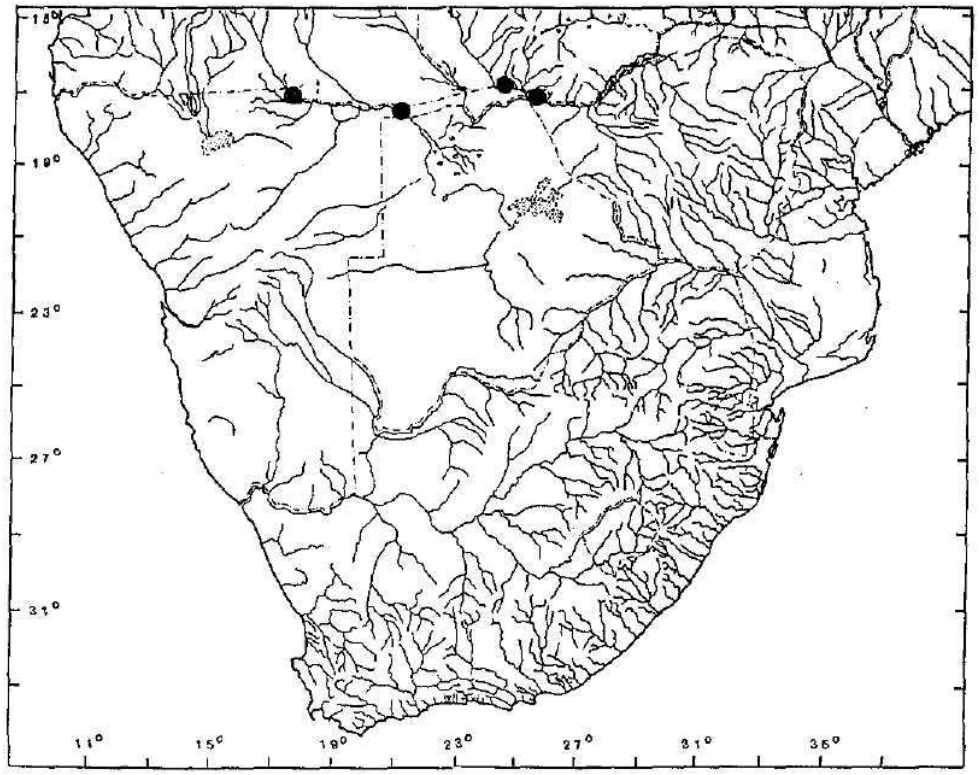
Begg (1978, 1984a); Bell-Cross (1976); Blaber et al (1984); Bourquin (1986); Bruton (1974, 1979); Bruton and Kok (1980); Bruton and Taylor (1979); Crass (1964); Hecht et al (1981, 1983); Jackson (1961); Jubb (1967a); Kleynhans (1985); Kyle (1984); Poll (1933, 1967); Tweddle and Willoughby (1979); Weber (1897),

Correspondence: M Coke; Dr T Hecht; R H Taylor; Dr B C W Van der Waal.

BROADHEAD CATFISH / BReEKQP-BABER

FIGURE 40, The broadhead catfish, *Clariallabes platyprosopos,* 287 mm SL, with distribution in the Okavango and Zambezi River systems in southern Africa.





Key

● Site record from literature or museum collection

BROADHEAD CATFISH / **BREeKOP-BABER** **RARE**

Clariallabes platyprosopos (Jubb 1964)

Family: Clariidae

SUMMARY

Status: Rare in South West Africa/Namibia. Known only from a few locales where rapids occur in the Zambezi and Okavango Rivers.

Research: Poor. Known incidentally only from a few specimens collected during river surveys.

SPECIES DATA

Identification: A moderately small clariid catfish {maximum size 283 mm SL) with a relatively short and broad head. The suprabranchial organs are poorly developed. There are no dermal plate-like bones on head behind eye. The colour is usually dark brown to black, juveniles may be lighter brown.

Distribution: Known from Upper Zambezi River: 25 km above Victoria Falls (Jubb 1964, 1967a; Bell-Cross 1976), the rapids near Impalila Island and Katima Mulilo (Eastern Caprivi) (Van der Waal 1976; Van der Waal and Skelton 1984). The species has been collected also from the Okavango River at Namatuntu and Popa rapids in Kavango (Skelton et al 1985).

Habitat and ecology: It lives in crevices and holes in rocks in fast flowing water (Van der Waal 1976; Van der Waal and Skelton 1984). Cohabiting fish species include rheophilic cyprinids, mormyrids, siluroids and mastacembeloid eels.

Breeding biology: Unknown.

Remarks: The taxonomic status of this species is uncertain and is being reviewed at present (Skelton and Teugels in preparation).

CONSERVATION

Threats: There are no major threats operating against the survival of this species at present. Possible future threats include pesticide pollution and large-scale water abstraction. Gravel exploitation at low water levels occurs in Caprivi and could threaten the habitat of this species. Collecting of fishes for aquarium trade has occurred in Kavango in the past but is not permitted at present.

Conservation attention given: No practical action to conserve this species has been made. B C W Van der Waal (personal communication) has drawn the attention of threatened fishes in Caprivi and Kavango to the Nature Conservation authorities of the areas.

Conservation recommendations: The biology and ecology of the species should be studied and the status monitored regularly every three or four years. Large-scale water abstraction via the Eastern National Water Carrier (Anonymous 1983; Ravenscroft 1985) must be carefully controlled and managed so as to minimize deleterious impacts on restricted and

vulnerable habitats such as the rocky rapids in the middle and lower reaches of the system.

Remarks: Rocky rapids are restricted in extent along the Okavango and Zambezi Rivers in South West Africa/Namibia. These are hnth i$_{fl}$m r-ivprc with more extensive rocky-rapid type habitat beyond the borders of South West Africa/Namibia where the broadhead catfish and other rheophilic species are likely to occur. The conservation status of the species is therefore considered to be reasonably secure at this time

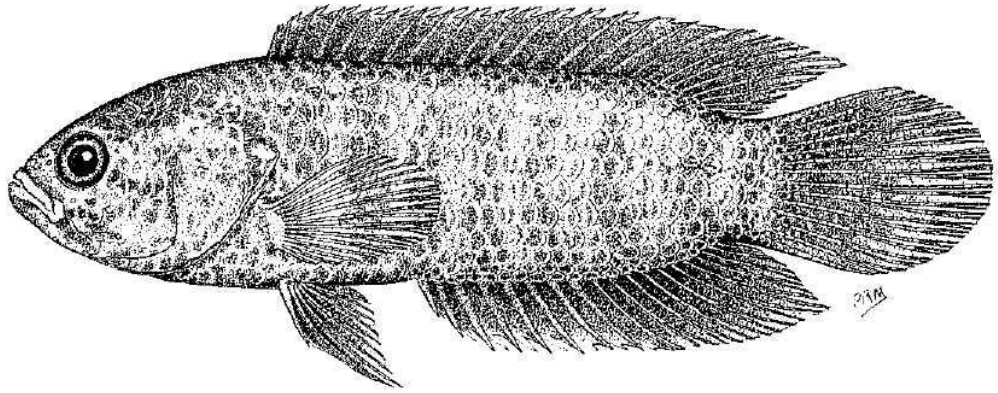
REFERENCES

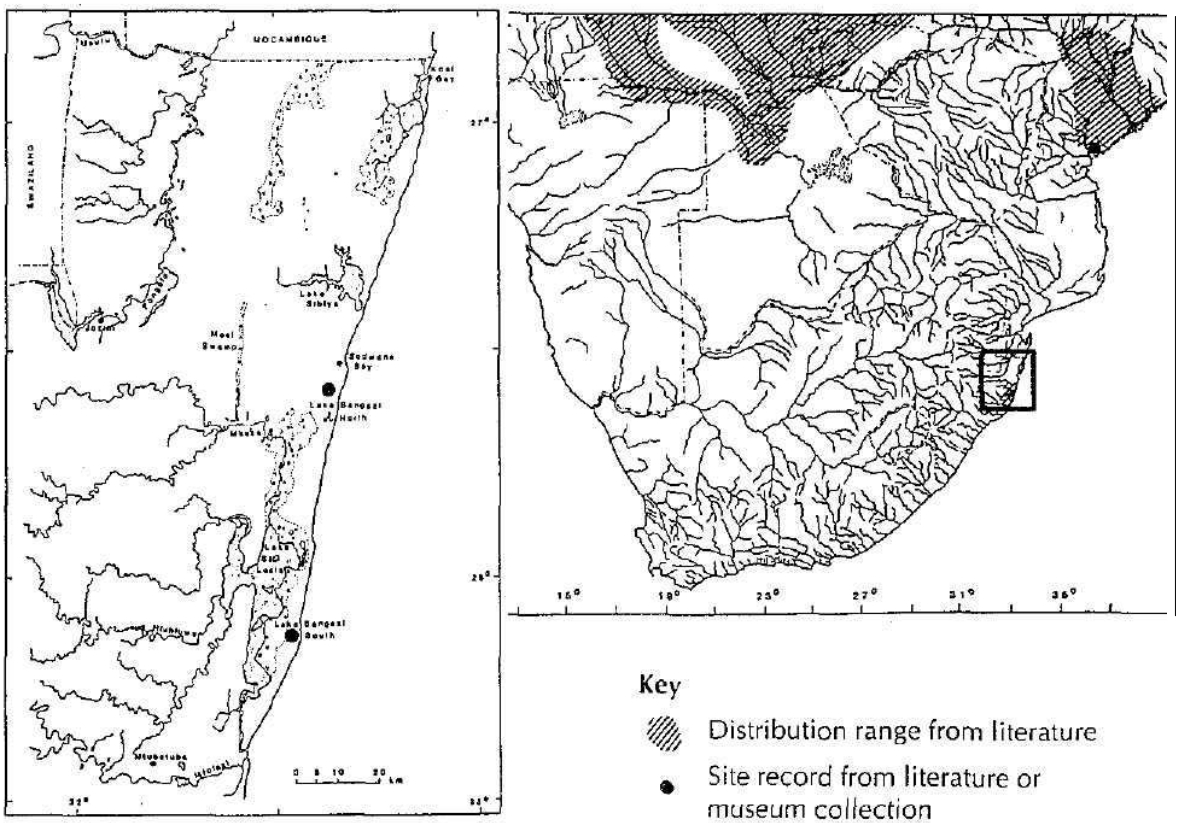
Anonymous (1983); Bell-Cross (1976); Jubb (1964); Skelton (1984); Van der Sand

Correspondence: Dr B C W Van der Waal.

BIACKSPOT CLIMBIKG PERCH / SWARTKOL-KURPER

FIGURE 41. The blackspot climbing perch, *Ctenopoma ctenotis,* 42 mm SL with distribution in southern Africa and north-east Natal.





BLACKSPOT CLIMBING PERCH / SWARTKOL-KURPER RARE

Ctenopoma ctenotis (Boulenger 1919)

Family: Anabantidae

SUMMARY

Status: Rare in South Africa. In South Africa this species is known only from two locales near Lake St Lucia in Natal.

Research: Poor. Primarily known on the basis of museum specimens and casual observations in captivity.

SPECIES DATA

Identification: A small slender anabantid (attains 55 mm SL) with a series of spines in both the dorsal and anal fins (D XV-XVI +8-10; A VIII + 8 - 10). There are small spines on the hind edge of the upper half of the operculum. The general colour is dark brown with vertical black bars along the body and a spot at the base of the caudal fin, two or three radiating bars on cheeks behind and below the eye. The lappets on the spinous portion of the dorsal and anal fins are white.

Distribution: In South Africa *C ctenotis* has been recorded from two localities: Lake Bangazi-South on the eastern shores of Lake St Lucia (Blaber 1978b; Bruton and Taylor 1979; Bruton and Kok 1980), and the Hlabinyathi Pan adjacent to the Mkuze swamps, north of Lake St Lucia (Taylor 1982b). Beyond South Africa *C ctenotis* was described from the Lukuga River near Lake Tanganyika (Boulenger 1919). It is reported from the east coast in Mozambique (AMG 3668, AMG 6387) and Malawi (Tweddle and Willoughby 1979) as well as in the Upper Zambezi, Kafue, Okavango and Zaire River systems (Poll 1933, 1967; Jackson 1961; Jubb 1967a; Skelton et al 1985; Van der Waal and Skelton 1984).

Habitat and ecology: The Blackspot climbing perch inhabits shallow, well vegetated marginal habitats on the floodplains of rivers and lakes (Van der Waal and Skelton 1984). Blaber (1978b) collected it from shallow marginal vegetation in Lake Bangazi South.

Breeding biology: There are no published reports but the species has been maintained and bred in captivity and is a bubble nest spawner <J A Cambray personal communication).

CONSERVATION

Threats: The hydrology of Lake Bangazi South is dependent on percolating rainfall from the adjacent dunes. Pine plantations have been planted in the area and do have an adverse effect on the water table (Taylor 1982a) which may adversely affect the marginal habitats of the Lake. In April-May 1982 the water level had dropped to a point beyond any emergent marginal vegetation (P H Skelton personal observation). Hlabinyathi Pan falls within KwaZulu where human population pressures are high and use or interference with the habitat is likely (Taylor 1982b).

Conservation attention given: No specific measures have been taken to conserve this species. Lake Bangazi South falls within the boundaries of

the Eastern Shores Nature Reserve which is administered by the Department of Forestry (Directorate of Environmental Affairs) and the Natal Parks Board. Ecological studies are being carried out on the Mkuze Swamps through the University of Natal. Bruton and Kok (1980) recommended that this species be added to the list of threatened species in South Africa.

Conservation recommendations: Known locales fall within the ordinary environmental reserve area proposed for Maputaland by Bruton (1980c). A thorough fish survey of the Eastern Shores Nature Reserve and Mkuze swamps is necessary and could be done as part of a multidisciplinary ecological survey of the Mkuze swamps as proposed by Taylor (1982b). The biology and ecology should be studied. The species is small and suited for captive breeding studies.

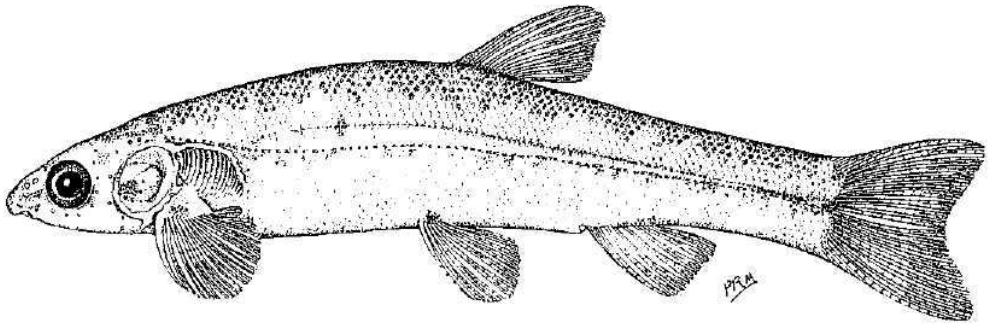
REFERENCES

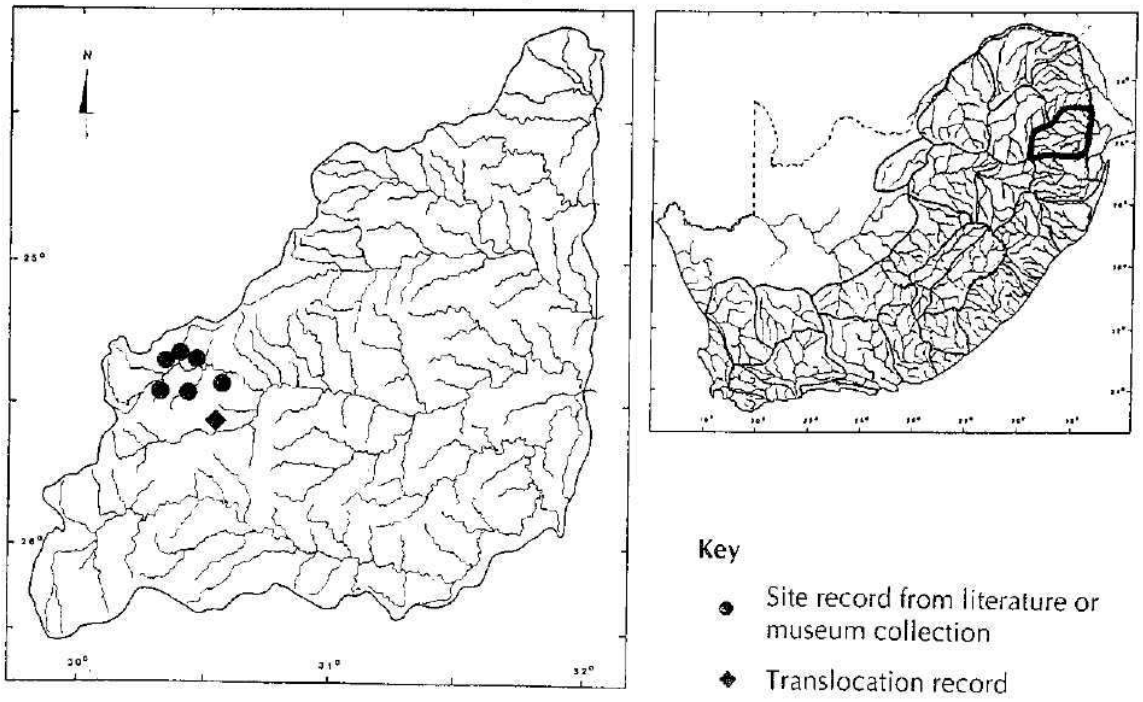
Blaber (1978b); Boulenger (1919); Bruton (1980c); Bruton and Kok (1980); Bruton and Taylor (1979); Jackson (1961); Jubb (1967a); Poll (1933, 1967); Skelton et al (1985); Taylor (1982a,b); Tweddle and Willoughby (1979); Van der Waal and Skelton (1984).

Correspondence: J A Cambray; R H Taylor.

SOUTHERN KWERIA / SUIDELIKE SKULPOORTJIE

FIGURE 42. The southern kneria, *Kneria auriculata,* 36 mm SL, with distribution in the Incomati River system in the Transvaal.





SOUTHERN KNERIA / SUIDELIKE SKULPOORTJIE RARE

Kneria auriculata (Pellegrin 1905)

Family: Kneriidae

SUMMARY

Status: Rare in South Africa. In South Africa this species is restricted in distribution to an area that is subject to agricultural development.

Research: Good. Kleynhans (1979, 1982, 1984) investigated the conservation status and distribution of this species in the Transvaal.

SPECIES DATA

Identification: A small (attains 70 mm SL), slender, minnow-like species with minute scales and bow-shaped ventral mouth. Males develop prominent disc-shaped structures on the gill cover and post-opercular region of the body. Their pectoral fins are broad and rounded, integrating functionally with the opercular organ. The dorsal fin is short-based and equidistant from the eye and the base of the caudal fin.

Distribution: In South Africa the southern kneria occurs in a few tributaries of the Crocodile River in the Badfontein area of the Transvaal (Kleynhans 1979). Beyond South Africa the species is recorded from the Save-Runde (upper Save) system, the Zambezi River system in Zimbabwe and Zambia and the upper Zaire system in Katanga (Zaire) and Zambia (Poll 1933; Bell-Cross 1976).

Habitat and ecology: *Kneria auriculata* occurs in pools and slow flowing sections of small riffle streams up to four metres wide and one metre deep (Kleynhans 1979, 1982, 1984). The substrate consists of stones and pebbles which usually are covered with "aufwuchs". The temperature of these streams ranges from nine to 26"C. Associated fish species include the minnow *Barbus anoplus,* the catlet *Chiloglanis pretoriae,* and the Natal mountain catlet *Amphilius natalensis.* In addition other minnows like *B argenteus* and *B pallidus,* eels *(Anguilla mossambica)* and the cichlid *Tilapia sparrmanii* occur sporadically in the same habitat.

Breeding biology: The southern kneria breeds during summer from October until April. Fecundity varies from 700 to 1 500 ova and the species is probably a fractional spawner (Kleynhans 1982, 1984). Anonymous (1972) reported the breeding of this species in a small artificial pond at the Lydenburg hatchery.

