Determining priorities, cutting losses and managing conflicts associated with aquatic invasions: a southern African perspective.

Olaf LF Weyl

South African Institute for Aquatic Biodiversity

DST/NRF Center of Excellence for Invasion Biology

ICAIS *International Conference of Aquatic Invasive Species, 10-14 April 2016, Fort Garry Hotel, Winnipeg, Manitoba, Canada*

science & technology Department: Science and Technology REPUBLIC OF SOUTH AFRICA

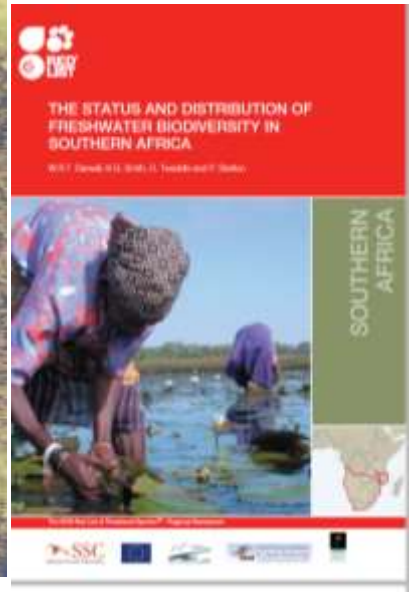
MEIA Manitoba Environmental Industries Association

Invasive Species Centre

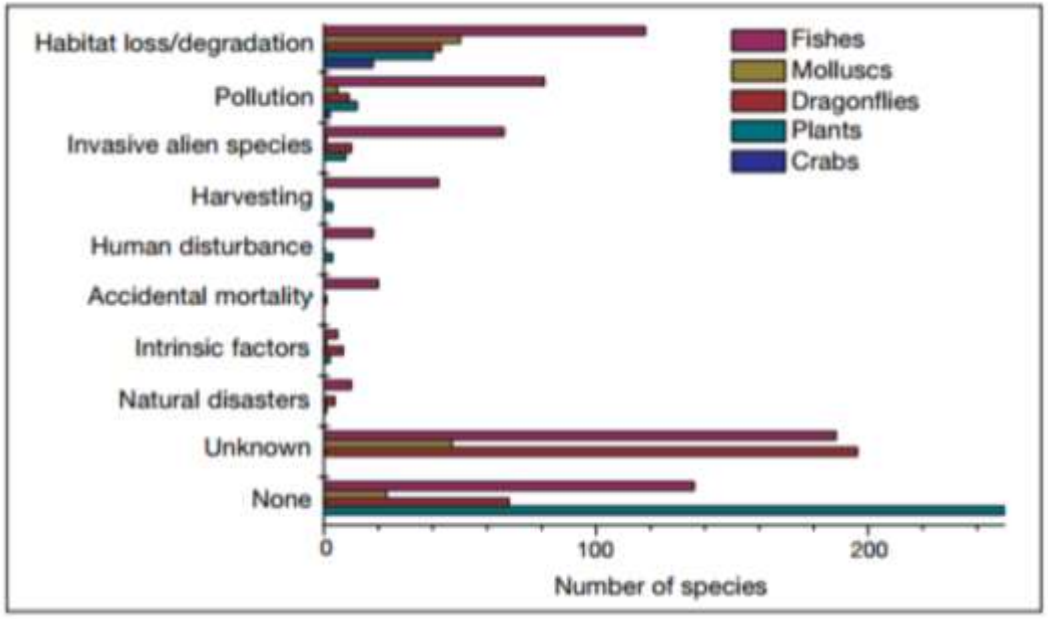
C•I•B DST-NRF Centre of Excellence for Invasion Biology

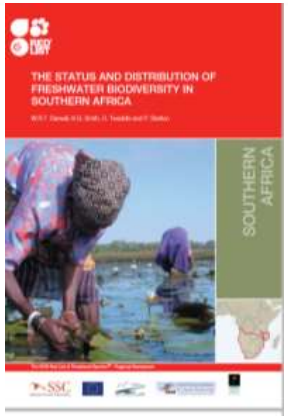
NRF National Research Foundation | SAIAB South African Institute for Aquatic Biodiversity