CONSERVATION

Threats: Habitat degradation from agricultural activities is the main threat to this species in South Africa. The known locales of the species are all on private agricultural land where weir construction, water abstraction, bank erosion through grazing and crop cultivation occur. Pollution from insecticide spraying is a potential threat. Alien riparian plant invaders (wattle and poplar) occur along certain of the streams. In several streams introduced rainbow trout *(Parasalmo mykiss)* appear to have restricted or eliminated populations of *K auriculata* (Kleynhans

1979) and it currently survives in locales unsuited (too restricted) for trout. At least part of one of the streams where *Kneria auriculata* occurs (the Alexanderloop) will be inundated by the waters of the Braam Raubenheimer Dam constructed on the Crocodile River. Species that could threaten the southern kneria by predation or habitat change that are already established in this impoundment are largemouth bass *Micropterus salmoides,* the sharptooth catfish *Clarias gariepinus* and carp *Cyprinus carpio* (C J Kleynhans personal communication).

Conservation attention giveni The status and distribution of this species was studied by Kleynhans (1979, 1982, 1984). As a result of this study several steps have been taken in the interests of the species[1] conservation: all official introductions of alien fishes have been stopped; in August 1981, 300 *K auriculata* were translocated from the Alexanderloop to a small tributary of the Elands River (Incomati system) on the farm Weltevreden 336 (Waterval Boven district) - in July 1982 it was found that the species was established in two kilometres of the stream; an information leaflet was prepared and distributed to land owners within the distribution range of *K auriculata* in the Transvaal - the results of this awareness exercise have not yet been assessed. Further surveys in the tributaries of the Crocodile River have been carried out during 1985 and additional populations of *K auriculata* discovered (C J Kleynhans personal communication).

Conservation recommendations; The following proposals were made by Kleynhans (1984): the distribution and status of the species should be monitored regularly, on an annual basis; no introductions of alien fish species should be permitted; a translocation exercise of the species from the habitat to be inundated by the waters of the Elandspruit Dam should be undertaken; a nature reserve to include a *Kneria auriculata* locale should be established. In addition to these proposals further studies of the breeding biology of the species are required. The extension work and habitat monitoring programme should be continued. Specific sanctuary streams should be established, possibly within the framework of the National Heritage Programme, as an alternative to formal acquisition and management as nature reserves.

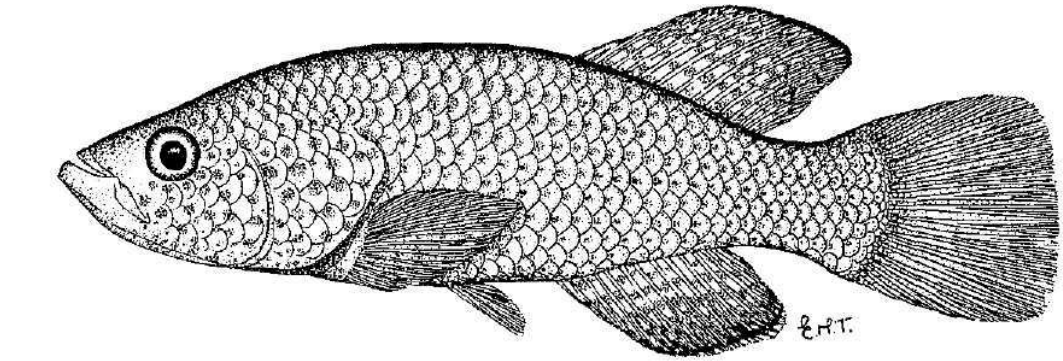
REFERENCES

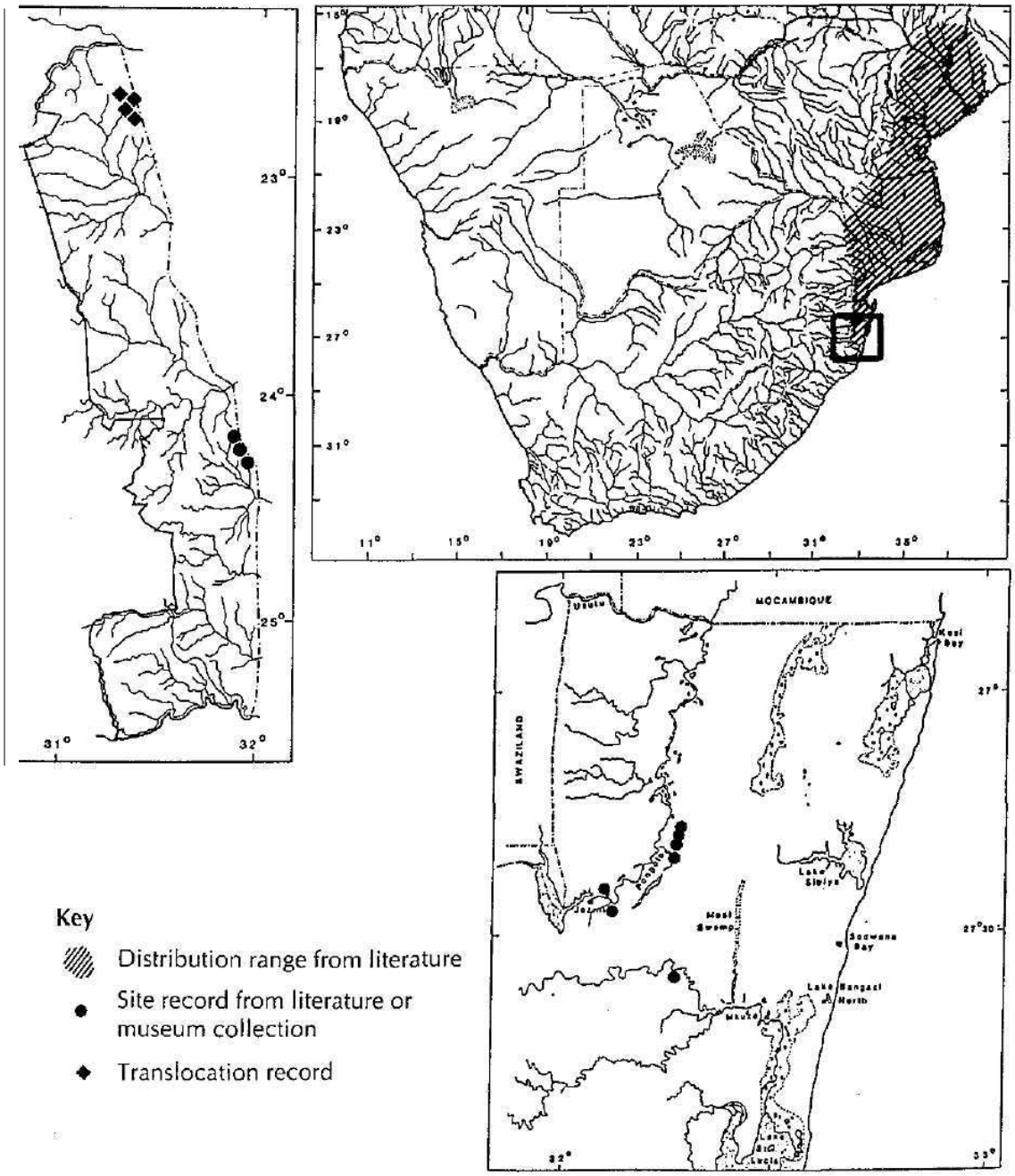
Anonymous (1972); Bell-Cross (1976); Kleynhans (1979, 1982, 1984); Poll (1933).

Correspondencei Dr C J Kleynhans.

SPOTTED KILLIFISH / GESPIKKELDE KUILVISSE

FIGURE 43. The spotted killifish, *Nothobranchius orthonotus,* + 50 mm SL, with distribution in southern Africa, the Kruger National Park and north-east Natal.





SPOTTED KILLIFISH / GESPIKKELDE KUILVISSIE RARE

Nothobranchius orthonotus (Peters 1844)

Family: Aplocheilidae

SUMMARY

Status: Rare in South Africa. Known only from a few localities in South Africa.

Research: Fair - good. The species is well known by aquarists and has been bred in captivity. Surveys and translocations have been made (la Hausse in press; Pienaar 1978a).

SPECIES DATA

Identification: Small fishes (attains 100 mm TL) with large dorsal fins placed far back over the anal fins, stout robust bodies and a superior mouth. Male colouration is an important feature in identification of *Nothobranchius* species (Jubb 1975, 1969b, 1981). Two colour forms of *N orthonotus* are known from South Africa (Jubb 1981): a "red" form (from the Kruger National Park) and a "blue" form from Natal. In the former red is the predominant body and fin colour. The outer portion of the dorsal and anal fins is olive-green becoming progessively darker sub-marginally with a contrasting brilliant white margin (see Pienaar 1978a, Plate 43 and Jubb 1981, Figure pl4). The "blue" form as illustrated in Jubb (1981, p7) has a predominantly greenish-blue body colour with dull red scale borders. The fins are olive-green with scattered deep maroon spots and a black submarginal band highlights the brilliant white margins of the dorsal, pelvic and anal fins. Females are a pale olive-brown with pale blue centered scales and creamy-white ventral parts. They do not have prominent dark spots.

Distribution: *Nothobranchius orthonotus* occurs from the southern basin of Lake Malawi and the floodplains of the Lower Zambezi southwards along the Mozambique coastal plain to the Mkuze River in northern Natal (Jubb 1981). In South Africa the species occurs naturally in the headwaters of the Mtomene River and a small pan at Pumbe Picket in the Kruger National Park (Pienaar 1968, 1978a); the Mkuze River in Natal (Fowler 1934b; Crass 1964); and the Pongolo River floodplain (Crass 1964; Kok abd Walley 1978; Bruton and Kok 1980). The species has recently (November 1985) been collected in the Mboneni Pan within the Mkuzi Game Reserve (M Coke personal communication). In the Pongolo floodplain area the species is reported from Ndumu Game Reserve, Lake Nhlanjane, Ngwema rainpool (Crass 1964; Kok and Walley 1978), rainpools in the Nomathasa area, an affluent of Lake Maya2ela north-east of Jozini, and near the Makatini Experimental Farm (la Hausse in press). Successful translocations have been made to other pans in the Kruger National Park (Pienaar 1978a) including a pan at Pumbe, a pool in the headwaters of the Nhlangulene spruit, pans in the Nyandu sandveld (Nwambiya pans) and the Machayi Pan.

Habitat and ecology: The habitat of this species consists of isolated or semi-isolated rainfilled or floodplain pans with a muddy substrate and dense submerged and emergent aquatic vegetation (Kok and Walley 1978; Pienaar 1978a; Jubb 1981). One noteworthy feature of *Nothobranchius* habitats is that complete dessication occurs regularly. As a result

these small fishes usually exist alone or only with other hardy species such as the lungfish which are adapted to the total drying out of the environment. Simple fish community structure may be an important factor in relation to their distribution on the Pongolo floodplain where they are absent from waterbodies that are regularly connected to the mainstream. *Nothobranchius* habitats are generally well used as watering points for game and domestic stock and eutrophication and high turbidity are characteristic features. Such conditions are also conducive for naturally rich communities of micro-organisms and invertebrates that provide the food required for rapid growth by these short lived fishes.

Breeding biology: *Nothobranchius* species lay drought resistant eggs on or in the substratum. Males are aggressive but not strictly territorial. Their bright colours and expansive finnage are important for the behavioural components of both intraspecific aggression towards other males and for spawning. Eggs are fertilized directly and laid in the substrate following short advances and lateral embracing of the female using the dorsal and anal fins by the male. Males are polygamous and range throughout the water body. The eggs develop in three stages interrupted by diapause depending on the prevailing environmental conditions (Wildekamp 1983). Captive breeding of both South African forms has been reported by J Vermaak (personal communication) and Rowley (1986).

Remarks: The family classification follows Parenti (1981). Male colouration is an important taxonomic character for *Nothobranchius* (Jubb 1981). The two colour forms noted above are strikingly different (Rowley 1986 suggests they may represent "reversed" patterns) and appropriate studies are necessary to determine their correct taxonomic status.

CONSERVATION

Threats: The species is considered safe in the Kruger National Park (Pienaar 1978a). Agricultural development has possibly reduced the species' range in the Mkuze River area (Jubb 1969b). Various threats to the Pongolo floodplain have been detailed by Heeg and Breen (1982) but not all these threats pertain to the known *Nothobranchius* sites most of which are off the floodplain itself. Threats to the rain pools are probably more in the line of direct agricultural development (eg ploughing) (la Hausse in press) or pollution from insecticides or domestic detergents. If not controlled, the demand for specimens by the aquarium trade could pose a threat to the few wild populations of this and other *Nothobranchius* species in South Africa.

Conservation attention given: In the Kruger National Park the original locales were designated as Project Aqua sites 18 and 19 (Noble 1974). Successful translocations have been made to a series of suitable pans (Shirombe, Nwambiya, Nwambiyane and Machayi) in the northern Nwambiya sandveld south of Pafuri (Pienaar 1978a). Surveys of rainpools in the Pongolo floodplain area have discovered several *If orthonotus* locales (la Hausse in press). One of the Pongolo floodplain locales is within the Ndumu Game Reserve (Crass 1964; Kok and Walley 1978; Bruton and Kok 1980) and the species has been recently collected in the Mboneni Pan within the Mkuzi Game Reserve (M Coke personal communication). Permission was given to a recognized killifish aquarist (J Vermaak) to collect specimens of both the red and blue forms of this species and establish aquarium stocks of both. Mr Vermaak has successfully bred both forms in captivity and has distributed stock to aquarists (Rowley 1986). An investigation of the

potential of this species for mosquito control has been made by the Malaria Research Institute in Tzaneen using stock from the Kruger National Park (D Theron personal communication).

Conservation recommendations: la Hausse (in press) has suggested that "blue" form *Nothobranchius orthonotus* be translocated from sites on the Pongolo floodplain area to safe locales within the Ndumu Game Reserve. Continued control of collecting for aquarium purposes is necessary as is the monitoring of known locales beyond formally conserved areas,

---

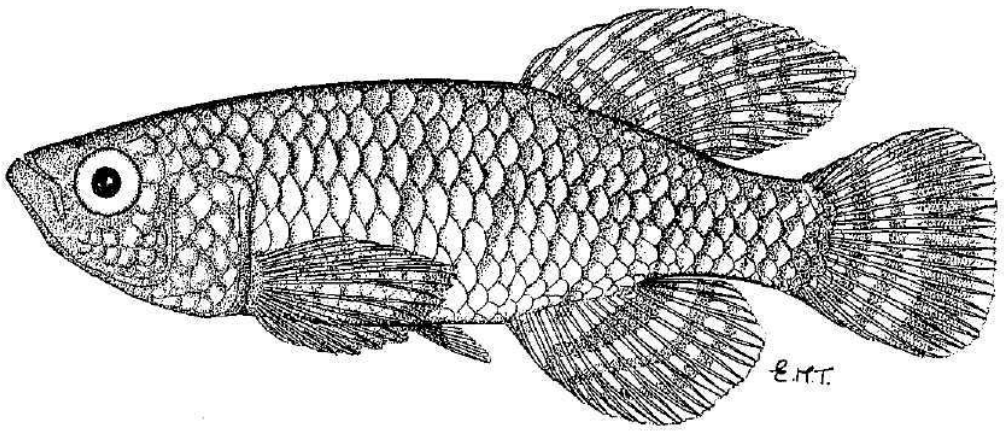
REFERENCES

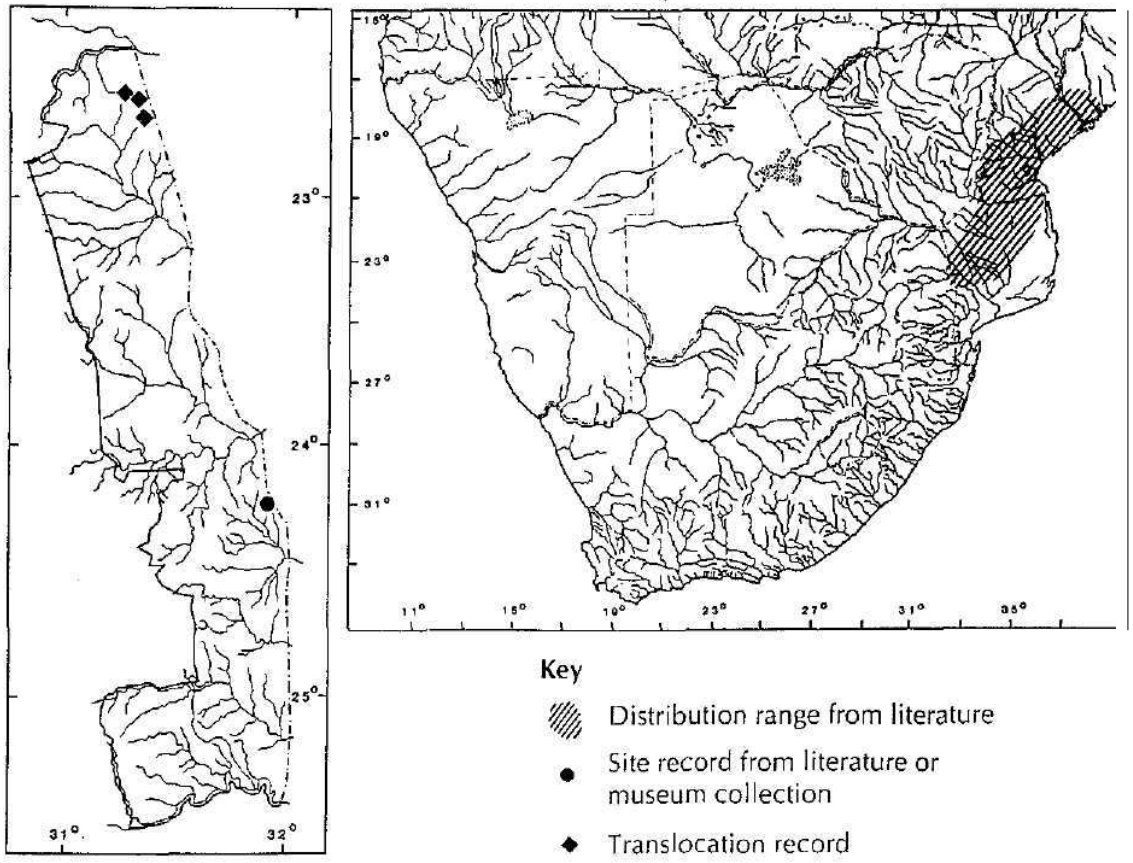
Bruton and Kok (1980); Crass (1964); Fowler (1934b); Heeg and Breen (1982); Jubb (1969b, 1981); Kok and Walley (1978); la Hausse (in press); Noble (1974); Parenti (1981); Pienaar (1968, 1978a); Rowley (1986); Wildekamp (1983).

Correspondence: M Coke; P la Hausse de Lalouviere; Dr U de V Pienaar; D Theron; J Vermaak.

BLUEBAHD KILUFISH / BLOUBMB-KUILVISSIE

FIGURE 44. The blueband killifish, *Nothobranchius rachovii,* £ 30 mm SL, with distribution in southern Africa and the Kruger National Park.





BLUEBAND KILLIFISH / BLOUBAWD-KUILVISSIE RARE

Nothobranchius rachovii (Ahl 1926)

Family: Aplocheilidae

SUMMARY

Status: Rare in South Africa. In South Africa this species is naturally restricted to a few small pans.

Research: Good. One of the best known *Nothobranchius* species in the aquarist world it has also received conservation attention from the authorities in the Kruger National Park (Pienaar 1978a).

SPECIES DATA

Identification: Small fishes (maximum size 60 mm TL) with a relatively stout body and a superior mouth. The large dorsal fin is positioned far back over the anal fin, the caudal fin is rounded. Male colouration is bright and distinctive: scales iridescent turquoise edged with carmine; dorsal and anal fins turquoise with deep maroon bands and blotches towards base; the caudal fin has a pale blue basal membrane mottled with red irregular bars which extend into a series of concentric bands of bright turquoise then orange-yellow and black with the extremity of the fin being edged with pale blue or white; the head is predominantly red, with turquoise centred scales; the iris is golden-yellow with a broad vertical black bar. Females are olive-brown with turquoise centred mid-scales, and blueish head (Jubb 1969b, 1981; Pienaar 1978a).