Southern Africa

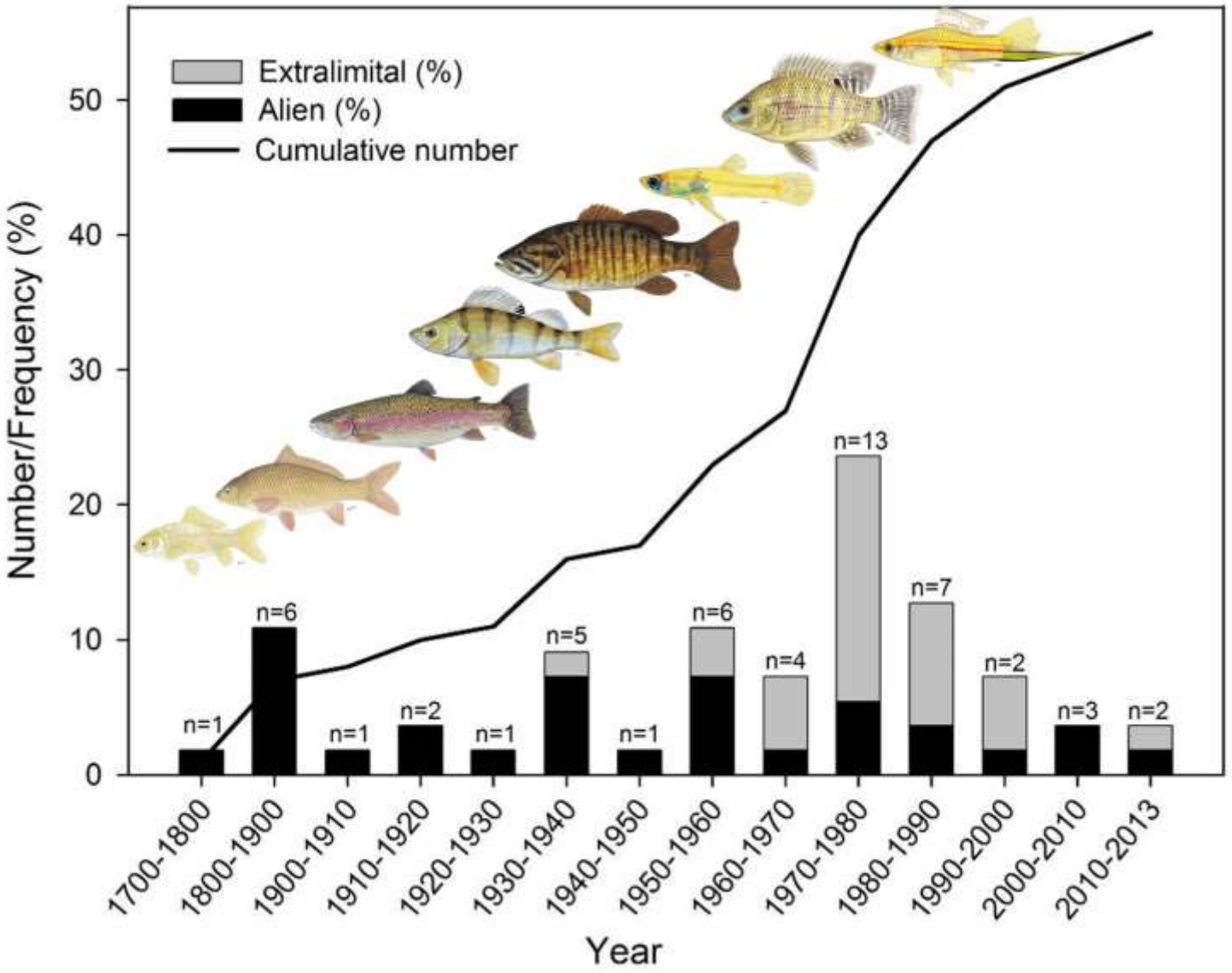


Main threats to Aquatic Biodiversity



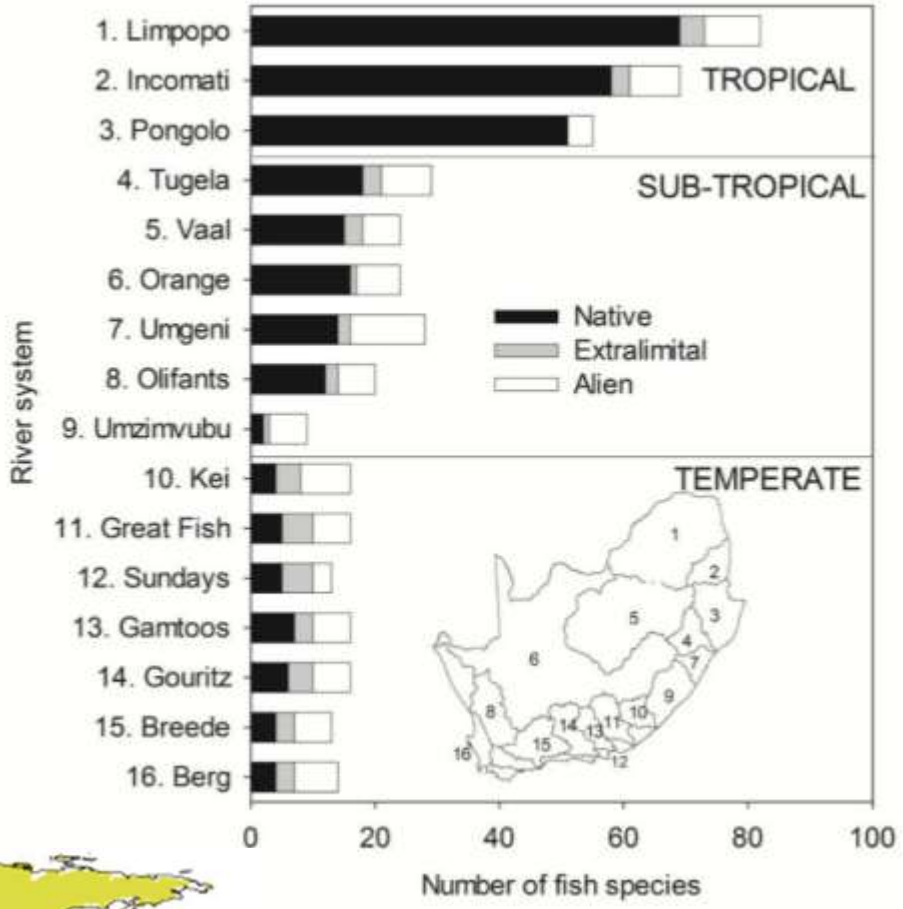


Long history of introductions e.g., fish



Status

- Occur in all major drainages.
- Multiple impacts
  - Predation and competition
  - Habitat alteration
  - Disease transfer
  - Hybridization



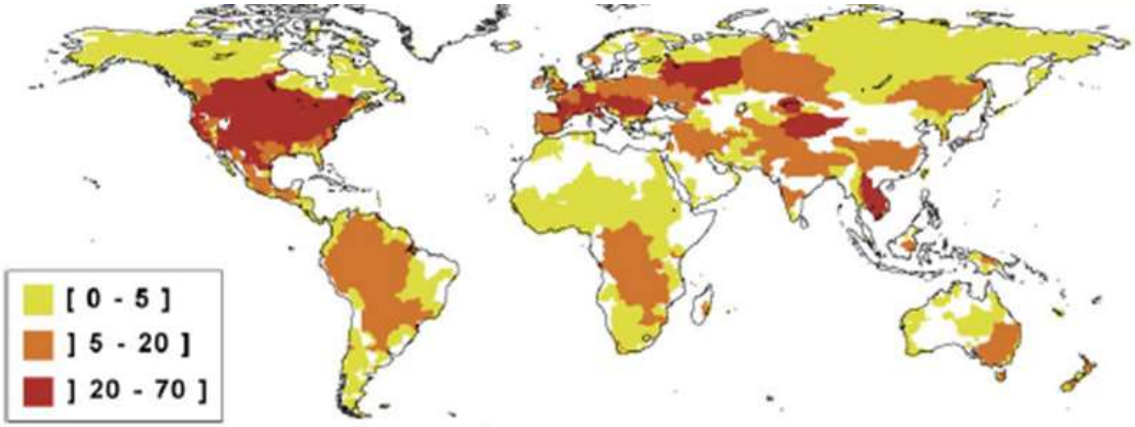


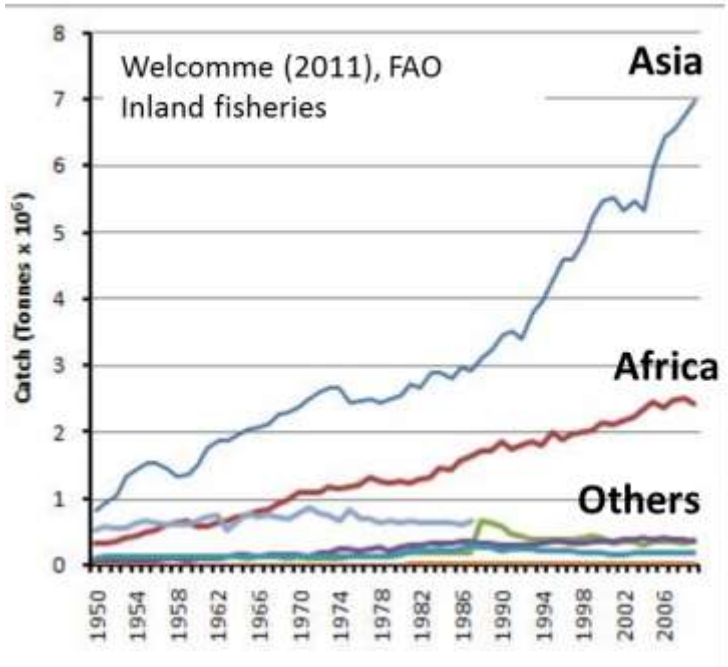
Figure 1. Worldwide Distribution of Non-Native Freshwater Fish

Source: Leprieur et al. 2008, Van Rensberg et al., 2011.

Considerations

- Africa is poor and food insecure.
- Population ca. 900 million.
- >200 million people are undernourished.
- Most are dependent on natural resources and agriculture.
- Enormous pressure to develop strategies to address National Policy objectives linked to **food security, unemployment and economic growth.**

“Inland fisheries more than ever before, are central in creating jobs and providing food for millions on the continent of Africa” (UN News Serving, 2014).

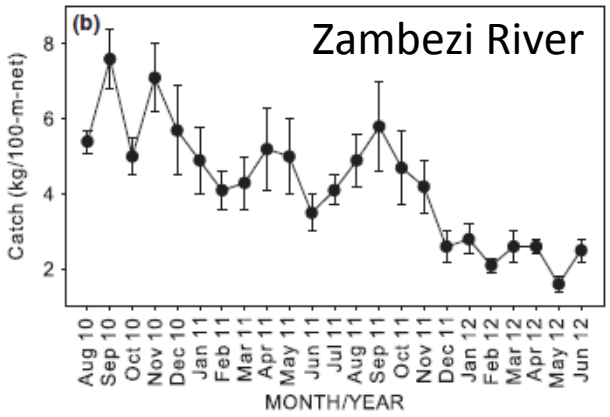


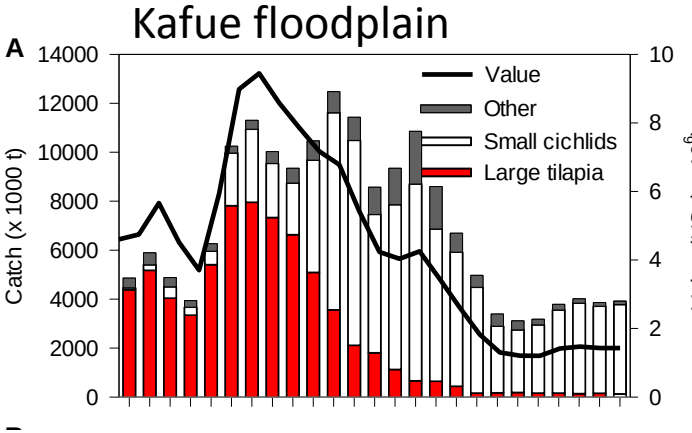
Fisheries Management and Ecology

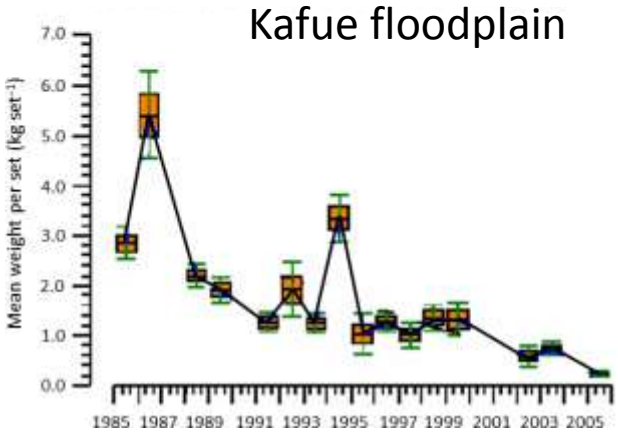
Fisheries Management and Ecology, 2015, 22, 99–111

Challenges in fisheries management in the Zambezi, one of the great rivers of Africa

- Almost all fisheries have experienced severe declines in catch rates and have lost larger, more valuable, fish species.
- Excessive fishing effort by an ever increasing population.
- Increased the use of environmentally damaging gears to keep up with decreasing fish size.