Distribution: In South Africa the blueband killifish occurs naturally only in pans (rainpools) around Pumbe picket in the Kruger National Park on the Mozambique border (Pienaar 1978a). This is the most southern and eastern record of the species which also occurs in coastal Mozambique (type locality near Beira) to as far north as Quelimane (north of the Zambezi delta) (Jubb 1981). In the Kruger National Park translocations have been made to pans south of Pafuri (Pienaar 1978a).

Habitat and ecology: In the Kruger National Park the habitat consists of shallow rain-filled pans with a sandy or pebbly substrate and dense aquatic vegetation, particularly of *Cyperus* species, *Paspalidium platyrachis, Echinochloa holubii* and *Nymphaea* species (Pienaar 1978a). Shallow temporary water bodies rich in aquatic vegetation is typical habitat around Beira (Roloff 1959). Cohabiting fishes include other *Nothobranchius* species, small cichlids and cyprinid minnows.

Breeding biology: Eggs are laid in soft peat or sand with the male embracing the female with the dorsal and anal fins. The eggs of this species are relatively small and hatch with or without dessication after five or six months (or later if kept dry) (Roloff 1959). Maturity is reached in seven to eight weeks and in captivity individuals may live from six to 18 months (Knaack 1970). This is a popular and well established aquarium species.

CONSERVATION

Threats: In South Africa the known locales are safely conserved within

the Kruger National Park. The major threat to this attractive fish is the demand for wild stock by the aquarium trade. Destruction of natural sites within the Kruger National Park is unlikely at present but the construction of a road along the border for security purposes could directly or indirectly result in habitat destruction.

Conservation attention given: The locality where the species was first found in South Africa occurs within the boundaries of the Kruger National Park and was designated as Project Aqua site 19 (Noble 1974; Pienaar 1978a). Successful translocations have been made from this site to a series of pans (Shirombe, Nwambiya and Mathlakuza) in the northern Nwambiya sandveld south of Pafuri. The Tropical Diseases Research Institute at Tzaneen have a project to breed this species from stocks collected in the Kruger National Park for use as a mosquito controlling agent in the Transvaal lowveld (Pienaar in littera; D Theron personal communication),

Conservation recommendations: Further translocations are planned to suitable safe habitats in the Kruger National Park (Pienaar in littera). Regular monitoring of the known locales of the species is necessary. Careful control of collecting for the aquarium trade is required.

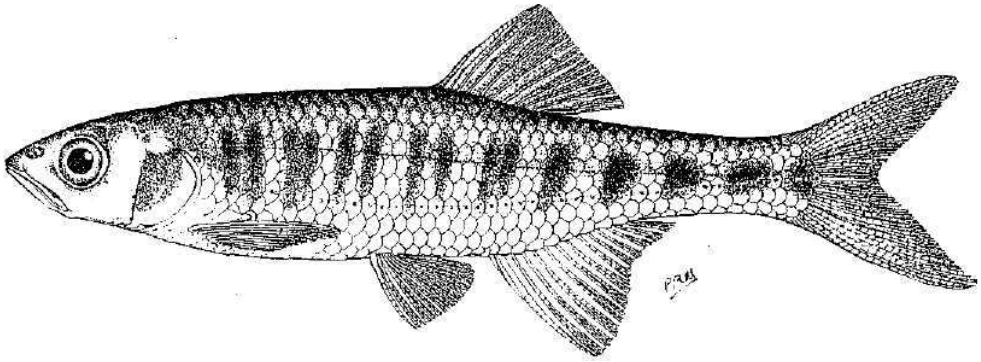
REFERENCES

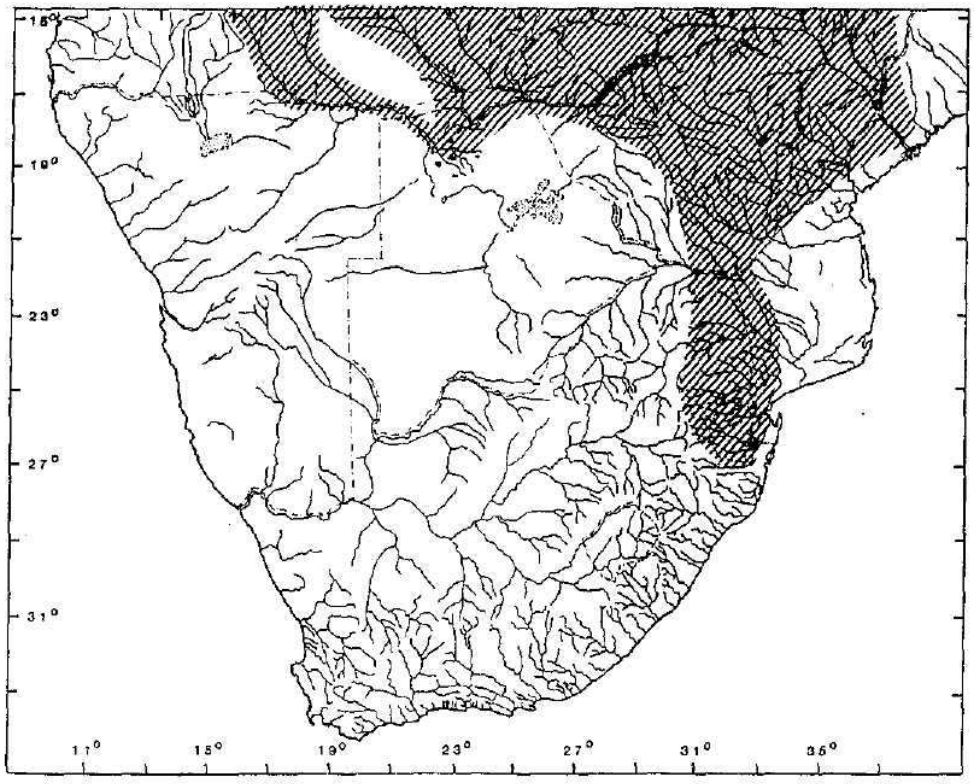
Jubb (1967a, 1969b, 1981); Knaack (1970); Noble (1974); Pienaar (1968, 1978a); Roloff (1959).

Correspondence: Dr U de V Pienaar; D Theron.

BARRED MINNOW / BALK-GHXELIEMXENTJIE

FIGURE 45. The barred minnow, *Opsaridium zambezense,* 73 mm SL, with distribution in southern Africa,





Key

Distribution range from literature

BARRED MINNOW / BALK-GHIELIEMIENTJIE **INDETERMINATE - RARE**

Opsaridium zambezense (Peters 1852)

Family: Cyprinidae

SUMMARY

Status: Indeterminate - Rare in South Africa. Large-scale environmental changes in rivers of the Transvaal and Natal have reduced and threatened populations of this species.

Research: Poor. No specific studies have been undertaken, but the rarity of the species is evident from surveys (Gaigher 1969; Kok 1980; Hecht and Scholtz 1983; Kleynhans 1984).

SPECIES DATA

Identification: A streamlined fusiform fish (attains 150 mm SL) with dorsal fin originating behind the pelvics and before the anal fin. The mouth is large and terminal, the jaws without teeth. The anterior rays of the anal fin are longer than the posterior rays. Alive, this species is usually bright silvery-gold or steel-blue with a series of steel-grey (black in preserved state) single or double vertical bars along body; the head and ventral parts are flushed with red; the dorsal, anal and caudal fins have a dusky or blackish membrane streaked with red.

Distribution: In South Africa *0 zambezense* occurs in the Limpopo Incomati and Pongolo River systems (Jubb 1967a; Gaigher and Pott 1972). Here it is restricted to middle and lowveld reaches (ie altitudes below 1 000 m) (Gaigher 1973; Crass 1964). Hecht and Mashego (1981) considered the species "very rare" in the Mohlapitse tributary of the Limpopo. In the Kruger National Park this species is found only in the clear perennial rivers (Pienaar 1978a). Beyond South Africa the barred minnow occurs in rivers as far north as the Zambezi River system in Zimbabwe and Mozambique (its downstream limits in Mozambique are not yet determined but it was not recorded there by Gaigher 1969), Malawi (Tweddle and Willoughby 1979) as well as in the Okavango (Skelton et al 1985), Upper Zambezi, the Kasai and Zambian Zaire systems (Bell-Cross 1976). The taxonomy of this species relative to *0 ubangense* (Pellegrin) needs to be resolved so there is uncertainty on the northern distribution limits of the species (Jackson 1961; Bell-Cross 1976; Howes 1980).

Habitat and ecology: A favoured habitat is sandy or rocky stretches of clear, flowing, well aerated rivers, often in the pools below rapids (Jackson 1961; Pienaar 1968, 1978a; Gaigher 1969,. 1973; Bell-Cross 1976; Tweddle and Willoughby 1979). It is not normally found in turbid or silt-laden waters (Pienaar 1968, 1978a) or marshes (Tweddle and Willoughby 1979). It occurs in shoals, usually in protected inshore habitats when tigerfish *(Hydrocynus forskahlii)* are present (Jackson 1961, personal observation).

Breeding biology: Not known apart from the fact that the species breeds in summer (Pienaar 1968, 1978a).

CONSERVATION

Threats: Habitat alteration and deterioration appears to be the major threat affecting the status of populations of this species. Many formerly perennial rivers of the Transvaal lowveld now cease flowing during the dry season due to impoundment and extraction of water for agricultural purposes (Pienaar 1978a; Cheney 1983). Turbidity and siltation through erosion from overgrazing and crop cultivation occurs when the rivers start flowing again at the beginning of the rainy season. Turbidity and siltation probably affect the sight feeding and breeding success of the species. In Malawi the breeding of a related species is adversely affected by siltation (Tweddle 1983). The construction of many weirs and dams in the rivers of the eastern Transvaal, Swaziland (Clay 1976) and Natal is a major impediment to fish movement. Other threats to this species are industrial and agricultural pollution (Cheney 1983), and the choking of such rivers by the alien plant *Eichhornia crassipes* (Botanical Research Institute 1980).

Conservation attention given: No specific conservation attention has yet been given to this species. *Opsaridium zambezense* does occur in reaches of rivers within conserved areas eg the Kruger National Park. In the Mohlapitse River it occurs within the Wolkberg Wilderness area but in relatively low numbers only (C J Kleynhans personal communication). Fish ladders have been constructed on certain dams in the Kruger Park (Pienaar 1978a).

Conservation recommendations: A study of the biology, ecology and a survey of the conservation status of the barred minnow are urgently required. Particular attention should be paid to migrations and breeding and the effect of potentially deleterious environmental perturbations. Suitable sanctuary streams for the species should be identified and conserved.

Remarks: The barred minnow is one of many species in the Olifants River which was adversely affected when a plug of heavily silt-laden water was flushed from the Phalaborwa Dam during January 1983 (Cheney 1983; Pienaar in littera). The action was investigated and reported on by the Kruger National Park authorities and steps have been taken to avoid or minimize future occurrences (Pienaar in littera).

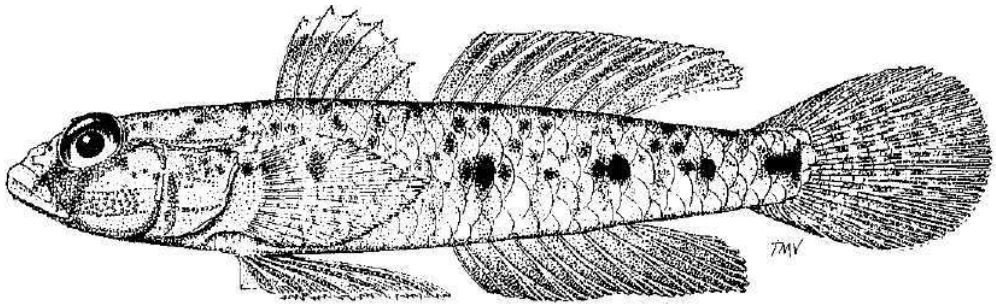
REFERENCES

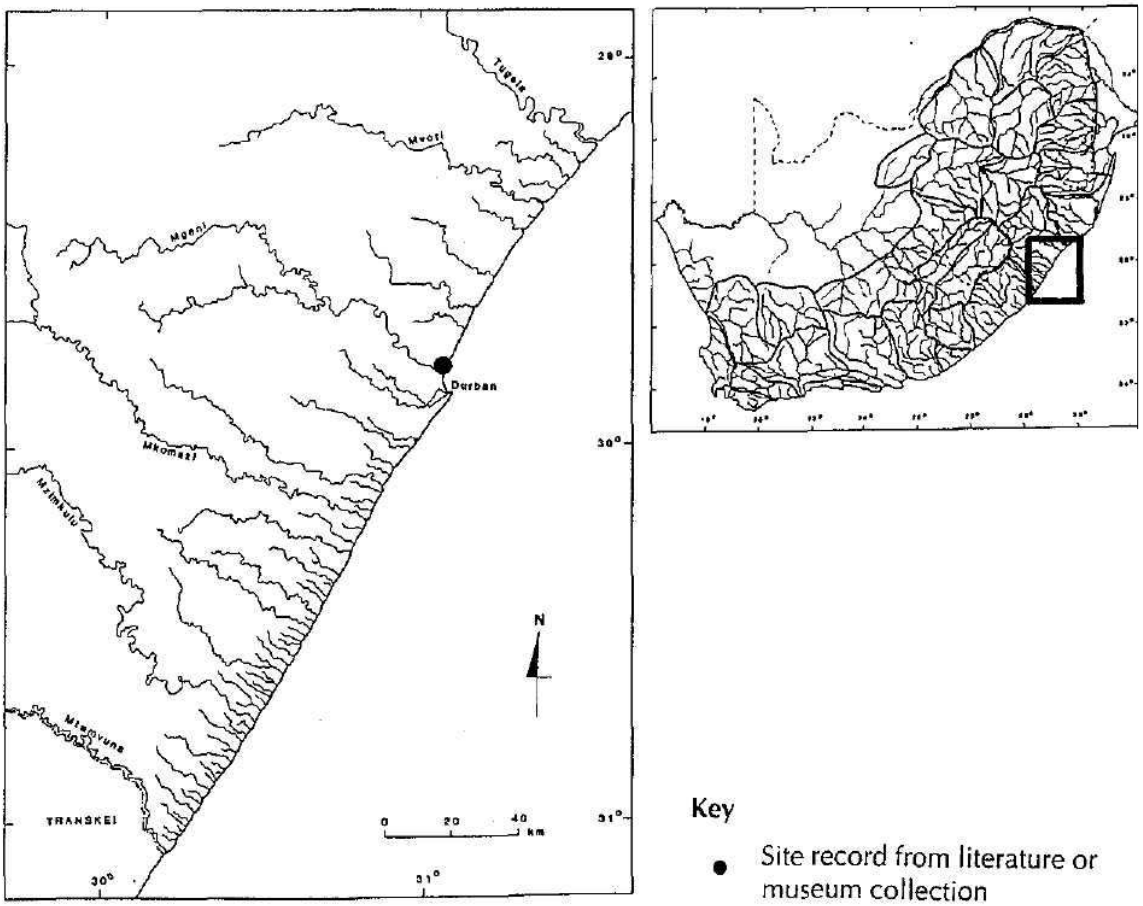
Bell-Cross (1976); Botanical Research Institute (1980); Cheney (1983); Clay (1976); Crass (1964); Gaigher (1969, 1973, 1978); Gaigher and Pott (1972); Hecht and Mashego (1981); Hecht and Scholtz (1983); Howes (1980); Jackson (1961); Jubb (1967a); Kleynhans (1984); Kok (1980); Pienaar (1968, 1978a); Skelton et al (1985); Tweddle (1983); Tweddle and Willoughby (1979).

Correspondence: M Coke; Dr T Hecht; Dr C J Kleynhans; P la Hausse de Lalouviere; Dr U de V Pienaar.

BLACKTHROAT GOBt / SWARTKEEL-DIKKOP

FIGURE 46. The blackthroat goby, *Favonigobius melanobranchvs,* 30 mm TL, with distribution in southern Natal.





BLACKTHROAT GOBY / SWARTKEEL-DIKKOP **ENDANGERED**

Favonigobius melanobranchus (Fowler 1934J

Family: Gobiidae

SUMMARY

Status: Endangered in South Africa. In South Africa this species is known only from a single specimen collected from the Mgeni estuary (Begg 1984a).

Research: Poor. Details of the biology of this species are lacking. The Mgeni estuary has been described by (Begg 1978, 1984a) and some details of the specific habitat have been provided by G W Begg (personal communication).

SPECIES DATA

Identification: A small gobiid (reaches 40 mm SL) with the gill opening extending to below the mid-operculum, scales ctenoid, and a naked opercle and preopercle. Body scales reach to the end of the opercle; the prepelvic area is naked anteriorly. In the adult fish the branchiostegal membranes are black or dusky below. There is a bar from the eye to the lower jaw; the body has numerous small spots with four or five enlarged groups of black spots mid-side. D VI + 1,8-9; A 1,8-9 (Hoese 1986a).

Distribution: In South Africa recorded only from Mgeni estuary near Durban (Begg 1984a). The type locality is at Den Pasar in southern Bali (Fowler 1934a). Hoese (1986a) records the distribution of this species as Indo-West Pacific, south to Natal but Begg (1984a) noted that this record (collected on 1 August 1980) was the first for Africa.

Habitat and ecology: The Mgeni estuary is described in detail by Begg (1978, 1984a). The substratum varies from silt and fine sand to gravel, but siltation on a large scale has occurred since 1978 (Begg 1984a). The specimen of blackthroat goby was collected at a site with the following characteristics (G W Begg personal communication): depth 80 cm; dissolved oxygen 5,3 mg $-^{1}$; salinity 25% ; temperature 18,7°C; secchi 40 cm; substratum mud-sandy; vegetation estuarine trees. The biotic characteristics of the Mgeni estuary are distinctive and include a mangrove community and relatively rich fish (56 species), and crustacean (prawns (13 species) and crabs (11 species)) communities (Begg 1984a). Day (1981) attributes the exceptionally rich fauna of this estuary to high nutrient levels provided by sewage.

Breeding biology: Unknown.

CONSERVATION

Threats: Pollution from several upstream sources including a large industrial complex located immediately inland is a major potential threat to the Mgeni estuary. Begg (1984a) describes a large scale pollution event which caused fish kills in August 1979. Other threats include siltation due to dredging and various engineering works (eg bridge building) and the physical perturbations due to scouring effects of large floods. Upstream canalization further exacerbates this threat. The estuary is

used as a major recreational outlet for canoeists, anglers and nature-lovers. The present conservation status of the Mgeni estuary is fair (Heydorn 1986).

Conservation attention given: No specific attention has been paid to this species but considerable attention has been given by various bodies to the conservation of the Mgeni estuary (Begg 1984a).