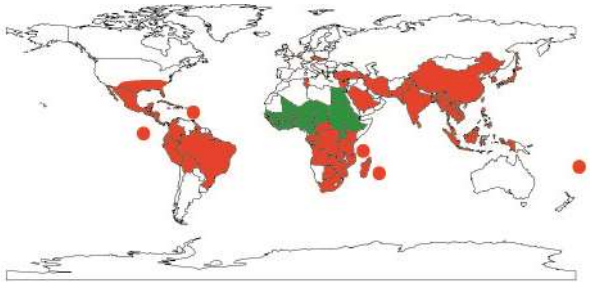




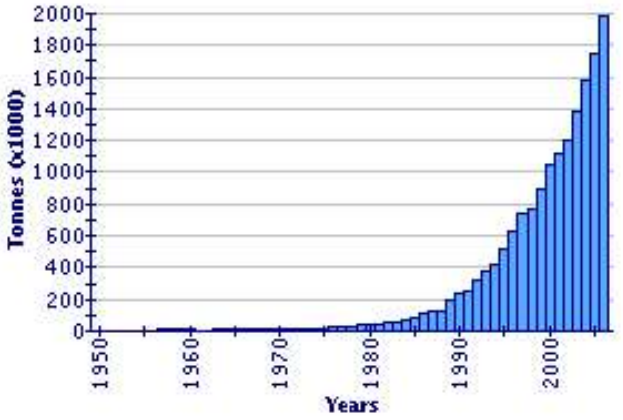
Constant search for new fisheries and aquaculture opportunities

Many are based on conflict species that provide benefits but also pose serious threats to biodiversity

Nile tilapia
Oreochromis niloticus



- Essential for effective tilapia culture
  - Desirable as a food fish (white flesh, neutral taste and firm texture).
  - Tolerate crowding; relatively poor water quality
  - Low susceptibility to disease.
  - Eat algae and detritus produced naturally as well as artificial feeds containing ingredients derived from plants.
  - Reach market size 600-800g < 1 year under optimum conditions.



Large scale


fresh
never frozen
2 TILAPIA
FILLETS
No skin, no bone
From the waters of Lake Cariba in Zimbabwe, delicate flavoured firm white fillets ready to cook.
ZIMBABWE
220g
24 JUN
£3.99
Lake Harvest


Tilapia
Raised in Lake Kariba
Tilapia
Tilapia

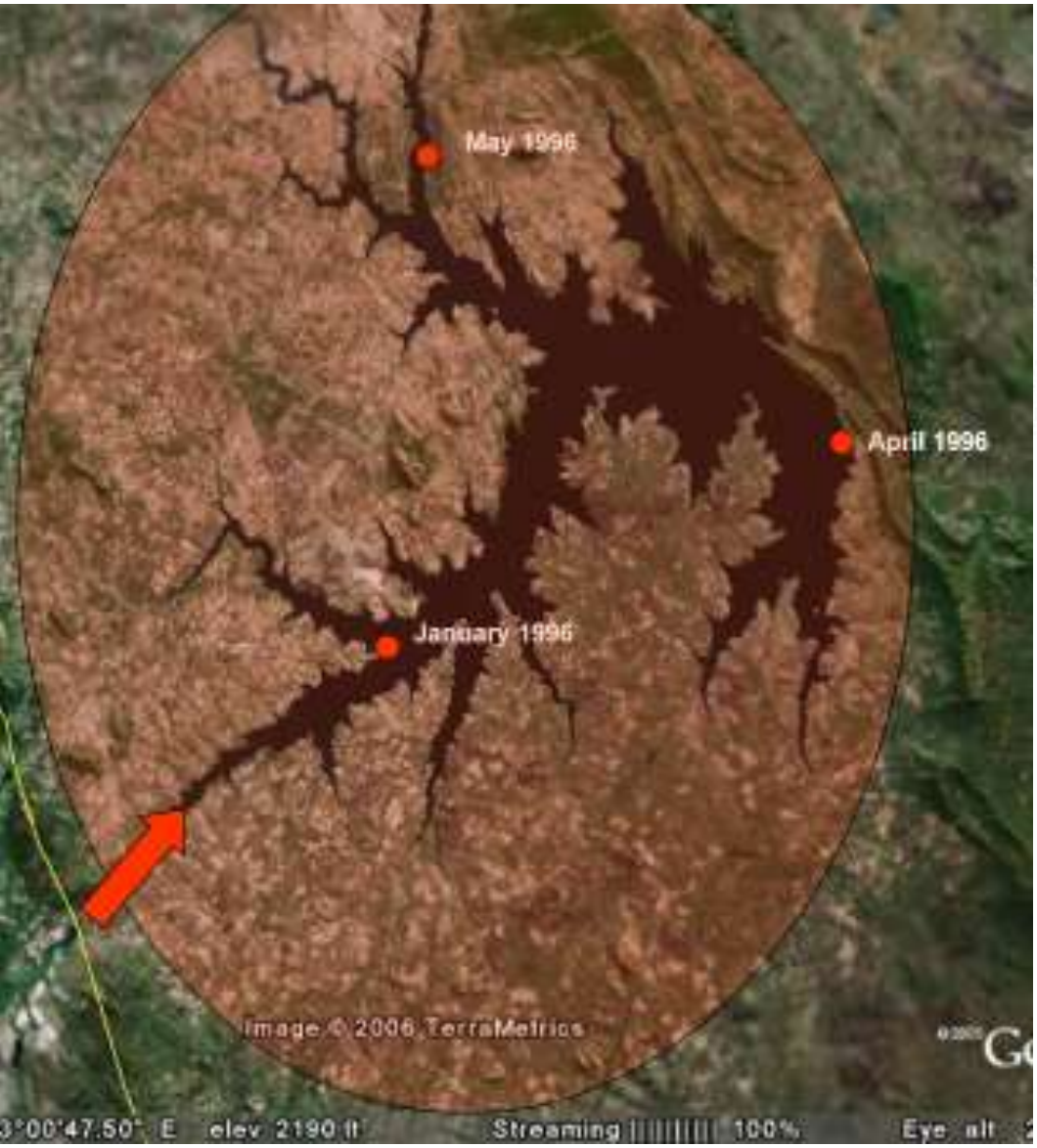
- Fee fishing
- Live-bait

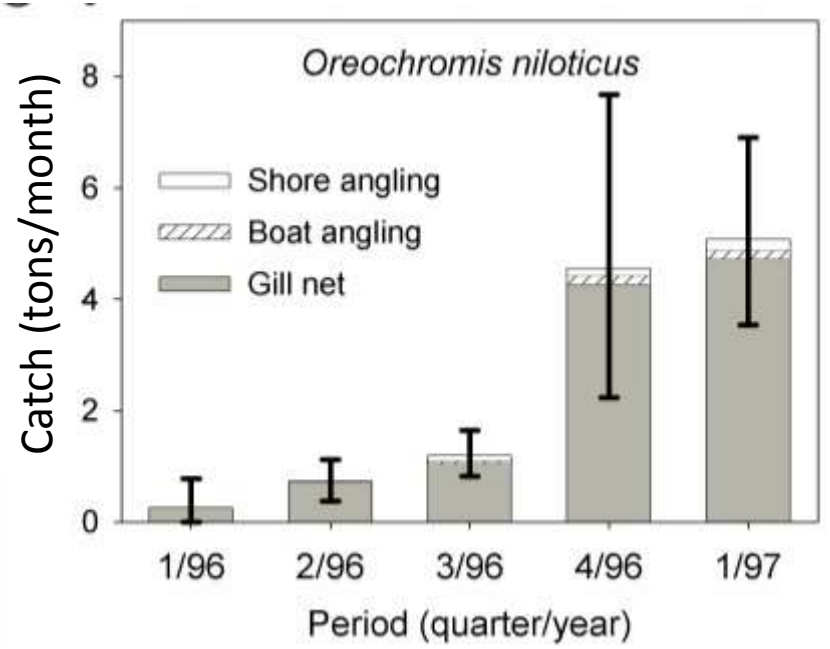
Escape & establishment are inevitable

AQUATIC CONSERVATION: MARINE AND FRESHWATER ECOSYSTEMS
Aquat. Conserv: Mar. Freshw. Ecosyst. 18: 939–951 (2008)
Published online 26 September 2007 in Wiley InterScience
(www.interscience.wiley.com) DOI: 10.1002/aqc.897

Rapid invasion of a subtropical lake fishery in central Mozambique by Nile tilapia*, Oreochromis niloticus *(Pisces: Cichlidae)

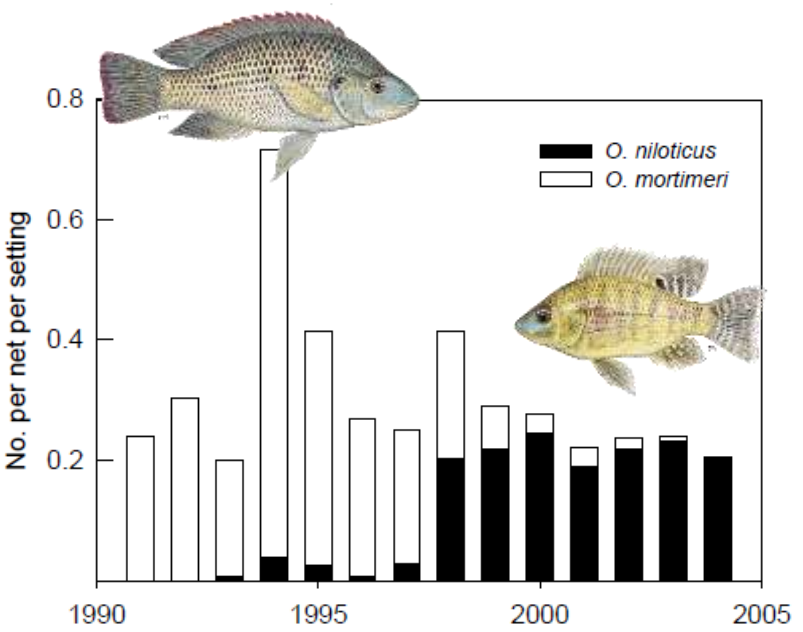
OLAF L.F. WEYL*
Department of Ichthyology and Fisheries Science, Rhodes University, PO Box 94, Grahamstown 6140, South Africa





Impacts

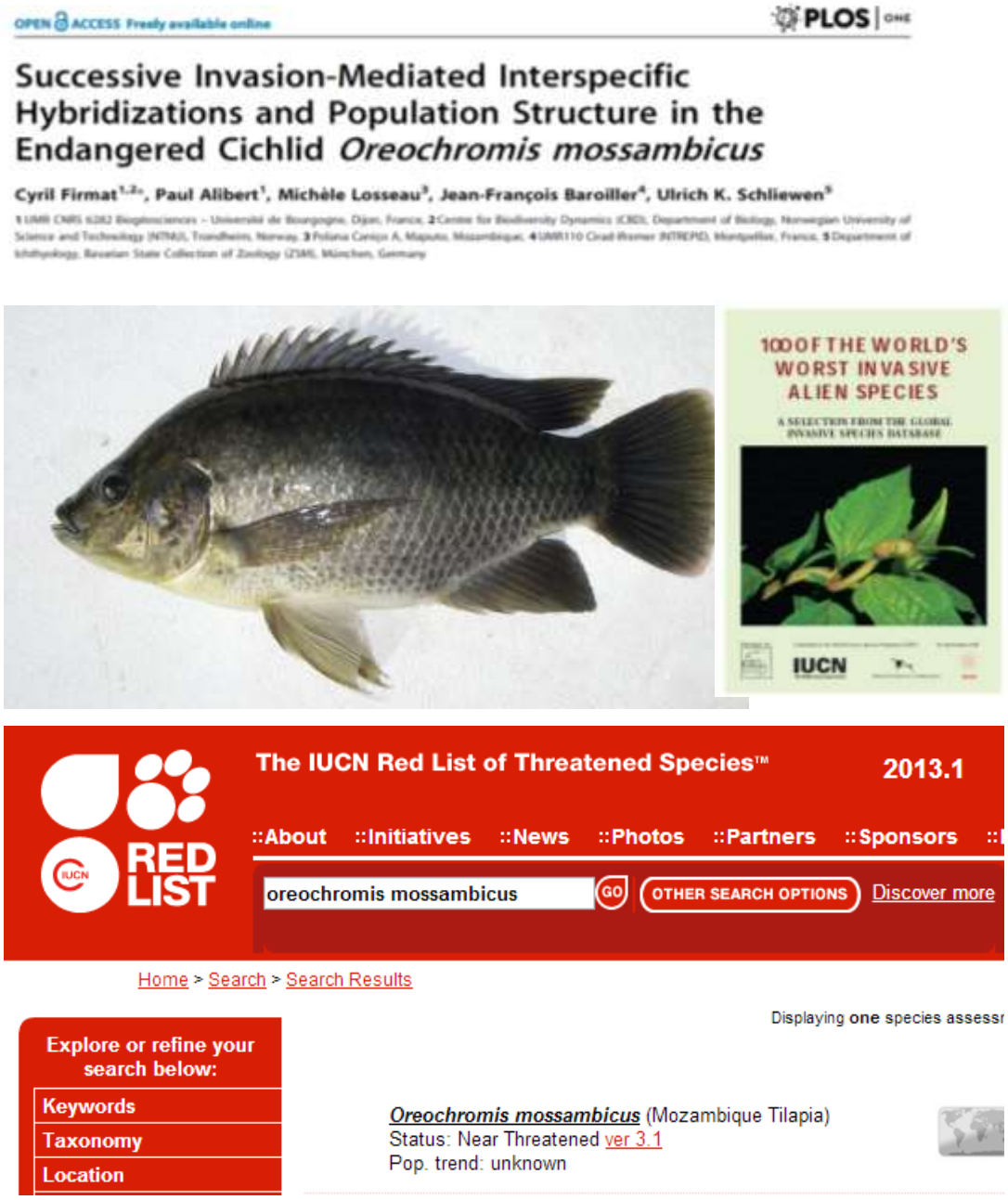
- Lake Kariba, Zimbabwe
  - Total replacement of native Kariba Tilapia O*reochromis mortermeri*
  - No decline in catch rate.