Conservation recommendations: The extreme scarcity of this species in South Africa prohibits detailed study of its biology. The greatest need at present is for a general conservation-orientated attitude to be instituted in matters of land, river and estuarine practices,

---

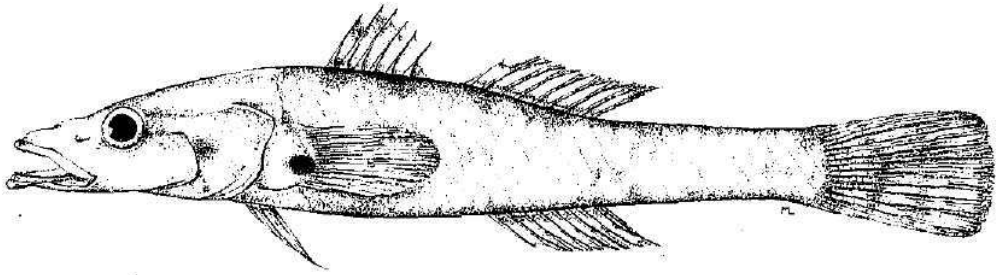
REFERENCES:

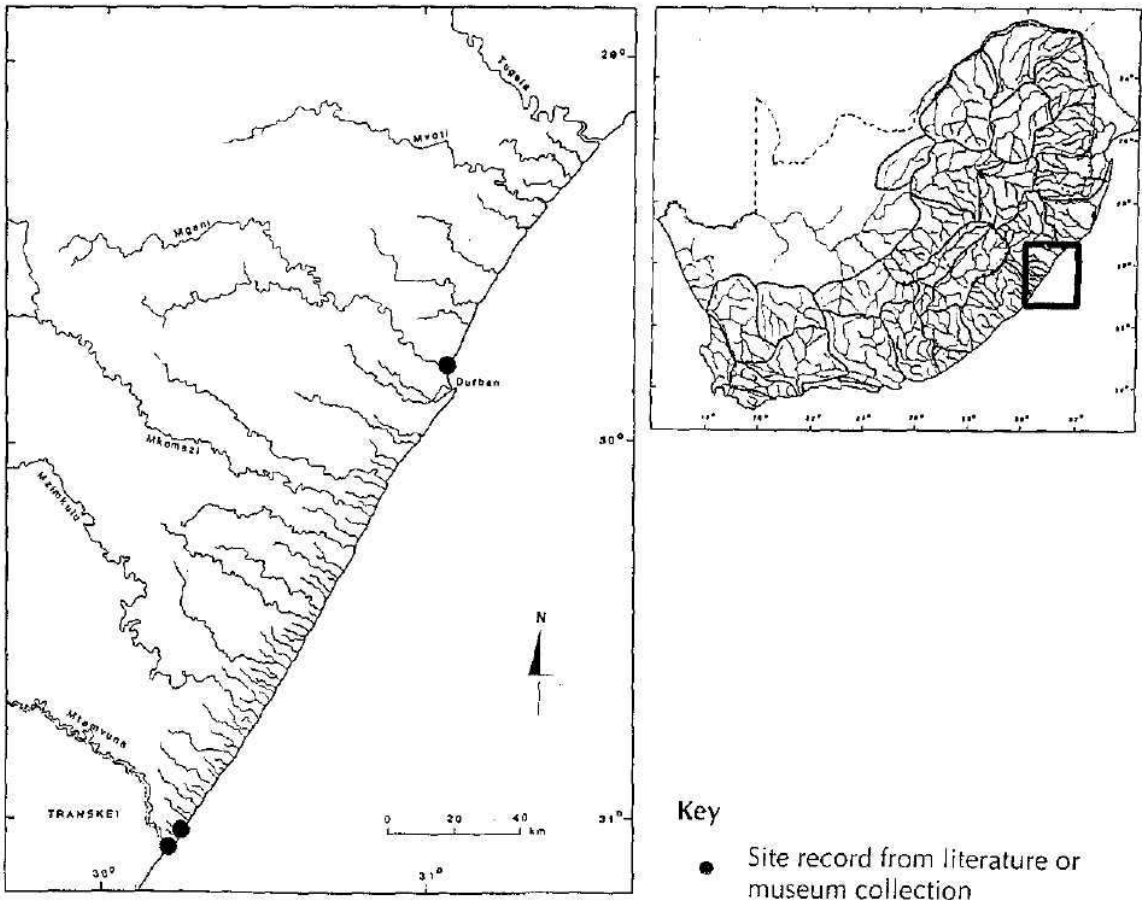
Begg (1978, 1984a,b); Day (1981); Fowler (1934a); Heydorn (1986); Hoese (1986a).

Correspondence: Dr G W Begg; Dr P C Heemstra.

DUCKBILL SLEEPER / VOeLBEK-SLAPER

FIGURE 47. The duckbill sleeper, *Butis but is,* 40 mm TL, with distribution in Natal.





DUCKBILL SLEEPER / VOeLBEK-SLAPER **INDETERMINATE-VULNERABLE**

Butis butis (Hamilton-Buchanan 1822)

Family: Eleotridae

SUMMARY

Status: Indeterminate, possibly vulnerable in South Africa. Recorded recently for the first time in South Africa by Begg (1984a,b).

Kesearch: Poor. Known only from a few specimens in South Africa.

SPECIES DATA

Identification: An eleotrid fish reaching 140 mm SL. Head depressed with elongated snout and jaws, lower jaw projecting. A serrated bony ridge runs along each upper orbit. The top of head, cheeks and opercles with small fine scales; larger body scales occur from behind the posterior opercle margin, D VI + 1,8; A 1,8-9. There is a large black spot at base of pectorals, and the body has dark longitudinal lines.

Distribution: In South Africa recorded only from the Beachwood Creek, a branch of the Mgeni estuary near Durban, the Sandlundlu and the Mtamvuna estuaries (Begg 1984a,b). Beyond South Africa the Duckbill sleeper has an Indo-West Pacific distribution (type locality in India) (Boulenger 1916; Smith 1965; Hoese 1986b).

Habitat and ecology: The Beachwood Creek and Mangrove community have been extensively studied (for summaries see Begg 1978, 1984a). The Beachwood Creek is three kilometres long and varies from two to five metres in width, running north from a point close to the mouth of the Mgeni estuary. It is relatively isolated and may act as a biotic refugium and inoculum when adverse conditions prevail in the main estuary. Salinity in the Creek varies with the tides from concentrations approaching full sea water at high tides to nearly fresh at low tide. Habitat details where the B *butis* was collected are (G W Begg personal communication): depth 30 cm; dissolved oxygen 5,7 mg $\sim^{1}$; salinity 6% ; temperature 20,6°C; substratum sand-muddy; vegetation estuarine trees. There are several species of indigenous and introduced mangrove species which harbour a rich community of benthic invertebrates. The fish community is also rich with 30 species being recorded by Edwards and Moll (1972). The small Sandlundlu estuary has a silt-sand substratum (Begg 1984a). Habitat details for the species at this locale are (G W Begg personal communication) : depth 95 cm; dissolved oxygen 7,0 mg $^{-1}$; salinity 12% ; temperature 24,1°C; secchi 60 cm; substratum sand-muddy; no vegetation present. The Mtamvuna estuary is relatively deep and characterized by silt throughout its length. Its faunal characteristics are rather different to the smaller estuaries to the north of it. Begg (1984a) collected 24 fish species there but noted that Cyrus (1980) recorded up to 38 species. Habitat details for *B butis* in the Mtamvuna are (G W Begg personal communication): depth 200 cm; dissolved oxygen 6,1 mg $\sim^{1}$; salinity 18% ; temperature 18,9^{8}C; secchi 9 cm; substratum mud (silt); vegetation *Phragmites* reeds.

Breeding biology: Unknown.

CONSERVATION

Threats: The general deterioration of the tropical-subtropical South African estuaries in Natal (Begg 1978, 1984a,b) from various causes poses the main threat to rare marginal species such as *8 butis** In the Umgeni estuary the more specific threats are beach erosion, development/ conservation conflicts and problems of industrial and urban pollution, siltation and urban encroachment. Several alien plant and animal introductions have been made including mangrove species, water hyacinth *{Eichhornia crassipes)*, Kariba weed *(Salvinia molests)* and "guppies" (presumably *Poecilia reticulata)* (Begg 1984a). One of the major problems is the high rate of invasion of alien plants from seeds introduced via urban runoff (F Junor personal communication). Agriculture was given as the main source of sediment in the Sandlundlu by Begg (1978). Recreational use, development and siltation represent additional threats to the Sandlundlu and Mtamvuna estuaries at present (Begg 1984a). The conservation status of the Mgeni and Sandlundlu estuaries is fair and the Mtamvuna good (Heydorn 1986).

Conservation attention given: No specific attention has been given to this species. The Beachwood Mangrove Nature Reserve was established in May 1977 and is an important environmental education facility (F Junor personal communication). Various steps to conserve the Mgeni estuary in general have been made and the City Council have commissioned a study by environmental consultants (G W Begg personal communication).

Conservation recommendations: The importance of the Beachwood Creek Nature Reserve is recognized bearing in mind its significance as an ecological refugium for this and several other rare fish species. *Butis butis* is probably not present in sufficient numbers to warrant biological or autecological study. The conservation of South African estuaries is dependent on sound environmental conservation strategies being practised throughout the catchment areas (Begg 1984b).

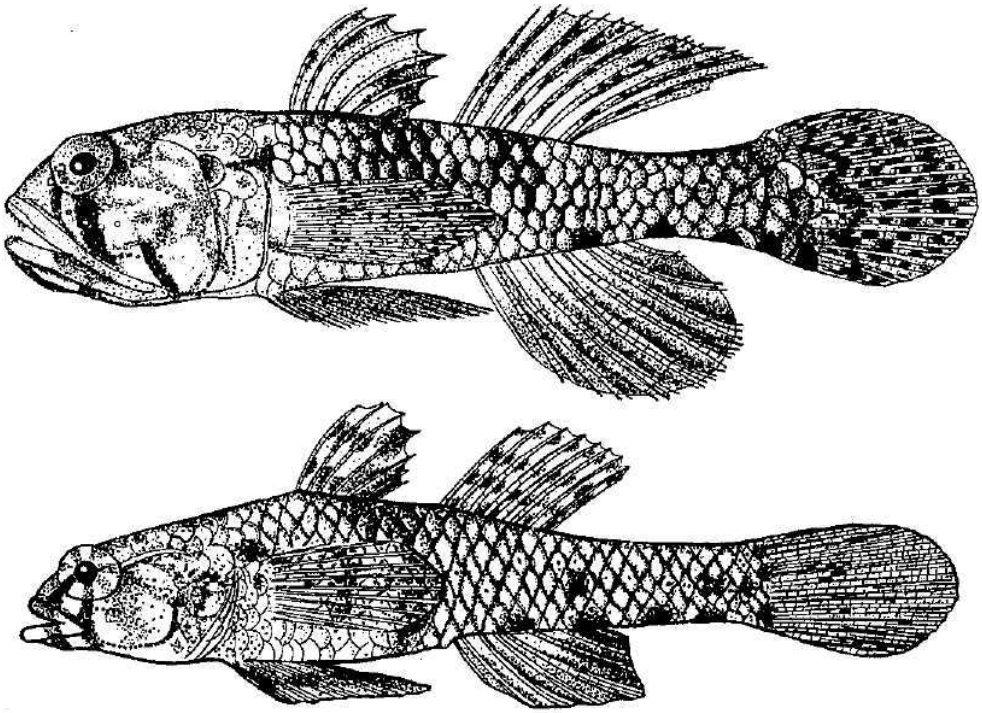
REFERENCES

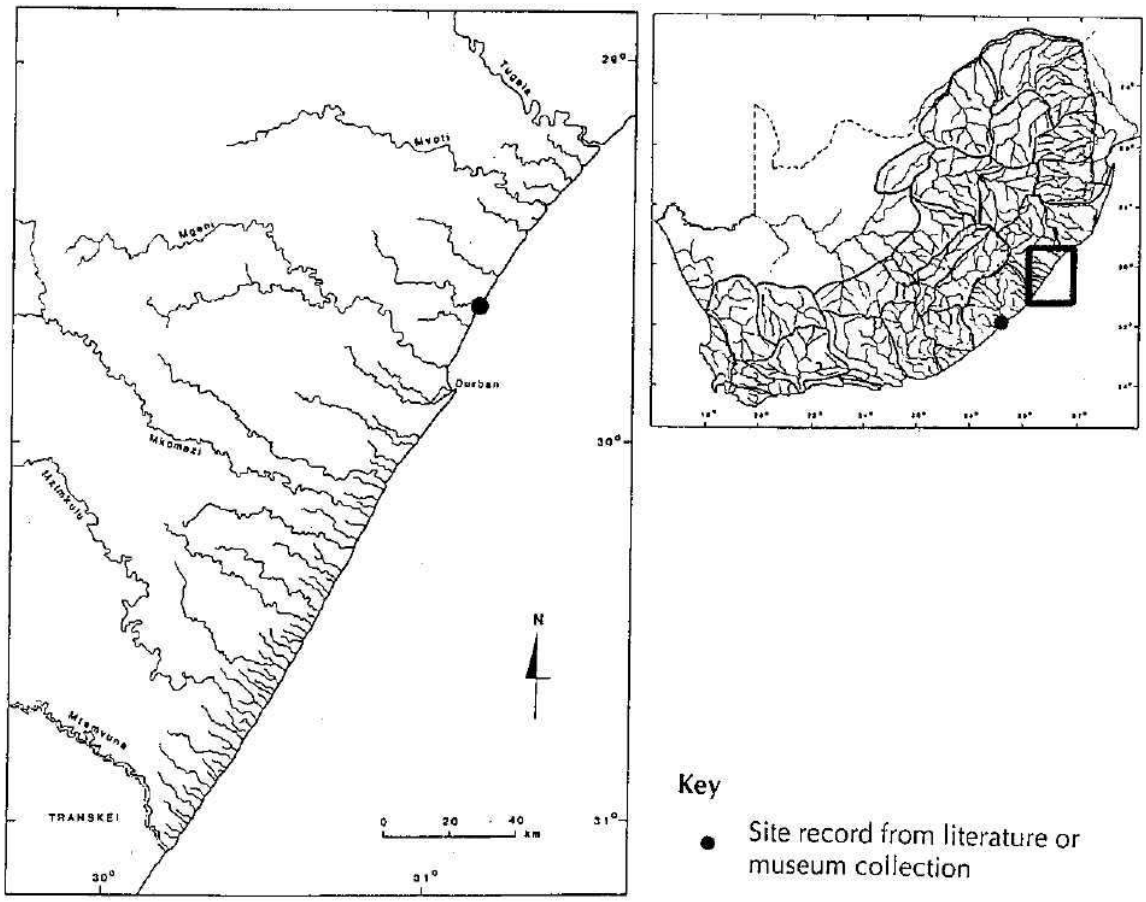
Begg (1978, 1984a,b); Boulenger (1916); Edwards and Moll (1972); Heydorn (1986); Hoese (1986b); Smith (1965).

Correspondence: Dr G W Begg; M Coke; Dr P C Heemstra; F Junor.

BIGMOUTH GOBY / GROOTBEK-DIKKOP

FIGURE 48. The bigmouth goby, *Redigobius bikolanus,* male above 30 mm TL, female below 20 mm TL, with distribution in Natal.





BIGMQOTH GOBY / GROOTBEK-DXKKGP **VULNERABLE**

Redigobius bikolanus (Herre 1927)

Family: Gobiidae SUMMARY

Status: Vulnerable in South Africa. An uncommon species that is known from two estuarine systems only in South Africa.

Research: Poor. Known only from museum specimens.

SPECIES DATA

Identification: A small goby (attains 30 mm St), with the males having larger mouths and longer soft dorsal and anal fins than the females. The head is compressed and the head papillae are in a longitudinal pattern. The body has large ctenoid scales, and there are six to eight predorsal scales. There is a black spot on the base of the first dorsal fin and a black blotch on each side of urogenital papillum CHoese 1986a).

Distribution: In South Africa recorded from Mdloti lagoon by Begg (1984a,b). A single specimen is also known from the Umtata River mouth in Transkei (RUSI 17045). Hoese (1986a) records the distribution as Indo-Pacific, south to Coffee Bay (see remarks). The type locality is in the Phillippines (Herre 1927).

Habitat and ecology: The Mdloti lagoon is 1,5 km in length and has a substratum of muddy sand of fluvial origin with beach sand nearer the sea and silt in the backwater reaches. Freshwater mangroves, reeds and water hyacinth *(Eichhornia crassipes)* occur. Habitat details recorded for this species by G W Begg (personal communication) are: depth 40 cm; dissolved oxygen 9,7 mg $-^{1}$; salinity 5% ; temperature 25,1'C; secchi > 40 cm; substratum mud (silt); vegetation lagoonal trees. The fish community includes 28 species of which the dominant is *Oreochromis mossambicus.*

Breeding biology: Not known.

Remarks: Hoese (1986a) notes the southern most distribution as "Coffee Bay". The specimen on which this is based was collected by P C Heemstra from the Umtata River mouth (RUSI 17045) to the south of Coffee Bay.

CONSERVATION

Threats: Although Begg (1978) notes that the Mdloti lagoon is in relatively good condition he lists several problems of direct concern to the environment including siltation, cane encroachment, periodic influxes of industrial and agricultural pollutants, impacts from roadbridge construction and, more recently, severe contamination by dieldrin (Begg 1984a; Blaber et al 1984). The lagoon is also used extensively for recreational purposes at certain times of the year. Siltation arising from poor land-use practices in the catchment has been severe in recent years (Begg 1978). Heydorn (1986) gives the conservation status of the Mdloti as fair and notes that the system is breached regularly and is influenced' by urban development and pollution.

Conservation attention given: No specific conservation measures have been made. The ecological survey conducted by Begg (1978, 1984a,b) and the study by Blaber et al (1984) are important contributions for conservation of the estuary.

Conservation recommendations: The species occurs in insufficient numbers to recommend specific biological studies. Begg (1984b) recommended "the implementation of a comprehensive nation-wide policy to conserve estuaries and lagoons throughout the country no matter how large or small". Heydorn (1986) recommends rehabilitation and protection measures due to the fresh-water mangrove community, reed swamp and abundant bird life.

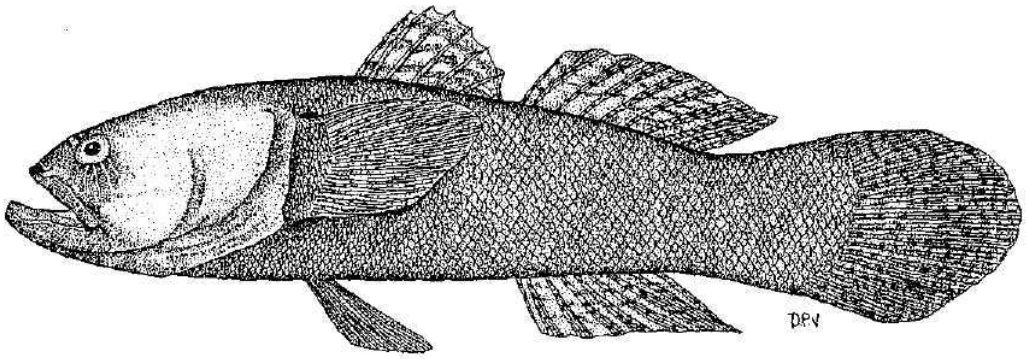
REFERENCES

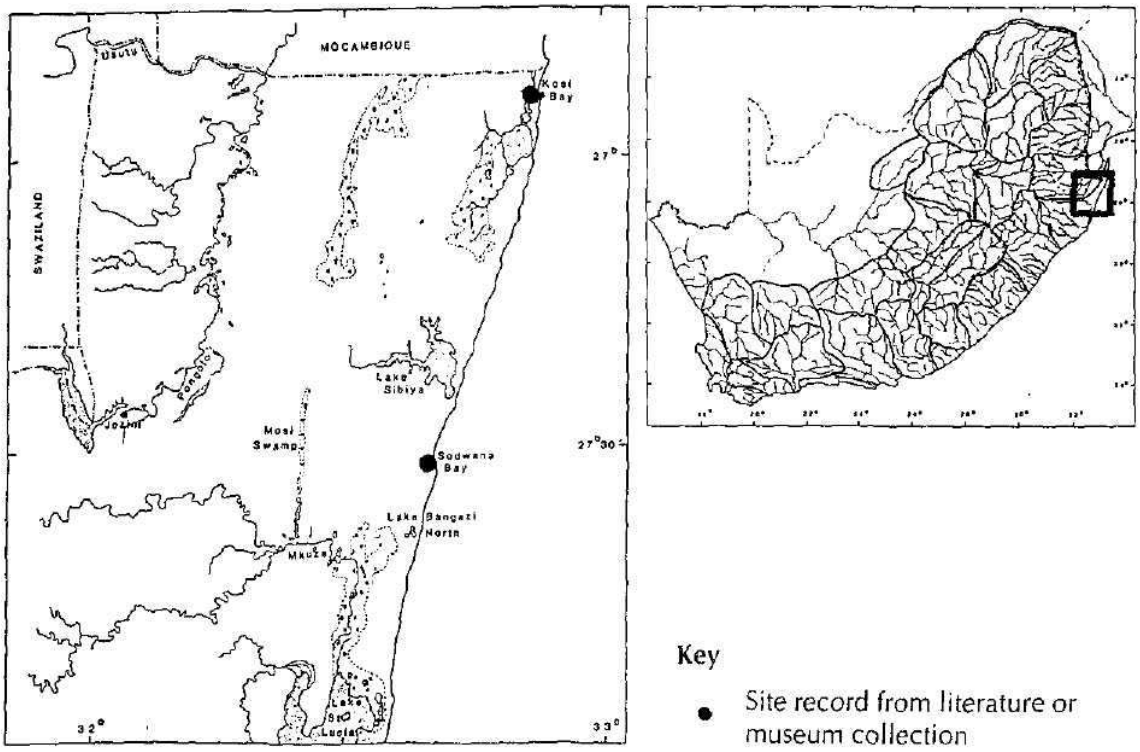
Begg (1978, 1984a,b); Blaber et al (1984); Herre (1927); Heydorn (1986); Hoese (1986a).