- Lake Victoria
  - Caused extinction of 2 native tilapias *Oreochromis esculentis* and *O. variabilis*
  - Increased tilapiine catch by 25%

Hybridisation

- Main threat
- Genetic pollution is a one-way and irreversible process.
- Southern Africa
  - Native Mozambique tilapia *Oreochromis mossambicus* are declining
- Competition for breeding space and sneaking may also be mechanisms



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Article

Broad Niche Overlap between Invasive Nile Tilapia *Oreochromis niloticus* and Indigenous Congenerics in Southern Africa: Should We be Concerned?

Tsungai A. Zengeya [1,2,*], Anthony J. Booth [2] and Christian T. Chimimba [3]

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Academic Editor: Nathaniel A. Brunsell

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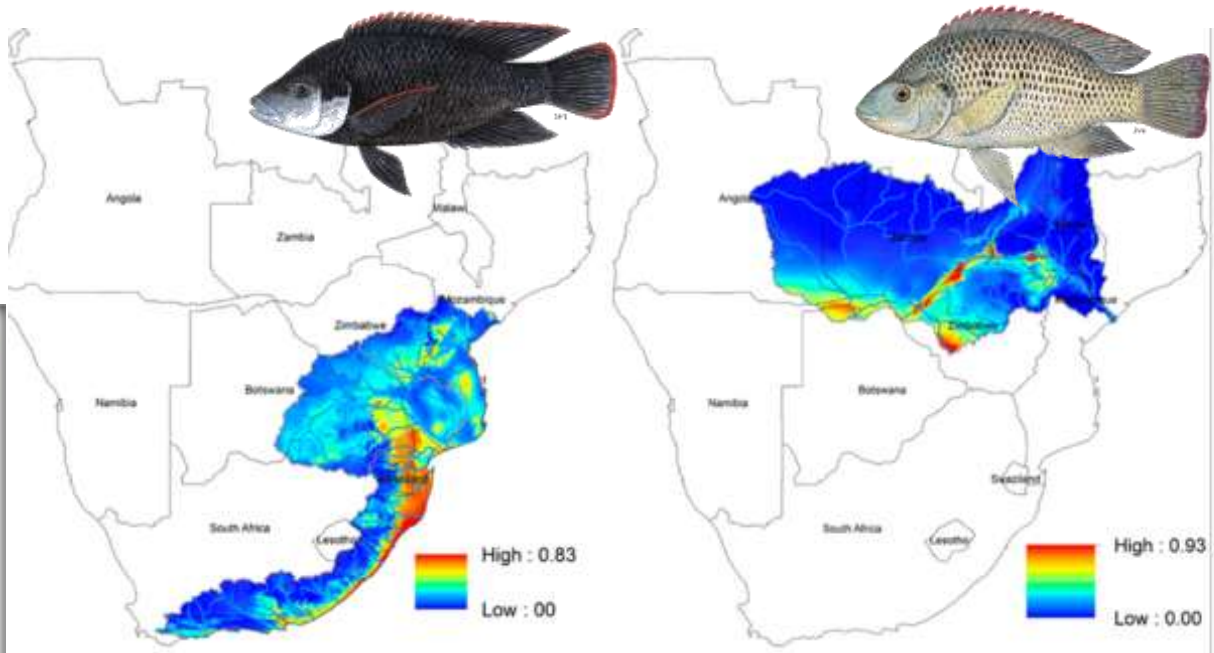
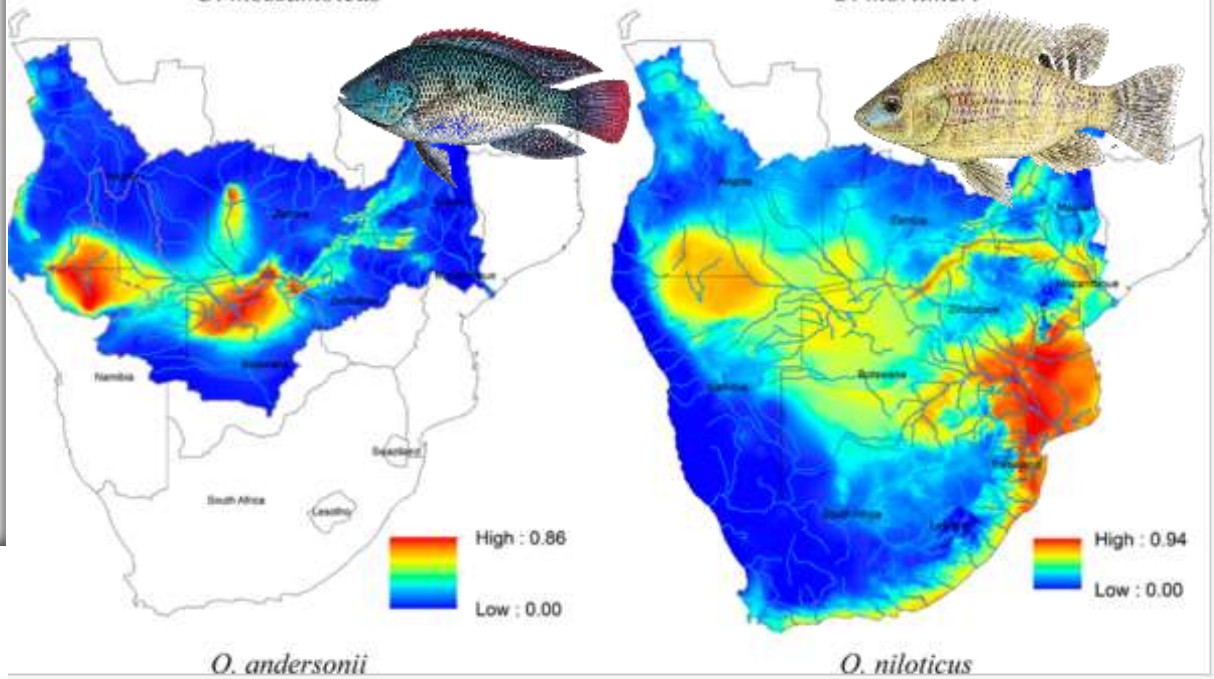
Abstract: This study developed niche models for the native ranges of *Oreochromis andersonii*, *O. mortimeri*, and *O. mossambicus*, and assessed how much of their range is climatically suitable for the establishment of *O. niloticus*, and then reviewed the conservation implications for indigenous congenerics as a result of overlap with *O. niloticus* based on documented congeneric interactions. The predicted potential geographical range of *O. niloticus* reveals a broad climatic suitability over most of southern Africa and overlaps with all the endemic congenerics. This is of major conservation concern because six of the eight river systems predicted to be suitable for *O. niloticus* have already been invaded and now support established populations. *Oreochromis niloticus* has been implicated in reducing the abundance of indigenous species through competitive exclusion and hybridisation. Despite these well-documented adverse ecological effects, *O. niloticus* remains one of the most widely cultured and propagated fish species in aquaculture and stock enhancements in the southern Africa sub-region. Aquaculture is perceived as a means of protein security, poverty alleviation, and economic development and, as such, any future decisions on its introduction will be based on the trade-off between