Correspondence: Dr G W Begg; Dr P C Heemstra.

BROADHEAD SLEEPER / BREeKOP-SLAPER

FIGURE 49. The broadhead sleeper, *Eleotris melanosoma,* 100 mm SL, with distribution in north-east Natal.





BROADHEAD SLEEPER / BREeKOP-SLAPER **RARE (SAFE?)**

Eleotris melanosoma (Bleeker 1852)

Family: Eleotridae

SUMMARY

Status: Rare in South Africa, possibly safe. The species is comparatively scarce in collections but it may be being confused with the closely similar *E fusca* (Hoese 1986b).

Research: Poor - fair. Known only from museum specimens and general field observations.

SPECIES DATA

Identification: A moderately large eleotrid species (reaches 170 mm SL) with a broad depressed head. Maxilla reaches to below rear half of the eye. The top of the head, cheeks and gill covers are scaled and the gill opening extends to below the end of the preopercle. Scales in lateral series 46 to 56; preopercle scales do not reach to below the eyes.

Distribution: In South Africa it has been recorded from the Kosi system (Kyle in littera), the Sodwana system including the estuary and Mgobezeleni estuary (Bruton and Kok 1980; Kyle in littera), as well as the Umtata and Qora River mouths in the Transkei (Hoese 1986b; Rusi records). Begg (1984a) only recorded the closely similar species *Eleotris fusca* from various Natal estuaries and lagoons between Sodwana and the Transkei. It is possible and seems likely that some of his *E fusca* records are actually *E melanosoma.* Beyond South Africa *E melanosoma* is tropical Indo-West Pacific in distribution (Hoese 1986b).

Habitat and ecology: Bruton and Kok (1980) found specimens under stones and logs in the mangrove and Phragmites swamp at Mgobezeleni estuary. Smith (1965) reported *E fusca* under stones and among refuse in shallow water, mainly in estuaries but extending to fresh water (part of Smith's material is reallocated by Hoese (1986b) to *E melanosoma)*. Kyle (in littera) states that small numbers are caught in traditional fish kraals at Kosi and that it is found mainly in the *Phragmites* beds and reed margins of the more northern areas of the Kosi Lakes. Indications from tagged specimens are that the adults are territorial.

Breeding biology: Unknown. Incidental observations have been made by Kyle (in littera): Very small specimens were found in a stream at Zilonde Pan (Kosi system) suggesting that breeding probably occurs either in the stream or in the estuary itself.

Remarks: Kyle (in littera) stated that two specimens survived well in captivity and were fed on live chironomid larvae.

CONSERVATION

Threats: The main threat to this species at the southern end of its range is the rapid deterioration taking place in the coastal lagoon and estuarine, environments (Begg 1978, 1984a,b). The particular threats which

affect individual populations depend on the system eg the construction of a causeway at the Mbobezeleni estuary disrupted the tidal regime and consequently the ecology of the system above the structure (Bruton and Appleton 1975). This has been rectified by rebuilding the bridge to allow tidal interchange (Bruton 1980c). The system provides the main water supply for the Sodwana Bay National Park. Heydorn (1986) gives the conservation status of the Mbobezeleni estuary as good but notes it is highly disturbed.

Conservation attention given: Parts of the Kosi and Mgobezeleni estuarine systems fall within nature conservation reserves. At Kosi Bay the status of threatened fishes is being investigated and monitored by the fisheries Research Officer of the KwaZulu Bureau of Natural Resources. The status of Natal estuaries has been investigated in detail (Begg 1978, 1984a,b). This work is being continued through the Estuarine Research Unit of the Council for Scientific and Industrial Research.

Conservation recommendations: If possible the autecology and biology of the broadhead sleeper should be studied. The adoption of a nation-wide policy to conserve estuaries and coastal lagoons throughout the country as proposed by Begg (1984b) is essential for the long-term conservation of this and other peripheral fish species.

Remarks: Kyle (in littera) states that the populations of this species in Kosi and the Mgobezeleni estuary are protected and in no immediate danger.

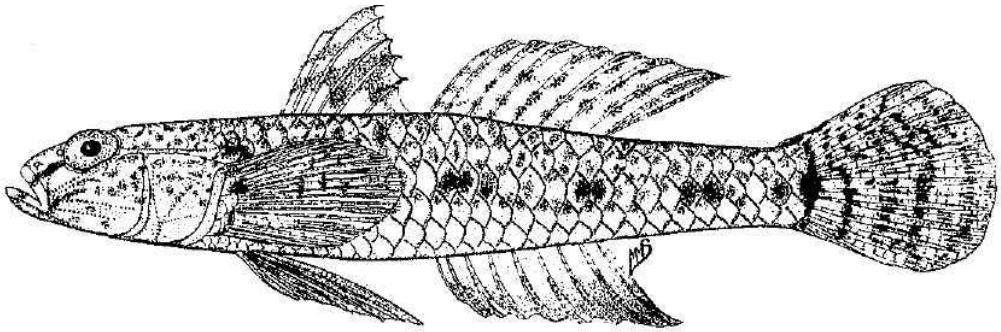
REFERENCES

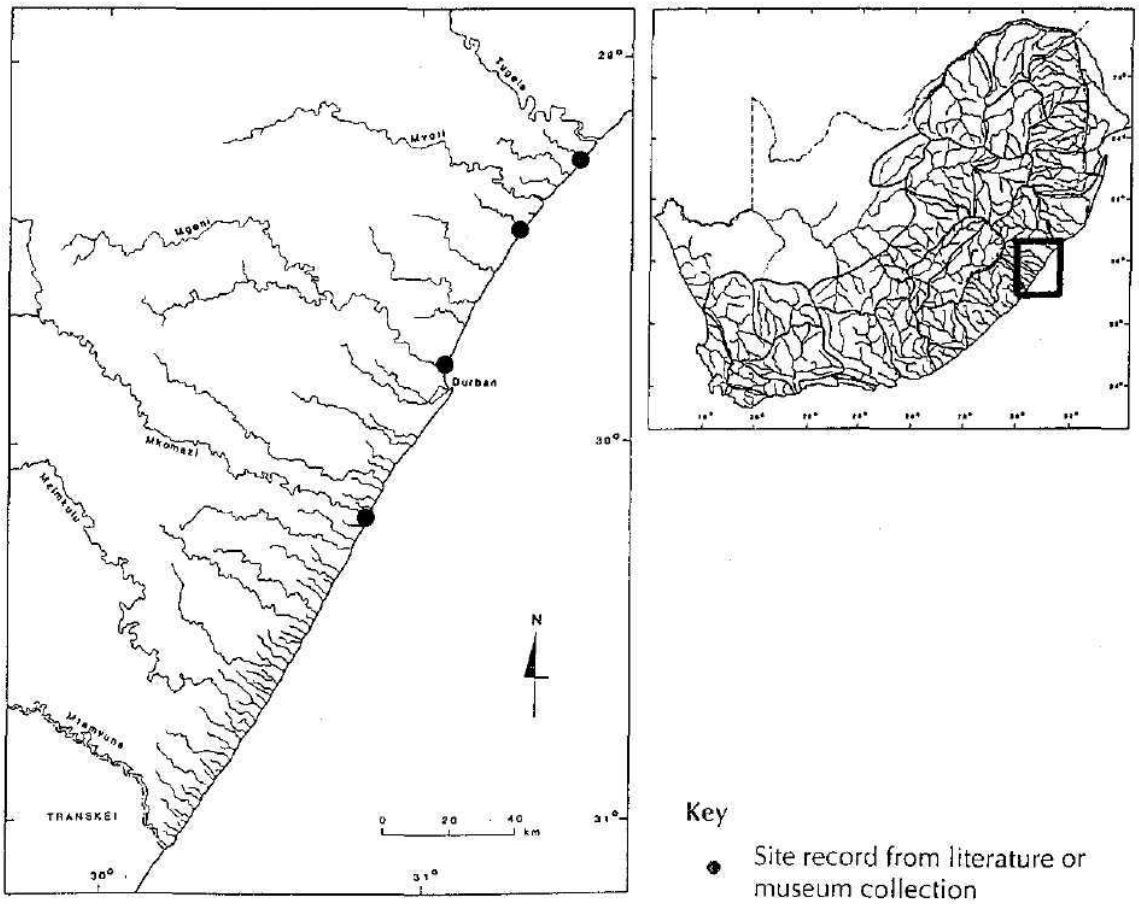
Begg (1978, 1984a,b); Bruton (1980c); Bruton and Appleton (1975); Bruton and Kok (1980); Heydorn (1986); Hoese (1986b); Skelton (1977); Smith (1965).

Correspondence: Dr G W Begg; M Coke; Dr R Kyle.

TROPICAL SAND-GOBY / TROPIESE SAND-DIKKOP

FIGURE 50. The tropical sand-goby, *Favonigobius reichei,* 50 mm SL with distribution in Natal.





TROPICAL SAND-GOBY / TROPIESE SAUD-DXKKGP RARE

Favonigobius reichei (Bleeker 1853)

Family: Gobiidae

SUMMARY

Status: Rare in South Africa. This species is known only from a few specimens collected in four estuarine locales in Natal,

Research: Poor. In South Africa the species is known only from estuarine surveys conducted by Begg (1984a,b), and a specimen described by Fowler (1934b) as *Bhinogobius robinsoni,*

SPECIES DATA

Identification: A small goby (attains 65 mm SL) with the gill opening extending to below the mid-opercle. The scales on the body are ctenoid and extend to above mid-operculum. The prepelvic area is completely scaled but scales are not present on opercle or preopercle. -ph branchiostegal membranes are pale, and meet on isthmus below eye. D VI + 1,8; A 1,7-8 (after Hoese 1986a).

Distribution: Recorded by Begg (1984a) from the Zinkwasi lagoon th Mhlali estuary, the Mgeni estuary and the Mkomazi estuary. Hoese (I986a^ gives the overall range of this species as Indo-West Pacific south to Natal.

Habitat and ecology: The four locales where the tropical sand-goby was collected by Begg (1984a) are either generally open estuaries, or, in the case of Zinkwasi lagoon, an exceptionally saline system. The substratum in these locales is silt or sand. Faunal associations include from 37 to 56 species of fish and rich invertebrate communities (from 11 to 13 praw species and from seven to 10 crab species) (Begg 1984a). Specific habitat details where *F reichei* was collected by Begg (1984a,b) are as follows (G W Begg personal communication): Zinkwasi: depth 70 to 90 cm; dissolved oxygen 5,4 to 6,9 mg ~^{x}; salinity 3 to 28% ; temperature 17,1 to 22 3°c secchi 20 to 55 cm; substratum mud (silt); vegetation lagoonal trees* Mhlali: depth 95 cm; dissolved oxygen 7,6 mg -^{1}; salinity 28% ; tempera ture 19$_{t}$6°C; secchi 60 cm; substratum mud-sandy; vegetation grasses" Mgeni: depth 80 to 145 cm; dissolved oxygen 5,3 to 6,2 mg -*; salinity 10 to 25% ; temperature 18,7 to 25°C; secchi 30 to 40 cm; substratum mud or mud-sandy; vegetation estuarine and coastal trees. Mkomazi: depth 15 to 210 cm; dissolved oxygen 7,0 to 7,4 ing -^{1}; salinity 8 to 307 • temperature 22,4 to 27,1°C; secchi 8 to 20 cm; substratum mud (silt)' vegetation lagoonal trees.

*

Breeding biology: Not known.

CONSERVATION

Threats: Although Begg (1978) classified all four locales as in "fair" environmental condition sedimentation is a serious threat to all of the locales where the tropical sand-goby is found (Begg 1984a), The main cause of sedimentation is attributed to agricultural practices (can cultivation) and veld deterioration in the catchments through overgrazing

and human overpopulation. Other threats include urban development (Mhlali, Umgeni andMkomazi), recreational pressure, artificial breaching (Zinkwasi), industrial or agricultural pollution (especially the Mgeni and Mkomazi) and freshwater abstraction. The conservation status of all these estuaries is fair (Heydorn 1986).

Conservation attention given: The surveys and ecological investigations of Begg (1978, 1984a,b) represent the most significant conservation attention given to these and other coastal systems of Natal. In certain cases Begg (1978, 1984a,b) reports action taken by various agencies to alleviate problems in these systems.

Conservation recommendations: The species does not occur in sufficient numbers to justify autecological or biological studies. Begg (1984b) concluded: "the only way in which the interests of nature conservation can really be served is through the implementation of a comprehensive nation-wide policy to conserve estuaries and lagoons throughout the country no matter how large or small".

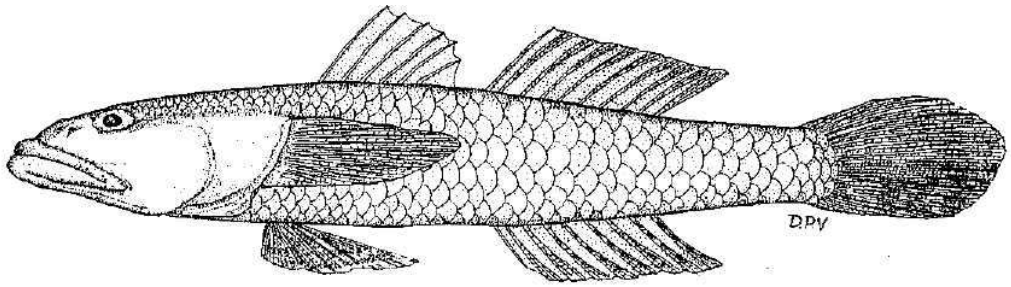
REFERENCES

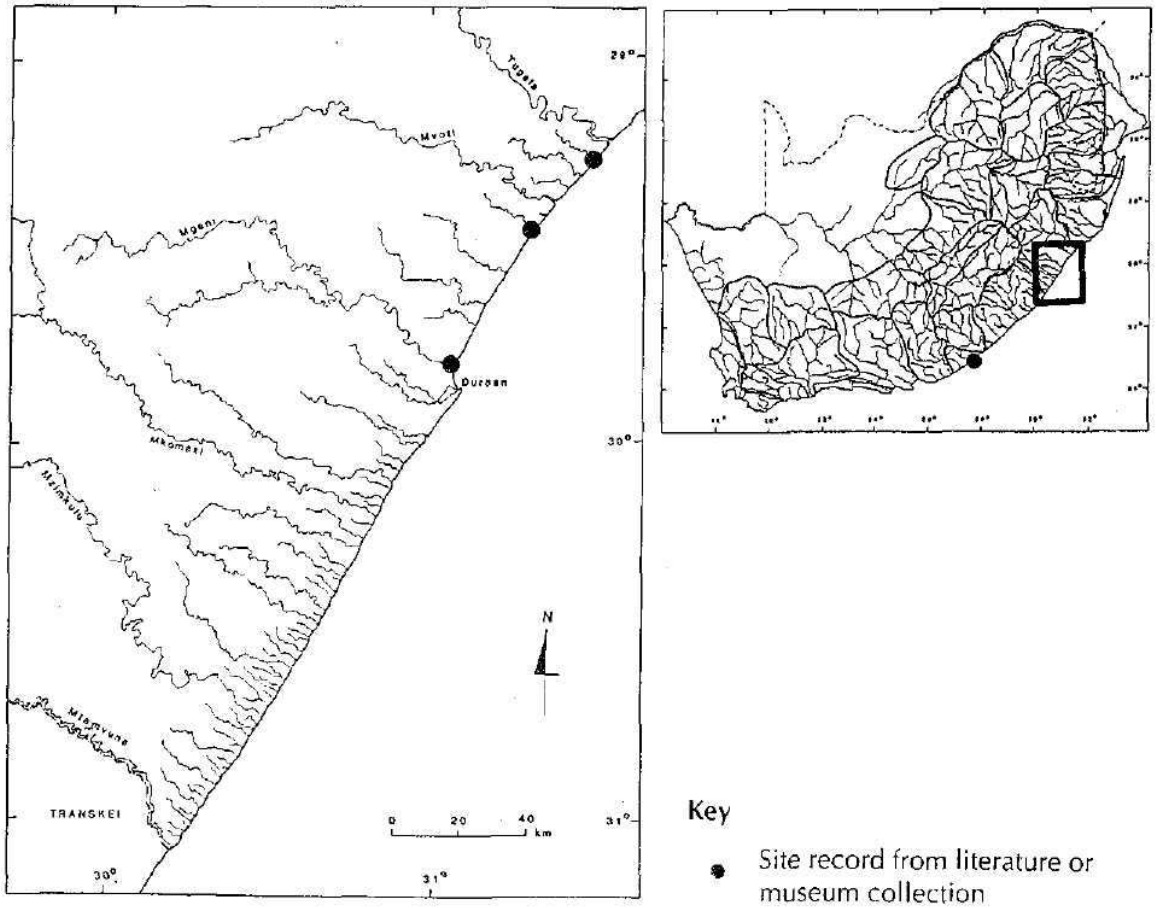
Begg (1978, 1984a,b); Fowler (1934b); Heydorn (1986); Hoese (1986a).

Correspondence: Dr G W Begg; Dr P C Heemstra.

SLEEPY GOBY / VAAK-DIKKOP

FIGURE 51. The sleepy goby, *Glossogobius biocellatus,* 75 mm SL, with distribution in Natal.





SLEEPY GOBY / VAAK-DIKKGP RARE

Glossogobius biocellatus (Valenciennes 183 7)

Family: Gobiidae

SUMMARY

Status: Rare in South Africa. This species is known from a few specimens taken from four locales in South Africa.

Research: Poor. The species is known from museum specimens with certain ecological data available from Begg (1978, 1984a,b).

SPECIES DATA

Identification: It is a gobiid fish (attains 100 mm SL) with a depressed head and elongate snout. The maxilla reaches to below the anterior half of the eye. The branchiostegal membranes form a free fold across the isthmus. The body has dark longitudinal lines and two to three saddles on the back. The first dorsal is black and the pelvics have dark crossbands (from Hoese 1986a).

Distribution: In South Africa the most southern record is East London (Rusi 5489) but Hoese and Winterbottom (1979) mention that *G biocellatus* occurs from Port Elizabeth. Begg (1984a,b) records the species from the Mgeni estuary, the Mhlali estuary and the Zinkwasi lagoon. Hoese (1986a) gives the general distribution of the species as Indo-Pacific south to East London.

Habitat and ecology: Occurs in tropical and subtropical estuaries.. Begg (1978, 1984a) provide broad detailed descriptions of the above locales. The Zinkwasi lagoon is a particularly saline system in spite of usually being closed to the sea. It has a silty substratum and reedbeds along the margins. G W Begg (personal communication) collected this species in a habitat with the following parameters: depth 50 cm; dissolved oxygen 5,8 mg $^{-1}$; salinity 22% ; temperature 22,7°C; secchi 40 cm; substratum mud-sandy; vegetation grasses. The Mhlali and Mgeni are generally open estuaries covered by sandy and silty substrata respectively. In the Mhlali the marginal vegetation of hibiscus and reeds has been reduced and replaced largely by sugar cane. The details of the habitat at which the species was taken are (G W Begg personal communication): depth 35 to 70 cm; dissolved oxygen 5,2 to 6,1 mg $^{-1}$; salinity seven to 30% ; temperature 19,5 to 19,8^{C}C; secchi 55 cm; substratum mud (silt); vegetation *Phragmites* reeds. The Mgeni has mangroves, reeds and grass covered margins. The specific habitat here was (G W Begg personal communication): depth 20 cm; dissolved oxygen 7,6 mg -*; salinity 16% ; temperature 18°C; secchi > 20 cm; substratum fine sand; no vegetation. The fish faunas of these estuaries are relatively rich with from 37 to 56 species being recorded by Begg (1984a). Crustacean communities are also diverse (11 to 13 prawn species and 7 to 10 crab species).

Breeding biology: Not known.

Remarks: This species was not collected in recent surveys of the estuarine gobies in the East London area (G Bell-Cross and G Brett personal communication).

CONSERVATION

Threats: The main threat to the habitat of east coastal lagoons and estuaries is accelerated sedimentation through catchment deterioration (Day and Grindley 1981a; Begg 1984a,b). A variety of other threats affect the Zinkwasi, Mhlali and Mgeni and include agricultural and industrial pollution, urban encroachment, destruction of riparian vegetation, artificial breaching, recreational impact and reduction of freshwater inflow by damming and water extraction. The conservation status of these three systems at present is fair (Heydorn 1986).

Conservation attention given: No specific attention has been given to this species but overall the surveys and ecological studies by Begg (1978, 1984a,b) have provided valuable environmental assessments and a data base for their conservation. Recommendations to alleviate environmental problems in the specific locales of the species are given by Begg (1978 1984a,b).

Conservation recommendations: The species has not been found in sufficient numbers to consider biological or autecological studies. As in the case of other marginal peripheral species the conservation of the sleepy goby is best served through the development and implementation of a national policy which demands catchment wide conservation practices (Day and Grindley 1981b; Begg 1984b). The conservation value of the Beachwood Creek Nature Reserve is important and the conservation potential of the Mhlali estuary is high (Heydorn 1986).

REFERENCES

Begg (1978, 1984a,b); Day and Grindley (1981a,b); Heydorn (1986); Hoese (1986a); Hoese and Winterbottom (19*79).

Correspondence: Dr G W Begg; G Bell-Cross; G Brett; Dr P C Heemstra.

REFERENCES

Allanson B R and Rabie M A 1983. Freshwater systems. In: Fuggle R F and Rabie M A (editors) Environmental Concerns in South Africa, pp 237-259.

Anonymous 1945. Report No 1 (1944). Inland Fisheries Department, Provincial Administration of the Cape of Good Hope, and Union of South Africa.

Anonymous 1972. Shell-ear breeds. Fauna and Flora 23, 21.

Anonymous 1982. Test tube fish for Olifants River. Nature Reserve News (19), 4-6.

Anonymous 1983. The Eastern National Water Carrier, from dreams to reality, water for the future. Swaplan 23, 4-5.

Anonymous 1984. 'n Oog op besoedelde lug. Scientiae 25(2), 22-23.

Appleton C C 1974. A checklist of the flora and fauna of the Gladde-spruit, Nelspruit district, eastern Transvaal. Newsletter of the Limnological Society of Southern Africa (22), 49-58.

Balon E K 1971. Replacement of *Alestes imberi* Peters, 1852 by *Alestes lateralis* Boulenger, 1900 in Lake Kariba, with ecological notes. Fisheries Research Bulletin of Zambia 5, 119-162.

Barnard K H 1937. Note on the identity of the Cape "White-fish" *Barbus capensis.* Annals and Magazine of Natural History (10) 19, 304-306.

Barnard K H 1938a. Description of a new species of freshwater fish from Natal. Annals of the Natal Museum 8(3), 525-528.

Barnard K H 1938b. Notes on the species of *Barbus* from the Cape Province, with descriptions of new species. Annals and Magazine of Natural History (11) 2, 80-88.

Barnard K H 1943. Revision of the indigenous freshwater fish fauna of the SW Cape region. Annals of the South African Museum 36, 101-262.

Begg G W 1978. The estuaries of Natal. Natal Town and Regional Planning Report 41, 1-657.

Begg G W 1984a. The estuaries of Natal Part 2. Natal Town and Regional Planning Report 55, 1-631.

Begg G W 1984b. The comparative ecology of Natal's smaller estuaries. Natal Town and Regional Planning Report 62, 1-182.

Bell-Cross G 1976. The fishes of Rhodesia. National Museums and Monuments of Rhodesia, Salisbury.

Blaber S J M 1978a. Fishes of the Kosi system. The Lammergeyer 24, 28-41.

Blaber S J M 1978b. First record of *Ctenopoma ctenotis* (Boulenger) from South Africa. The Lammergeyer 26, 63.

Blaber S J M, Hay D G, Cyrus D P and Martin T J 1984. The ecology of two degraded estuaries on the north coast of Natal, South African Journal of Zoology 19(3), 224-240.

Blaber S J M and Whitfield A K 1977. The biology of the burrowing goby *Croilia mossambica* Smith (Teleostei, Gobiidae). Environmental Biology of Fishes 1(2), 197-204.

Bok A H 1979. The distribution and ecology of two mullet species in the eastern Cape, South Africa. Journal of the Limnological Society of Southern Africa 5(2), 97-102.

Bok A H 1980. Freshwater mullet in the eastern Cape. Eastern Cape Naturalist 69, 12-14.

Bok A H 1983. The demography, breeding biology and management of two mullet species (Pisces, Mugilidae) in the eastern Cape, South Africa. Unpublished PhD Thesis, Rhodes University, Grahamstown. 268 pp.

Bok A H 1984. Freshwater mullet in the eastern Cape - a strong case for fish ladders. The Naturalist 28(3), 31-35.

Bok A H and Heard H W 1982. Induced spawning of *Barbus trevelyani* (Pisces, Cyprinidae). South African Journal of Wildlife Research 12, 106-108.

Bosch J M 1979. Treatment effects on annual and dry period stream flow at Cathedral Peak. South African Forestry Journal (108), 29-38.

Botanical Research Institute 1980. Southern African Plants W.7/1980 Water Hyacinth/Waterhiasint *(Eichhornia crassipes* (Mart.) (Solms).

Botha J (editor) 1984. A new type of park in the offing. Custos 12(12), 9-13.

Boulenger G A 1916. Catalogue of the fresh-water fishes of Africa in the British Museum (Natural History). Volume IV. British Museum of Natural History, London. 392 pp.

Boulenger G A 1919. On some new fishes from near the west coast of Lake Tanganyika. Proceedings of the Zoological Society, London (2), 399-404.

Bourquin 0 1985. Conservation aspects related to the development of aquaculture in South Africa. In: Hecht T, Bruton M N and Safriel 0 (editors) Aquaculture South Africa. Occasional Report Series No 1. Foundation for Research and Development, CSIR, Pretoria, pp 136-142.

Bourquin 0 1986. Additional fish records: Mgobezeleni Lake, Maputaland. The Lammergeyer 36, 50,

Bourquin 0, Vincent J and Hitchins P M 1971. The vertebrates of the Hluhluwe Game Reserve-corridor (State land) - Umfolozi Game Reserve complex. The Lammergeyer 14, 5-58.

Brooks P M and Gardner B D 1980. Effect of cattle dip containing toxaphene on the fauna of a South African river. Journal of the Limnological Society of Southern Africa 6(2), 113-118.

Bruton M N 1974. Two new fish records from Lake Sibaya. Newsletter of the Limnological Society of Southern Africa (22), 47-48.

Bruton M N 1975. First record of *Sarotherodon placidus* (Pisces: Cichlidae) from South Africa. The Lammergeyer 22, 33-36.

Bruton M N 1979a. The fishes of Lake Sibaya. In: Allanson B R (editor) Lake Sibaya. Monographiae Biologicae 36, 162-245.

Bruton M N 1979b. The utilization and conservation of Lake Sibaya. In: Allanson B R (editor) Lake Sibaya. Monographiae Biologicae 36, 286-312.

Bruton M N 1980a. Conservation and development in Maputaland. In: Bruton M N and Cooper K C (editors) Studies on the Ecology of Maputaland (40), 497-529. Rhodes University, Grahamstown and the Natal Branch of the Wildlife Society of Southern Africa, Durban, pp 497-529.

Bruton M N 1980b. An outline of the ecology of the Mgobezeleni Lake system at Sodwana, with emphasis on the Mangrove community. In: Bruton M N and Cooper K C (editors) Studies on the Ecology of Maputaland (32), 408-426. Rhodes University, Grahamstown and the Natal Branch of the Wildlife Society of Southern Africa, Durban, pp 408-426.

Bruton M N 1980c. An outline of the ecology of Lake Sibaya, with emphasis on the vertebrate communities. In: Bruton M N and Cooper K C (editors) Studies on the Ecology of Maputaland (31), 382-407. Rhodes University, Grahamstown and the Natal Branch of the Wildlife Society of Southern Africa, Durban, pp 382-407.

Bruton M N 1985. The effects of suspensoids on fish. In: Davies B R and Walmsley R D (editors) Perspectives in Southern Hemisphere Limnology. Developments in Hydrobiology 28, 221-242.

Bruton M N 1986. Life history styles of invasive fishes. In: Kruger F J, Macdonald I A W and Ferrar A A (editors) The ecology of biological invasions in southern Africa. Oxford University Press, Cape Town, pp 201-208.

Bruton M N and Appleton C C 1975. A survey of the Mgobezeleni Lake-system in Zululand, with a note on the effect of a bridge on the mangrove swamp. Transactions of the Royal Society of South Africa 41(3), 283-294.

Bruton M N, Bok A H and Davies M T (in press). Life history styles of diadromous fishes in inland waters of southern Africa. In: Dadswell M J (editor) Common strategies of anadromous and catadromous fishes. American Fisheries Society, Columbia, Maryland, pp 104-121.

Bruton M N and Cooper K C (editors) 1980. Studies on the ecology of Maputaland. Rhodes University, Grahamstown and the Natal Branch of the Wildlife Society of Southern Africa. Durban.

Bruton M N and Haacke W D 1980. The reptiles of Maputaland. In: Bruton M N and Cooper K H (editors) Studies on the Ecology of Maputaland, (22), 251-287. Rhodes University, Grahamstown and the Natal Branch of the Wildlife Society of Southern Africa, Durban, pp 251-287.

Bruton M N and Kok H M 1980. The freshwater fishes of Maputaland. In: Bruton M N and Cooper K H (editors) Studies on the Ecology of Maputaland (20), 210-244. Rhodes University, Grahamstown and the Natal Branch of the Wildlife Society of Southern Africa, Durban, pp 210-244.

Bruton M N, and Merron S V 1985. Alien and translocated aquatic animals in southern Africa, a general introduction, checklist and bibliography. South African National Scientific Programmes Report No 113. CSIR, Pretoria. 71 pp,

Bruton M N and Taylor R H 1979. Cichlid fish mortality in a freshwater lake in Natal. The Lammergeyer 27, 1-4.

Bruton M N and Van As J G 1986. Faunal invasions of aquatic ecosystems in southern Africa, with suggestions for their management. In: Kruger F J, Macdonald I A W and Ferrar A A (editors) The ecology of biological invasions in South Africa. Oxford University Press, Cape Town, pp 47-62.

Cambray J A 1978. A contribution to the character phylogeny of the Anabantidae: with particular reference to the respiratory organs of *Sandelia bainsii.* Unpublished BSc (Hons) project, Rhodes University, Grahamstown. 115 pp.

Cambray J A 1981. The eastern Cape Rockey *{Sandelia bainsii).* The Naturalist 25(1), 28-30.

Cambray J A 1984. Fish populations in the middle and lower Orange River, with special reference to the effects of stream regulation. Journal of the Limnological Society of Southern Africa 10(2), 37-49.

Cambray J A 1985a. Early development of an endangered African barb *Barbus trevelyani* (Pisces:Cyprinidae). Revue d'Hydrobiologie Tropicale 18(1), 51-60.

Cambray J A 1985b. Early ontogeny of *Labeo capensis* (Pisces, Cyprinidae). South African Journal of Zoology 20, 190-196.

Cambray J A, Davies B R and Ashton P J 1986. The Orange River system. In: Davies B R and Walker K F (editors) The Ecology of River Systems. Monographiae Biologicae 60, 89-122.

Cambray J A and Stuart C T 1985. Aspects of the biology of a rare redfin minnow, *Barbus burchelli* (Pisces, Cyprinidae), from South Africa. South African Journal of Zoology 20, 155-165.

Carter R A 1983. Report No 21: Bree (CSW 22). In: Heydorn A E F and Grindley J R (editors) Estuaries of the Cape Part II: Synopses of available information on individual systems. CSIR Research Report (420).

Cheney C S 1983. River pollution a threat - even for Kruger Park. Custos 12(9), 17-19.

Chutter F M 1969. The effects of silt and sand on the invertebrate fauna of streams and rivers, Hydrobiologia 34(1), 57-76.

Chutter F M 1973. An ecological account of the past and future of South African rivers. Newsletter of the Limnological Society of Southern Africa (21), 22-34.

Clay D 1976* An investigation into the distribution of fish in Swaziland. Revue de Zoologie Africaines 90(3), 547-558.

Crass R S 1964. Freshwater fishes of Natal. Shuter and Shooter, Pietermaritzburg.

Crass R S 1968. A rare freshwater fish from Natal. African Aquarist 1(6), 7-8.

Crass R S 1969. The effects of land use on freshwater fish in South Africa, with particular reference to Natal. Hydrobiologia 34, 38-56.

Crass R S 1977. Trout in the Drakensberg. Journal of the Natal Fly Fishers Club 1(5), 11-12.

Crass R S 1985. Should we banish the alien fish? Journal of the Natal Fly Fishers Club 10(5), 16-17.

Cyrus D P 1980. The biology of Gerreidae Bleeker, 1859 (Teleostei). Unpublished MSc Thesis, University of Natal, Pietermaritzburg.

Cyrus D P 1983. The influence of turbidity on fish distribution in Natal estuaries. Unpublished PhD Thesis, University of Natal, Pietermaritzburg.

Day J H 1981. Estuarine ecology with particular reference to southern Africa. Balkema, Cape Town.

Day J H and Grindley J R 1981a. The estuarine ecosystem and environmental constraints. In: Day J H (editor) Estuarine ecology with particular reference to southern Africa. Balkema, Cape Town, pp 345-372.

Day J H and Grindley J R 1981b. The management of estuaries. In: Day J H (editor) Estuarine ecology with particular reference to southern Africa. Balkema, Cape Town, pp 373-379.

Day J H, Blaber S J M and Wallace J H 1981. Estuarine fishes. In: Day J H (editor) Estuarine ecology with particular reference to southern Africa. Balkema, Cape Town, pp 197-221.

Davies D H 1949. A new goby from the Knysna River. Annals and Magazine of Natural History (12) 1 (5), 357-376.

Davies B R and Day J A 1986. The biology and conservation of South Africa's Vanishing Waters. The Centre for Extra-Mural Studies, University of Cape Town, Cape Town. 186 pp.

Dawson C E 1986. Family No 145: Syngnathidae. In: Smith M M and Heemstra P C (editors) Smiths' Sea Fishes: 445-458. Macmillan, Johannesburg. 1047 pp.

De Wet B 1986. New era in conservation. Environment RSA 13(1), 4-12.

Duvenage I R and Morant P D 1984. Report No 31 Keurboom/Bitou system (CMS 19), Piesang (CMS 18). In: Heydorn A E F and Grindley J R (editors) Estuaries of the Cape Part II; synopses of available information on individual systems. CSIR Research Report (430), 1-64.

Edwards R and Moll E J 1972. The Beachwood mangroves and their present status and a plan for their conservation. Project Report, Wildlife Society of South Africa, Natal field work section (2), 1-12.

Edwards T 1986. From the brink. Custos 15(7), 34-38.

Farquharson F L 1970a. A new freshwater gobi (Pisces: Gobiidae) from Lake Sibayi, Zululand, South Africa. Annals of the Cape Provincial Museums (Natural History) 8(10), 85-87.

Farquharson F L 1970b. Roads versus estuaries. Newsletter of the Limnological Society of Southern Africa (15), 40-45.

Fourie J M and Gorgens A H M 1977. Mineralisation studies of the Berg River (1974-1976). CSIR Research Report (334).

Fourie J M and Steer A G 1971. Water quality survey of the Berg River for the period 1963 to 1970. NIWR/CSIR Research report. 80 pp.

Fowler H W 1934a. Zoological results of the third De Schauensee Siamese Expedition Part I. Additional fishes. Proceedings of the Academy of Natural Sciences of Philadelphia 86, 67-163.

Fowler H W 1934b. Natal fishes obtained by Mr H W Bell-Marley. Annals of the Natal Museum 7, 403-433.

Fowler H W 1934c. Fishes obtained by Mr H W Bell-Marley, chiefly in Natal and Zululand in 1929 to 1932. Proceedings of the Academy of Natural Sciences of Philadelphia 86, 405-514.

Fuggle R F and Ashton E R 1979. Climate. In: Day J, Siegfried W R, Louw G N and Jarman M L (editors) Fynbos ecology: a preliminary synthesis. South African National Scientific Programmes Report No 40. CSIR, Pretoria, pp 7-15.

Gaigher C M 1973a. Voorlopige verslag: Die Status van die inheemse vis in die Olifants Rivier. Internal report, Cape Department of Nature and Environmental Conservation. 18 pp,

Gaigher C M 1973b. The Clanwilliam River; it is not yet too late? Piscator (88), 75-78.

Gaigher I G 1969. Aspekte met betrokking tot die ekologie, geografie en taksonomie van varswatervisse in die Limpopo- en Incomatirivier sisteem. Unpublished DSc Thesis, Rand Afrikaans University, Johannesburg.

Gaigher I G 1973. The habitat preferences of fishes from the Limpopo River system, Transvaal and Mocambique. Koedoe 16, 103-116.

Gaigher I G 1975. The ecology of a minnow, *Barbus trevelyani* (Pisces, Cyprinidae) in the Tyume River, Eastern Cape. Annals of the Cape Provincial Museums (Natural History) 11(1), 1-19.

Gaigher I G 1978. The importance of the Kruger National Park and the conservation and utilisation of indigenous fish species. Custos 7(6), 43-48.

Gaigher I G 1979. Overgrazing endangers fish species. African Wildlife 33(1), 41.

Gaigher I G 1983. Fish farming: a threat to fish conservation? The Naturalist 27(3), 24-28.

Gaigher I G and Pott R Me C 1972. A check-list of indigenous fish in the east-flowing rivers of the Transvaal. Newsletter of the Limnological Society of Southern Africa (18), 26-32.

Gaigher I G, Hamman K C D and Thome S C 1980. The distribution, conservation status and factors affecting the survival of indigenous freshwater fishes in the Cape Province. Koedoe 23, 57-88.

Gephard S R 1978. Observations on the three allopatric populations of the Maluti minnow *Oreodaimon quathlambae* (Barnard) with notes on its evolution, ecology, spawning and conservation. Journal of the Limnological Society of Southern Africa 4(2), 105-111.

Gow C 1968. Aigamas Cave. Bulletin of the South African Speleological Association (1968), 25-27.

Greenwood P H 1979. Towards a phyletic classification of the 'genus' *Haplochromis* (Pisces, Cichlidae) and related taxa Part I. Bulletin of the British Museum Natural History (Zoology Series) 35(4), 265-322.

Greenwood P H and Jubb R A 1967. The generic identity of *Labeo quathlambae* Barnard (Pisces, Cyprinidae). Annals of the Cape Provincial Museums 6(2), 17-37.

Grindley J R 1985. Report No 30 Knysna Estuary. In: Heydorn A E F and Grindley J R (editors) Estuaries of the Cape Part II. Synopses of available information on individual systems. CSIR Research Report (429), 1-82.

Groenewald A A van J 1958. A revision of the genera *Barbus* and *Varicorhinus* (Pisces: Cyprinidae) in Transvaal. Annals of the Transvaal Museum 23(3), 263-330.

Hall A V (editor) 1984. Conservation of threatened natural habitats. South African National Scientific Programmes Report No 92. CSIR, Pretoria. 183 pp.

Hamman K C D, Thome S C and Scott H A 1982. Preliminary report on the effects of the January 1981 flood damage on the indigenous fish fauna of certain sections of the Bree and Gourits River systems. Internal report, Cape Department of Nature and Environmental Conservation, Cape Town. 7 PP.

Hamman R C D, Thome S C and Skelton P H 1984. The discovery of the Cape kurper, *Sandelia capensis* (Cuvier in C & V, 1831) in the Olifants River system (Western Cape Province). The Naturalist 28(1), 24-26.

Hansmann J 1986. The future water resource development of the Orange River. Orange River Environmental Impact Studies Meeting, Department of Water Affairs, Pretoria, August 1986.

Harrison A C 1936. Black bass in the Cape Province. Second report on the progress of American largemouth Black Bass *(Micropterus salmoides,* Lacepede). Investigational Report No 7, Department of Commerce and Industries, Union of South Africa,

Harrison A C 1952a. Cape minnows ("Rooivlerks" and "Gillieminkies"). Piscator (24), 117-128.

Harrison A C 1952b. The Cape Witvis. Piscator (21), 24-26.