Disease Vector

Epizootic Ulceritic Syndrome EUS

Aphanomyces invadans

Epizootic ulcerative syndrome: Exotic fish disease threatens Africa's aquatic ecosystems

Authors:
Karl D.A. Huchzermeyer[1,2]
Benjamin C.W. van der Waal[3]

Affiliations:
[1]Sterkspruit Veterinary Clinic, Lydenburg, South Africa

TABLE 1: List of fish species with presumptive macroscopic lesions of epizootic ulcerative syndrome collected in Caprivi from February 2007 to October 2008.

Scientific name	Common name
Marcusenius macrolepidotus	Northern bulldog
Petrocephalus catostoma	Churchill
Brycinus lateralis	Striped robber
Micral	
Hydro	
Hepsetus odoe	African pike
Barbus poechii	Dashtail barb
Barbus paludinosus	Straightfin barb

24 species and counting

- Pathogenic water mould of fish that shows little host specificity.
- Introduced into upper Zambezi most likely in association with Nile tilapia (asymptomatic carriers) for smallholder aquaculture in Zambia
- 2006 reported for the first time in Africa and is spreading rapidly:
  - 2006 upper Zambezi & Chobe Rivers in Botswana.
  - 2010 Okavango Delta in Botswana
  - 2011 South Africa
  - 2012 Zimbabwe

Research Papers

Nile tilapia invades the Lake Malawi catchment

DOI: 10.2989/16085914.2013.842157

MJ Genner[a*], E Connell[a], A Shechonge[b], A Smith[c], J Swanstrom[a], S Mzighani[d], A Mwijage[d], BP Ngatunga[d] & GF Turner[b]

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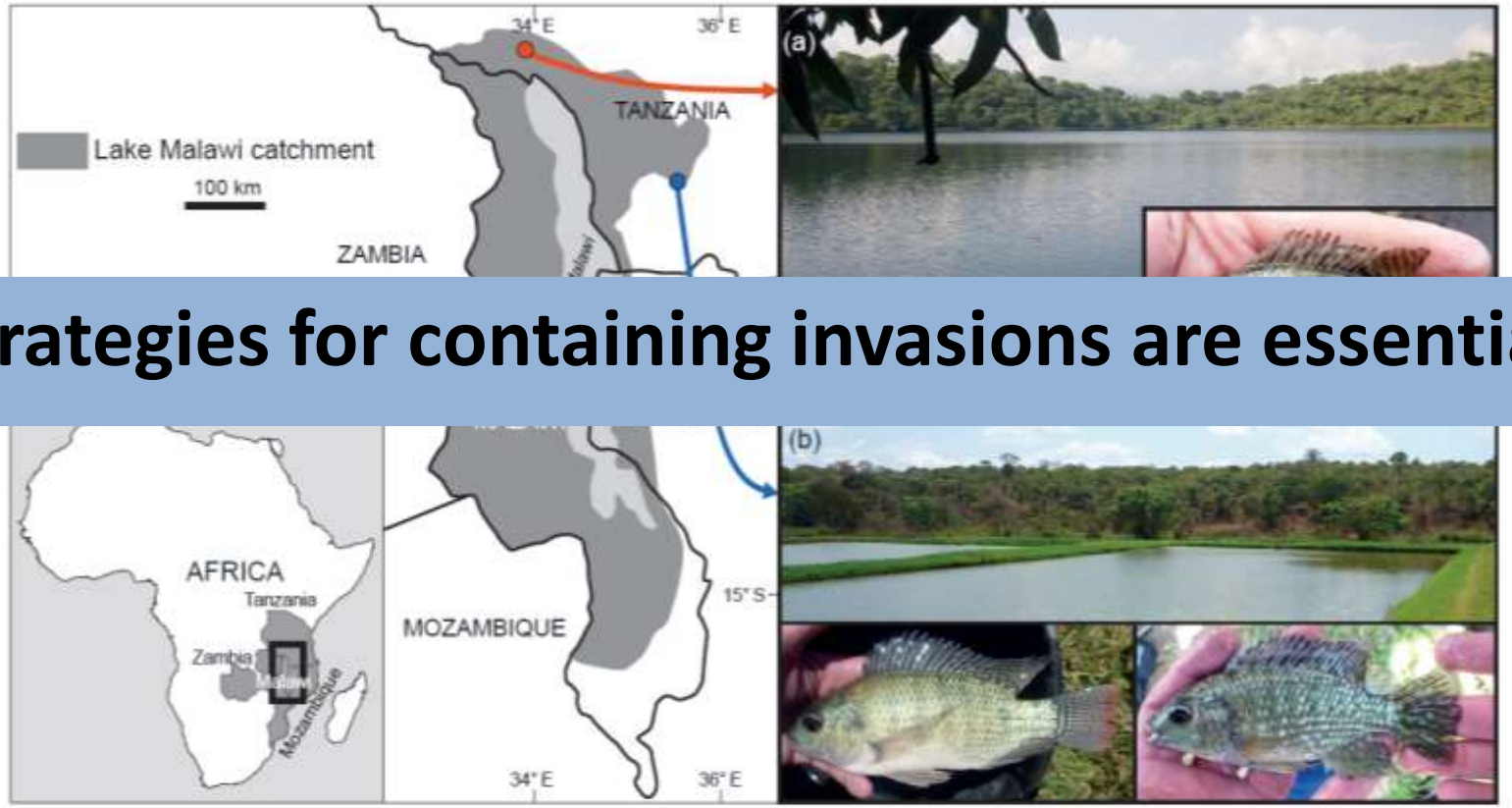