Harrison A C 1952c. The Cape Kurper. Piscator (23), 82-91.

Harrison A C 1973. Endemic species in the Clanwilliam Olifants River in the surveys of 1937 and 1938. Piscator (88), 78.

Harrison A D 1958. The effects of sulphuric acid pollution on the biology of streams in the Transvaal, South Africa. Verhandelingen International Verein Limnologie 13, 603-610.

Harrison A D 1964. An ecological survey of the Great Berg River. In: Davies D H S (editor) Ecological studies in southern Africa. Monographiae Biologicae 14, 143-158.

Harrison A D and Elsworth J F 1958. Hydrobiological studies on the Great Berg River, Western Cape Province Part I. A general description, chemical studies on the water and main features of the fauna and flora. Transactions of the Royal Society of South Africa 35, 125-226.

Hart R C (editor) 1982. Water quality in the Buffalo River catchment. A synthesis. Co[1]' iborative Report, Institute for Freshwater Studies, Rhodes University, Grahamstown. 138 p. .

Hecht T and Mashego S N 1981. The fishes of the Limpopo at ' Olifants tributaries (Limpopo Drainage Basin, South Africa), Part II. Annotated checklist of the fishes of the Mohlapitse tributary of the Olifants River, University of the North Series A 26, 1-12.

Hecht T, Polling L and Saayman J E 1981. First record of the snake catfish *Clarias theodorae* (Weber 1897) (Clariidae: Pisces) from the Transvaal, South Africa. Journal of the Limnological Society of Southern Africa 7(2), 57-58.

Hecht T and Saayman J E 1981. The fishes of the Limpopo and Olifants River tributaries (Limpopo Drainage Basin). Part I. Introduction. University of the North Series A 25, 1-5.

Hecht T and Scholtz A T J 1983. The fishes of the Limpopo and Olifants River tributaries (Limpopo drainage basin, South Africa). Part IV. Annotated checklist of the fishes of the Steelpoort tributary of the Olifants River. University of the North Series A 28, 1-11.

Hecht T, Polling L and Mokgalong N M 1983. The fishes of the Limpopo and Olifants tributaries (Limpopo drainage basin, South Africa). Part III. Annotated checklist of the fishes of the Nwanedi tributary of the Limpopo River. University of the North Series A 27, 1-8.

Heeg J, Breen C M and Rogers K H 1980. The Pongolo floodplain: a unique ecosystem threatened. The Civil Engineer in South Africa 1980 (5), 125-128.

Heeg J and Breen C M 1982. Man and the Pongolo floodplain. South African National Scientific Programmes Report No 56. CSIR, Pretoria. 113 pp.

Hennig W 1977. Note on the blind catfish *Clarias cavernicola.* SWA Wissenschaftliche Gesellschaft, Arbeitsberichte des Vereins fuer Hoehlen-forschung 10, 11-12.

Herre A W C T 1927. Gobies of the Philippines and the China Sea. Monographs of the Philippine Bureau of Science 23, 1-352.

Heydorn A E F and Tinley K L 1980. Estuaries of the Cape Part 1. Synopsis of the Cape coast. Natural features, dynamics and utilization. CSIR Research Report (380), 96 pp.

Heydorn A E F (editor) 1986. An assessment of the state of the estuaries of the Cape and Natal in 1985/86, South African National Scientific Programmes Report No 130. CSIR, Pretoria. 39 pp.

Hoese D F 1986a. Family No 240: Gobiidae. In: Smith M M and Heernstra P C (editors) Smiths' Sea Fishes. Macmillan, Johannesburg, pp 774-807.

Hoese D F 1986b. Family No 241: Eleotridae. In: Smith M M and Heemstra P C (editors) Smiths' Sea Fishes. Macmillan, Johannesburg, pp 807-811,

Hoese D F and Winterbottom R 1979. A new species of *Lioteres* (Pisces, Gobiidae) from KwaZulu, with a revised checklist of South African gobies and comments on the generic relationships and endemism of western Indian Ocean gobioids. Royal Ontario Museum, Life Sciences Occasional Paper (31), 1-13.

Hofmeyr H P 1966. The salinity tolerance of some Eastern Province fish in relation to their known distribution. Unpublished MSc Thesis, Rhodes University, Grahamstown.

Howes G J 1980. The anatomy, phylogeny and classification of bariliine cyprinid fishes. Bulletin of the British Museum Natural History (Zoology Series) 37(3), 129-198.

Jackson P B N 1961. The fishes of Northern Rhodesia. Joint Fisheries Research Organisation, Lusaka. 140 pp.

Jackson P B N 1975. Common and Scientific names of southern African fishes Part II Freshwater Fishes. Rhodes University Department of Ichthyology, Special Publication 14, 179-213.

Jackson P B N 1982. Fish in the Buffalo River catchment system. In: Hart R C (editor) Water quality in the Buffalo River catchment. A synthesis, (8), 119-132. Collaborative report, Institute for freshwater studies, Rhodes University, Grahamstown. 138 pp.

Jackson P B N, Cambray J A, Eccles D H, Hannnan K C D, Tomasson T and White P N 1983. Distribution, structure and relative abundance of fish populations. In: Allanson B R and Jackson P B N (editors) Limnology and fisheries potential of Lake Le Roux. South African National Scientific Programmes Report No 77. CSIR, Pretoria, pp 77-107.

Jacot-Guillarmod A 1972. The bogs and sponges of the Orange River catchment within Lesotho. The Civil Engineer in South Africa 14(2), 84-85.

Jaeger F and Waibel L 1921. Landschaften des nbrdlichen Siidwestafrika. Beitrage zur Landeskunde von Sudwesafrika. Band II. E S Mittler and Sohn, Berlin.

Janse van Vuren C J 1978. Die verspreiding van vis in die rivier-sisteme in die Oranje-Vrystaat. OVS Provinsiale Administrasie, Afdeling Natuurbewaring, Vorderingverslag (6), 1-12.

Johnels A G and Svensson G S 0 1954. On the biology of *Protopterus annectens* (Owen). Arkiv for Zoologi 7(7), 131-164.

Jordan K S 1936. Dr. Karl Jordan's expedition to South West Africa and Angola: narrative. Novitates Zoologicae (Tring) 40, 17-62.

Joubert S C J 1986. Pollution of the Kruger National Park rivers. African Wildlife 40(1), 29-30.

Jubb R A 1958. A cave-dwelling catfish *Clarias cavernicola* Trewavas 1936, in South West Africa. Piscator 12(43), 56-57.

Jubb R A 1959. The plump redfin (rooivlerke) *Barbus asper* Boulenger, 1911. Piscator (45), 34-35.

Jubb R A 1964. A new species of *Clariallabes* (Pisces, Clariidae) from the Upper Zambezi River. Annals and Magazine of Natural History (13) 7, 393-395.

Jubb R A 1965. Freshwater fishes of the Cape Province. Annals of the Cape Provincial Museums 4, 1-72.

Jubb R A 1967a. Freshwater fishes of southern Africa. Balkema, Cape Town. 247 pp.

Jubb R A 1967b. A new *Serranochromis* (Pisces, Cichlidae) from the Incomati River system, Eastern Transvaal, South Africa. Annals of the Cape Provincial Museums (Natural History) 6(5), 55-62.

Jubb R A 1968a. The *Barbus* and *Varicorhinus* species (Pisces: Cyprinidae) of Transvaal. Annals of the Transvaal Museum 26, 79-97.

Jubb R A 1968b. A new *Chetia* (Pisces, Cichlidae) from the Incomati River system, Eastern Transvaal, South Africa. Annals of the Cape Provincial Museums (Natural History) 6(7), 71-76.

Jubb R A 1969a. Fishes of the dolomitic limestone caves and sinkholes of southern Africa. Piscator 23(75), 15-20.

Jubb R A 19&9b. The *Nothobranchius* (Pisces, Cyprinodontidae) of southern Africa and a new species from Lake Chilwa, Malawi. Annals of the Cape Provincial Museums (Natural History) 8(1), 1-11.

Jubb R A 1971a, *Oreodaimon quathlambae* (Barnard) in the Tsoelikane River, south-east Lesotho. Newsletter of the Limnological Society of Southern Africa (16), 4-7.

Jubb R A 1971b. The Cape kurper, *Sandelia capensis,* and Eastern Cape Rockey *Sandelia bainsii.* Piscator 25(81), 34-38.

Jubb R A 1972. The fishes of the Orange River. The Civil Engineer in South Africa 14(2), 89-93.

Jubb R A 1975. The identification of *Nothobranchius orthonotus* (Peters, 1844). The Jubb Papers: 1-5. Journal of the American Killifish Association (1975), 159-172.

Jubb R A 1981. *Nothobranchius,* TFH Publications, Neptune City. 61 pp.

Jubb R A and Le Roux P J 1969, Revision of the *Chiloglanis* (Pisces, Mochokidae) of Southern Africa, and descriptions of two new species. Annals of the Cape Provincial Museums (Natural History) 8(2), 13-23.

Kemp P H 1967. Hydrogeological studies on the Tugela River system, Part VI. Acidic drainage from mines in the Natal coalfields. Hydrobiologia 29 (3-4), 393-425.

King J M, Day J A and van der Zel D 1979. Hydrology and hydrobiology. In: Day J, Siegfried W R, Louw G N and Jarman M L (editors) Fynbos ecology, a preliminary synthesis. South African National Scientific Programmes Report No 40. CSIR, Pretoria, pp 27-42.

Kleynhans C J 1979. The distribution and status of *Kneria auriculata* (Pellegrini (Pisces: Kneriidae) in the Transvaal. Journal of the Limnological Society of Southern Africa 5(1), 27-29.

Kleynhans C J 1982. Die ekologie van skaars en moontlik bedreigde vis-soort van Transvaal. Finale verslag, Transvaal Afdeling Natuurbewaring, Lydenburg. 247 pp.

Kleynhans C J 1984. Die verspreiding en status van sekere seldsame vis-soorte van die Transvaal en die ekologie van sommige spesies. Unpublished DSc Thesis, University of Pretoria, Pretoria.

Kleynhans C J 1985. The future of rare fish species in the Transvaal. Fauna and Flora 42, 30-32.

Knaack K 1970. Killifische im Aquarium, Kosmos, Stuttgart. 63 pp.

Kok H K 1980. Ecological studies of some important fish species of the Pongolo floodplain, KwaZulu, South Africa. Unpublished PhD Thesis, University of Natal, Pietermaritzburg.

Kok H M 1981. Knysna seahorse distribution poses a problem. African Wildlife 35(6), 9.

Kok H M and Walley G C B 1978. Natal records of the spotted killifish, *Nothobranchius orthonotus* (Peters, 1844). The Lammergeyer (24), 42-43.

Kok H M and Blaber S J M 1977. A new freshwater goby (Teleostei: Gobiidae) from the Pongolo floodplain, Zululand, South Africa. Zoologica Africana 12(1), 163-168.

Kyle R 1981. The golden sleeper fish - extension of range. The Lammergeyer (31), 43-44.

Kyle R 1984. Interesting results from extensive survey of freshwater areas in northern Maputaland February - March 1984. Internal report, Director, Bureau of Natural Resources, KwaZulu.

La Hausse de LaLouviere P (in press). Notes on unusual fishes from the Pongolo River system, northern Zululand. The Lammergeyer.

Lambrechts J J N 1979. Geology, geomorphology and soils. In: Day J, Siegfried W R, Louw G N and Jarman M L (editors) Fynbos ecology: a preliminary synthesis. South African National Scientific Programmes Report No 40. CSIR, Pretoria, pp 16-26.

Laurenson L J B and Hocutt C H 1984. The introduction of the rock catfish, *Gephyroglanis sclateri* into the Great Fish River via the Orange Fish Tunnel, South Africa. The Naturalist 28(1), 12-15.

Laurenson L J B and Hocutt C H 1985. Colonisation theory and invasive biota: the Great Fish River, a case history. Environmental Monitoring and Assessment 6, 71-90.

Le Roux P J 1981. Utilization of inland water resources with special reference to conservation on areas controlled by the Directorate of Forestry and Environmental Conservation. South African Forestry Journal (118), 67-72.

Li H W and Moyle P B 1981. Ecological analysis of species introductions into aquatic systems. Transactions of the American Fisheries Society 110, 772-782.

Maxwell C 1974. Aigamas Cave. Bulletin of the South African Speleological Association (1974), 8-9.

Mayekiso M L du T 1986. Some aspects of the ecology of the eastern Cape Rockey *Sandelia bainsii* (Pisces, Anabantidae) in the Tyume River, eastern Cape, South Africa. Unpublished MSc Thesis, Rhodes University, Grahamstown.

Maitland P S 1985. Criteria for the selection of important sites for freshwater fish in the British Isles. Biological Conservation 31, 335-353.

Marshall R D 1972. A preliminary fish survey of the Caledon River system. The Civil Engineer in South Africa 14(2), 96-97.

McDowall R M 1968. Interactions of the native and alien faunas of New Zealand and the problem of fish introductions. Transactions of the American Fisheries Society 97(1), 1-11.

McDowall R M 1977. The possible effects on fishes of eucalypt enrichment of New Zealand Beech forests. New Zealand Journal of Forestry 22(1), 45-52.

McDowall R M 1984. Designing reserves for freshwater fish in New Zealand. Journal of the Royal Society of New Zealand 14(1), 17-27.

McDowall R M and Richardson J 1983. The New Zealand Freshwater Fish Survey. Fisheries Research Division, Information Leaflet (12), 15 pp.

Merron G S, La Hausse de LaLouviere P and Bruton M N 1985. The recovery of the fishes of the Pongolo floodplain after a severe drought. J L B Smith Institute of Ichthyology, Investigational Report (13), 1-48. (Unpublished report).

Miller R R 1977. Red Data Book Volume 4: Fishes. IUCN, Morges, Switzerland.

Minshull J 1985. Fishes of the Save/Runde River systems in Zimbabwe. The Hartebeest (The Magazine of the Lowveld Natural History Society) 1985 (17), 38-41.

Morant P. D 1984. Report No 26; Olifants (CW 10). In: Heydorn A E F and Grindley J R (editors) Estuaries of the Cape Part II: synopses of available information on individual systems. CSIR Research Report (425), 1-54.

Mulder P F S 1986. Fish populations of the Vaal River. In: Walmsley R D and Rogers K (editors) The Vaal River Ecosytem: status and problems. Occasional Report Series No 5. Foundation for Research Development, CSIR, Pretoria, pp 201-208.

Murgatroyd A L 1979. Geologically normal and accelerated rates of erosion in Natal. South African Journal of Science 75(9), 395-396.

Nanni U W 1982. Land use in the St Lucia catchment. In: Taylor R H (editor) St Lucia Review. Natal Parks Board, Pietermaritzburg. pp 212-225.

Nature Conservation Division, KwaZulu Department of Agriculture and Forestry 1981. Proposals towards an environmental plan for KwaZulu. 242 pp.

Nelson J S 1984. Fishes of the World. 2nd edition. John Wiley, New York.

Noble R G 1974. An evaluation of the conservation status of aquatic biotopes. Koedoe 17, 71-83,

Parenti L R 1981. A phylogenetic and biogeographic analysis of cyprinodontiform fishes (Teleostei, Atherinomorpha). Bulletin of the American Museum of Natural History 168(4), 335-557.

Paugy D 1986. Revision systematique des *Alestes* et *Brycinus* Africains (Pisces, Characidae). Etudes et Theses, ORSTOM, Paris. 295 pp.

Penrith M J 1978. Otjikoto Lake. South West Africa Annual (1978), 138-139.

Pienaar U de V 1968. The freshwater fishes of the Kruger National Park. National Parks Board of Trustees, Pretoria. 82 pp.

Pienaar U de V 1978a. The freshwater fishes of the Kruger National Park. National Parks Board of Trustees, Pretoria. 91 pp.

Pienaar U de V 1978b. Rare fish species flourishes in Stolznek Dam, Custos 7(10), 46-47.

Pienaar U de V 1981a. Another important ichthyological find in the Kruger National Park *(Protopterus annectens brieni)*. Koedoe 24, 189-191.

Pienaar U de V 1981b. A rare fish discovery in the Kruger Park. Custos 10(9), 32-34.

Pike T 1965. Fish survey of lakes in Zululand. Internal report, Natal Parks Board, Pietermaritzburg. 13 pp.

Pike T 1979. Fish survey of pans on the Mfolozi River floodplain. Internal report, Natal Parks Board, Pietermaritzburg. 10 pp.

Pike T and Tedder A J 1973. Rediscovery of *Oreodaimon quathlambae.* The Lammergeyer (19), 9-15.

Pitman W V 1978. Trends in streamflow due to upstream land-use changes. Journal of Hydrology 39, 227-237.

Poll M 1933. Contribution a la faune ichthyologique du Katanga. Annale du Musee du Congo Beige (1) 3 (3) (Zoologie), 101-152.

Poll M 1961. Revision systematique et raciation geographique des Protopteridae de l'Afrique centrale. Annale Musee royale de l'Afrique centrale (8) (Sciences Zoologie) 103, 1-50,

Poll M 1967. Contribution a la faune ichthyologique de 1'Angola. Diamang PublicacSes Culturais (75), 1-381.

Polling L, Mokgalong N M and Saayman J E 1983. The fishes of the Limpopo and Olifants River tributaries (Limpopo Drainage Basin; South Africa): Part V. Annotated checklist of the fishes of the Luvuvhu subsystem, Limpopo River system. University of the North - Series A 30 (1983), 1-13.

Porter R N 1982. The delicate balance. The impact of the Mfolozi dams. South African Construction World 1(1), 64-71.

Pott R McC 1969. The fish life on the Pongolo River and the effect of the erection of a dam on the fish populations. Unpublished MSc Thesis, University of Witerwatersrand, Johannesburg.

Pott R McC 1970. Fish refuges in the Transvaal. Report to the South African Project Aqua working group. 10 pp.

Pott R McC 1981. The Treur River Barb - a rare fish in good company. African Wildlife 35(6), 29-31.

Pott R McC and Le Roux P J 1968. Breeding behaviour of *Serranochromis meridianus* Jubb, 1967. Newsletter of the Limnological Society of Southern Africa (10), 13-16.

Poynton J C and Broadley D G 1978. The herpetofauna. In: Werger M J A (editor) Biogeography and Ecology of Southern Africa. Monographiae Biologicae 31, 925-948.

Ravenscroft W 1985. The Eastern National Water Carrier. South West Africa Annual (1985), 11-18.

Roloff E 1959. Collecting and breeding the *Nothobranchius* species. Tropical Fish Hobbyist (1959) (6), 12-19.

Rondorf D W 1975. Progress report: The rare and endangered *Oreodaimon quathlambae* (Barnard, 1938). Fisheries Section, Lesotho Ministry of Fisheries and Agriculture. 23 pp.

Rondorf D W 1976a. New locations of *Oreodaimon quathlambae* (Barnard, 1938) (Pisces, Cyprinidae) populations. South African Journal of Science 72, 150-151.

Rondorf D W 1976b. Progress report on the study of *Oreodaimon quathlambae* during the period October 1975 to April 1976. Fisheries Section, Lesotho Ministry of Agriculture. 40 pp.

Rowley A J 1986. Four larger and interesting species of *Nothobranchius.* Killi-News, Journal of the British Killifish Association (253), 1-8.

Safriel 0 and Bruton M N 1984. Aquaculture in South Africa: a cooperative research programme. South African National Scientific Programmes Report No 89. CSIR, Pretoria. 77 pp.

Sainthouse I 1925. Notes on the *Nothobranchius* species from Zambia and the adjacent areas of Zaire and Namibia. Killi-News, The Journal of the British Killifish Association (244), 57-76.

Scheide P 1977. Cave-dwelling catfish. SWA Wissenschaftliche Geselschaft, Verein fiir Hohlenforschung Arbeitsberichte (10), 10,

Scott H A 1982. Freshwater fish management in the Cape - past and present. Cape Conservation Series (1), 1-7.

Scott H A and Hamman K C D 1984. Freshwater fishes of the Cape. Cape Conservation Series (5), 1-23.

Siegfried W R and Davies B R (editors) 1982. Conservation of ecosystems: theory and practice. South African National Scientific Programmes Report No 61. CSIR, Pretoria. 97 pp.

Skelton P H 1974a. On the life colours and nuptial tubercles of *Oreodaimon quathlambae* (Barnard 1938). Annals of the Cape Provincial Museums (Natural History) 9 (12), 215-222.

Skelton P H 1974b. A new *Barbus* species (Pisces, Cyprinidae) from the Olifants River system, western cape Province, South Africa. J L B Smith Institute of Ichthyology Special Publication (13), 1-12.

Skelton P H 1976. A new species of *Mastacembelus* (Pisces, Mastacembelidae) from the upper Zambezi River, with a discussion of the taxonomy of the genus from this system. Annals of the Cape Provincial Museums (Natural History) 11(6), 103-116.

Skelton P H 1977. South African Red Data Book - Fishes. South African National Scientific Programmes Report No 14. CSIR, Pretoria. 39 pp.

Skelton P H 1980. Systematics and biogeography of the redfin *Barbus* species (Pisces: Cyprinidae) from southern Africa. Unpublished PhD Thesis, Rhodes University, Grahamstown.

Skelton P H 1981. The description and osteology of a new species of *Gephyroglanis* (Siluriformes, Bagridae) from the Olifants River, South West Cape, South Africa. Annals of the Cape Provincial Museums (Natural History) 13(15), 217-250.

Skelton P H 1983. Perspectives on the conservation of threatened fishes in southern Africa. The Naturalist 27(1), 3-12.

Skelton P H 1986a. Distribution patterns and biogeography of non-tropical southern African freshwater fishes. Palaeoecology of Africa 17, 211-230.

Skelton P H 1986b. The impact of trout and other introduced predatory fishes on indigenous fishes in South Africa. In: Skelton P H and Davies M T T (editors) Trout in South Africa. Ichthos Special Edition No 1, 3-5.

Skelton P H 1986c. The fishes of the Orange River. In: Davies B R and Walker K F (editors) The Ecology of River Systems. Monographiae Biologicae 60, 143-162.

Skelton P H (in press). A taxonomic revision of the redfin minnows (Pisces, Cyprinidae) of southern Africa. Annals of the Cape Provincial Museums (Natural History).

Skelton P H, Bruton M N, Merron G S and van der Waal B C W 1985. The fishes of the Okavango drainage system in Angola, South West Africa and Botswana: taxonomy and distribution. Ichthyological Bulletin of the J L B Smith Institute of Ichthyology (50), 1-21.

Skelton P H and Cambray J A 1981. The freshwater fishes of the middle and lower Orange River. Koedoe 24, 51-66.

Skelton P H and Davies M T T (editors) 1986. Trout in South Africa. Ichthos Special Edition No 1, 1-20.

Skelton P H, Jubb R A and Bruton M N 1980, Additions to the checklist and recent changes to the scientific names of southern African freshwater fishes. Journal of the Limnological Society of Southern Africa 6(2), 109-112.

Skelton P H and Merron G S 1984. The fishes of the Okavango River in South West Africa with reference to possible impact of the Eastern National Water Carrier on fish distribution. J L B Smith Institute of Ichthyology, Investigational Report (9), 1-32. (Unpublished report).

Skelton P H, Risch L and de Vos L 1984. On the generic identity of the *Gephyroglanis* catfishes from southern Africa (Pisces, Siluroidei, Bagridae). Revue de Zoologie Africaine 98(2), 337-372.

Smith J L B 1935. New and little known fishes from South Africa. Records of the Albany Museum 4, 169-235.

Smith J L B 1950. Two noteworthy non-marine fishes from South Africa. Annals and Magazine of Natural History (12) 3, 705-710.

Smith J L B 1955. An interesting new gobiiform fish from South Africa. Annals and Magazine of Natural History (12) 8, 106-110.

Smith J L B 1963. Fishes of the family *Syngnathidae* from the Red Sea and the Western Indian Ocean. Ichthyological Bulletin, Rhodes University 27, 515-543.

Smith J L B 1965. The Sea Fishes of Southern Africa. 5th edition. Central News Agency, Cape Town. 580 pp.

Smith J L B and Smith M M 1966. Fishes of the Tsitsikamma Coastal National Park. National Parks Board of Trustees, Pretoria. 161 pp.

Smith M M 1981. The seahorse of the Knysna Lagoon. African Wildlife 35(6), 5-9.

Smith M M, and Heemstra P C (editors) 1986. Smiths' Sea Fishes. Macmi1Ian, Johannesburg.

Stirton C H 1978. Plant invaders, beautiful but dangerous. Cape Provincial Administration, Department of Nature and Environmental Conservation, Cape Town. 175 pp.

Stuckenberg B R 1969. Effective temperature as an ecological factor in southern Africa. Zoological Africana 4(2), 145-197.

Taylor R H 1982a. The terrestrial environment and the vegetation of the eastern catchment. In: Taylor R H (editor) St Lucia Research Review. Natal Parks Board, Pietennaritzburg. pp 167-173.

Taylor R H 1982b. The Mkuze Swamps. In: Taylor R H (editor) St Lucia Research Review. Natal Parks Board, Pietermaritzburg. pp 201-210.

Taylor R H (editor) 1982c. St Lucia Research Review. Natal Parks Board, Pietermaritzburg. 257 pp.

Teugels G G 1986. A systematic revision of the African species of the genus *Clarias* (Pisces, Clariidae). Annale Musee royale de l'Afrique Centrale (Zoologie) 247, 1-199.

Travers R A 1984. A review of the Mastacembeloidei, a suborder of synbranchiform teleost fishes Part II: Phylogenetic analysis. Bulletin of the British Museum Natural History (Zoology Series) 47(2), 83-150.

Trewavas E 1936. Dr Karl Jordan's expedition to South West Africa and Angola: the fresh-water fishes. Novitates Zoologicae (Tring) 40, 63-74.

Trewavas E 1983. Tilapiine fishes of the genera *Sarotherodon, Oreochromis* and *Danakilia.* British Museum Natural History, London. 583 pp.

Tweddle D 1983. Breeding behaviour of the Mpasa, *Opsaridium microlepis* (Gunther) (Pisces, Cyprinidae), in Lake Malawi. Journal of the Limnological Society of Southern Africa 9(1), 23-28.

Tweddle D and Willoughby N G 1979. An annotated checklist of the fish fauna of the River Shire south of Kapachira Falls. Ichthyological Bulletin of the JLB Smith Institute of Ichthyology (39) (2), 11-22.

Van der Waal B C W 1976. 'n Visekologiese studie van die Liambezimeer in die oos-Caprivi met verwysing na visontginning deur die bantoebevolking. Unpublished DSc Thesis, Rand Afrikaans University, Johannesburg.

Van der Waal B C W and Skelton P H 1984. Checklist of fishes of Caprivi. Madoqua 13(4), 303-321.

Van der Zel D W 1981. Optimum mountain catchment management in southern Africa. South African Forestry Journal (116), 75-81.

Van Dyk L P 1978. Plaagdoders in rivierwater van die Nasionale Krugerwildtuin. Koedoe 21, 77-80.

Van Rensburg K J 1966. Die vis van die Olifantsrivier (weskus) met spesiale verwysing na die geelvis *{Barbus capensis)* en saagvin *(Barbus serra)*. Cape Provincial Administration, Department of Nature Conservation, Research Report (10), 1-14.

Van Schoor D J 1972. Relative population densities and breeding habits of fish in the upper Orange River. The Civil Engineer in South Africa 14(2), 94-96.

Visser J G 1969. *Barbus trevelyani* (minnow) in the Tyume River. Piscator 23(76), 70.

Von Wrede P 1969. Expedition zur Aigamas Hoehle (mit 1 Planskizze). SWA Wissenschaftliche Gesellschaft, Arbeitsberichte Verein fuer Hoehlenforschung (5), 11-14.

Von Wrede P 1977a. Zusammenfassung der Berichte Uber den blinde hoehlenfisch *Clarias cavernicola* Trewavas 1936. SWA Wissenschaftliche Gesellschaft, Arbeitsberichte Verein fuer Hoehlenforshung (10), 7.

Von Wrede P 1977b. Zur kenntniss dur nahrungsquelle des hoehlenfisches *Clarias cavernicola* Trewavas 1936. SWA Wissenschaftliche Gesellschaft, Arbeitsberichte Verein fuer Hoehlenforshung (10), 12-13.

Wallace J H and van der Elst R P (editors) 1983. Marine linefish programme priority species list. South African National Scientific Programmes Report No 70. CSIR, Pretoria. 113 pp.

Walmsley R D and Rogers K (editors) 1986. The Vaal River Ecosystem: status and problems. Occasional Report Series No 5. Foundation for Research and Development, CSIR, Pretoria. 234 pp.

Weber M 1897. Beitrage zur kenntniss de fauna von Siid-Afrika I. Zur kenntniss der Susswasser-fauna von Siid-Afrika. Zoologische Jahrbuch (Systematische abteilung) 10, 133-155.

White P N, Merron G S, Quick A J R and La Hausse de LaLouviere P 1984. The impact of sustained drought conditions on the fishes of the Pongolo floodplain, based on a survey in September 1983. JLB Smith Institute of Ichthyology, Investigational Report (7), 1-39 (Unpublished report).

Whitfield A K 1980. A checklist of fish species recorded from Maputaland estuarine systems. In: Bruton M N and Cooper K H (editors) Studies on the Ecology of Maputaland. Rhodes University, Grahamstown and the Natal Branch of the Wildlife Society of Southern Africa, Durban, pp 204-209.

Whitfield A K, Allanson B R and Heinecken T J E 1983. Report No 22: Swartvlei (CMS 11). In: Heydorn A E F and Grindley J R (editors) Estuaries of the Cape Part II: Synopses of available information on individual systems. CSIR Research Report (421), 1-62.

Whitlow J R 1983. Hydrological implications of land use in Africa, with particular reference to Zimbabwe. Zimbabwe Agricultural Journal 80(5), 193-212.

Wildekamp R H 1983. Preliminary study of the Somalian *Nothobranchius* species of larvivorous fish, 31 May - 12 July 1983. World Health Organisation, Report EM/MA1/198. EM/VBC/41.

Wilkins N P 1985. Genetics and fish farming: past imperfect, present indicative, future conditional. 5th Congress of European Ichthyologists, Stockholm, Sweden.

APPENDIX

ADDRESSES OF CORRESPONDEES

Mr A Batchelor, Department of Cooperation and Development, P 0 Box 384, Pretoria 0001.

Dr G W Begg, Chris Mulder Associates, P 0 Box 3540, Durban 4000.

Mr G Bell-Cross, Post Office Tree Museum, P 0 Box 371, Mossel Bay 6500.

Mr C Benade, Cape Department of Nature and Environmental Conservation, Rolfontein Nature Conservation Station, P 0 Box 23, Vanderkloof 8771.

Dr S J M Blaber, CSIRO, P 0 Box 21 Cronulla, New South Wales, 2230, Australia.

Dr A H Bok, Cape Department of Nature and Environmental Conservation, P 0 Box 12043, Amalinda 5252.

Prof A P Bowmaker, Oceanographic Research Institute, P 0 Box 10712, Marine Parade, Durban 4056.

Mr H H Boye, c/o Otavi Municipality, Otavi, South West Africa/Namibia.

Mr G Brett, East London Museum, P 0 Box 11021, Southernwood, East London 5213.

Prof M N Bruton, J L B Smith Institute of Ichthyology, Private Bag 1015, Grahamstown 6014.

Mr J A Cambray, Albany Museum, Somerset Street, Grahamstown 6014. Mr

M Coke, Natal Parks Board, P O Box 662, Pietermaritzburg 3200. Mr D

Cooke, P 0 Renishaw, Renishaw Estate, 4181. Mr R S Crass, 144

Villiers Drive, Pietermarit2burg 3200.

Dr S A Craven, c/o S A Spelaeological Association (Cape Section), P 0 Box 4812, Cape Town 8000.

Mr J S Engelbrecht, Provincial Fishery Institute, Private Bag X1088, Lydenburg 1120.

Mr A Ferrar, FRD, CSIR, P 0 Box 395, Pretoria 0001.

Prof I G Gaigher, Department of Zoology, University of Venda, Private Bag X2220, Sibasa, Republic of Venda.

Dr C Gow, Bernard Price Institute for Palaeontology, University of the Witwatersrand, Jan Smuts Avenue, Johannesburg 2000.

Dr K C D Hamman, Cape Department of Nature and Environmental Conservation, Private Bag 5014, Stellenbosch 7600.

Mr H W Heard, Cape Department of Nature and Environmental Conservation, Private Bag 5014, Stellenbosch 7600.

Prof T Hecht, Department of Ichthyology and Fisheries Science, Rhodes University, Grahamstown 6140.

Dr P C Heemstra, J L B Smith Institute of Ichthyology, Private Bag 1015, Grahamstown 6140.

Dr P A Hulley, South African Museum, P 0 Box 61, Cape Town 8000.

Mr J Irish, State Museum, P 0 Box 1203, Windhoek 9000, SWA.

Mr P B N Jackson, J L B Smith Institute of Ichthyology, Private Bag 1015, Grahamstown 6140.

Dr R A Jubb, Fairlands Cottages, P B Cambridge, East London 5206. Mr

F Junor, Natal Parks Board, P 0 Box 17019, Congella 4013.

Dr C J Kleynhans, Nature Conservation Division, Transvaal Provincial Administration, Private Bag X209, Pretoria 0001.

Dr H M Kok, c/o Hewlett-Packard SA (Pty)(Ltd), 511 Cape Road, Linton Grange, Port Elizabeth 6015.

Dr R Kyle, KwaZulu Bureau for Natural Resources, P 0 Box 43, Kwangwanase 3973, KwaZulu*

Mr P la Hausse de Lalouviere, Institute for Natural Resources, University of Natal, P 0 Box 375, Pietermaritzburg 3200.

Mr C Maxwell, 3 Balintore Road, Rondebosch 7700.

Mr M Mayekiso, Department of Zoology, University of Fort Hare, Private Bag X1314, Alice, Republic of Ciskei.

Mr K J Meyer, P 0 Box 26, Sehlabathebe 630, Lesotho, [new address: Sand Draw Route, Riverton, Wyoming 82501, USA].

Dr P F S Mulder, Nature Conservation Division, Transvaal Provincial Administration, Private Bag X209, Pretoria 0001.

Mr M J Penrith, National Zoological Gardens of South Africa, P 0 Box 754, Pretoria 0001.

Dr U de V Pienaar, 233 Hans Pirow Street, Muckleneuk, Pretoria 0002,

Mr T Pike, Natal Parks Board, P 0 Box 662, Pietermaritzburg 3200.

Mr D Pistor, P 0 Box 1275, Bloemfontein 9300.

Mr L Polling, Department of Zoology, University of the North, Private Bag X5090, Pietersburg 0700.

Mr B Ranchod, J L B Smith Institute of Ichthyology, Private Bag 1015, Grahamstown 6140.

Dr G Read, Institute for Freshwater Studies, Rhodes University, Grahamstown 6140.

Mr A B Smith, Cape Department of Nature and Environmental Conservation, Private Bag 5014, Stellenbosch 7600.

Prof M M Smith, J L B Smith Institute of Ichthyology, Private Bag 1015, Grahamstown 6140.

Mr R S Stobbs, J L B Smith Institute of Ichthyology, Private Bag 1015, Grahamstown 6140.

Mr R H Taylor, Natal Parks Board, P 0 Box 62, St Lucia 3936.

Dr D Toerien, NIWR, CSIR, P 0 Box 395, Pretoria 0001.

Mr S C Thome, Cape Department of Nature and Environmental Conservation, Private Bag 5014, Stellenbosch 7600.

Mr D Theron, Institute for Tropical Diseases, P 0 Box 33, Tzaneen 0850.

Mr R P Van der Elst, Oceanographic Research Institute, P 0 Box 10712, Marine Parade, Durban 4056,

Dr B C W Van der Waal, Department of Zoology, University of Venda, Private Bag X2220, Sibasa, Republic of Venda.

Mr J Vermaak, P 0 Box 157, New Germany 3620.

Dr J H Wallace, Port Elizabeth Museum, P 0 Box 13147, Humewood, Port Elizabeth 6013. (No longer in South Africa).

Dr A K Whitfield, Institute for Freshwater Studies, P 0 Box 49, Sedgefield 6573.

INDEX OF SCIENTIFIC NAMES - THREATENED SPECIES

INDEKS VAN AFRIKAANSE GEWONE NAME - BEDRESGDE SPESIES

INDEX OF ENGLISH COMMON NAMES - THREATENED SPECIES

RECENT TITLES 0N THIS SERIES

106. The Kuiseb environment: the development of a monitoring baseline. B J Huntley (editor). March 1985. 138 pp.

107. Annotated bibliography of South *African* indigenous evergreen forest ecology. C J Geldenhuys. May 1985. 125 pp.

108. "Review of metal concentrations in southern *African* coastal waters, sediments and organisms. H F-KQ Hennig. August 1985. 140 pp.

109. *Coastal dunes of South Africa. K L Tinley. September 1985. 293 pp.

110. The limnology of Hartbeespoort Dam. NIWR. September 1985. 269 pp.

111. Management of invasive alien plants in the fynbos biome. I A W Macdonald, M L Jarman and P Beeston (editors). October 1985. 140 pp.

112. The SANCOR Marine Pollution Research Programme 1986-1990. October 1985. 16 pp.

113. Alien and translocated aquatic animals in southern Africa: a general introduction, checklist and bibliography. M N Bruton and S V Merron. October 1985. 71 pp.

114. A synthesis of field experiments concerning the grasslayer in the savanna regions of southern Africa. T G O'Connor. October 1985. 126 pp.

115. *South African marine pollution survey report 1979-1982. 8 0 Gardner, A D Connell, G A Eagle, A G S Moldan and R J Watling. December 1985. 81 pp.

116. Basic needs in rural areas. A report on a seminar held in Cape Town on 19 February 1985. December 1985. 103 pp.

117. South African Red Data Book: Plants - fynbos and karoo biomes. A V Hall and H A Veldhuis. 1985. 144 pp.

118. Invasive alien plants in the terrestrial ecosystems of Natal, South Africa. I A W Macdonald *and* M L Jarman (editors). 1985. 88 pp.

119. Invasive alien organisms in South West Africa/Namibia. C J Brown, I A W Macdonald and S E Brown. 1985. 74 pp.

120. The impact of climate and weather on the activities of the building and construction industry in South Africa. G du Toit de Villiers (compiler). 1986. 40 pp.

121. Ecological research on South African rivers - a preliminary synthesis. J H O'Keeffe. 1986. 121 pp.

122. A description of the Karoo Biotne Project. R M Cowling. 1986. 42 pp.

123. *SANC0R; Summary report on marine research 1985. 1986. 57 pp.

124. The karoo biome: a prel iminary synthesis. Part I - Physical environment. R M Cowling, P W Roux and A J H Pieterse (editors). 114 pp.

125. South African Red Data Book - Terrestrial Mammals. R H N Smithers. 1986. 216 pp.

126. A bibliography of sandy beaches and sandy beach organisms *on* the African continent. R Bally. 1986. 179 pp.

127. Activities of the National Programmes for Ecosystem and Aquaculture Research, 1983-1985. E W Auret. 1986. 68 pp.

128. Historical sites at the Prince Edward Islands. J Cooper and G Avery. 1986. 80 pp.

129. Richards Bay effluent pipeline. D A Lord and N D Geldenhuys. 1986. 30 pp.

130. An assessment of the state of the estuaries of the Cape and Natal 1985/86. A E F Heydorn (editor). 1986. 39 pp.

131. The conservation of South African rivers. J H O'Keeffe (editor). 1986. 117 pp.

132. SIBEX - II: Report of the South African study in the sector (48~64°E) of the Southern Ocean. D G M Miller (editors). 1986. 47 pp.

133. The regional landscape: Nylsvley in perspective. P G H Frost. 1987. 30 pp.

134. South African Southern Ocean Research Programme. SASCAR. 1986. 58 pp.

135. Disturbance and the dynamics of fynbos communities. R M Cowling, C D Le Maitre, B McKenzie, R P Prys-Jones and B W ^ar) Wilgen (editors). 1987. 70 pp.

136. SANKON: Opsommingsverslag oor mariene navorsing. SANKOR. 1987. 45 pp.

137. South African Red Data Book - Fishes. P H Skelton. 1987. 199 pp.

*0ut of Print