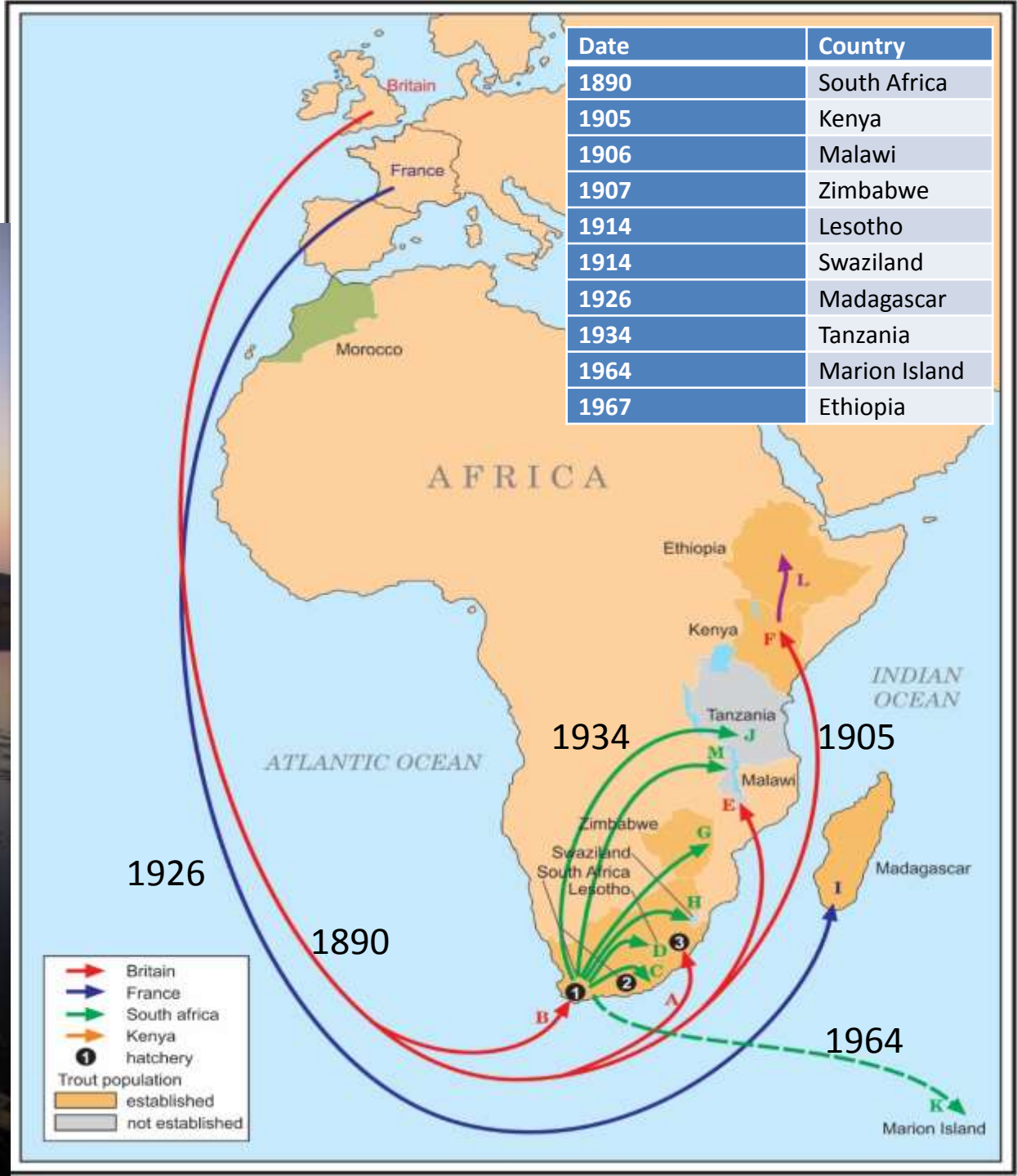
Strategies for containing invasions are essential

Figure 1: Catchment of Lake Malawi, with coloured circles indicating sites where invasive *Oreochromis* have been recorded: (a) Lake Itamba, where *O. niloticus* (inset) was collected during July and November 2011; (b) aquaculture ponds near Songea where *O. niloticus* (inset left) and *O. leucostictus* (inset right) were collected in September 2012

Trout in SA

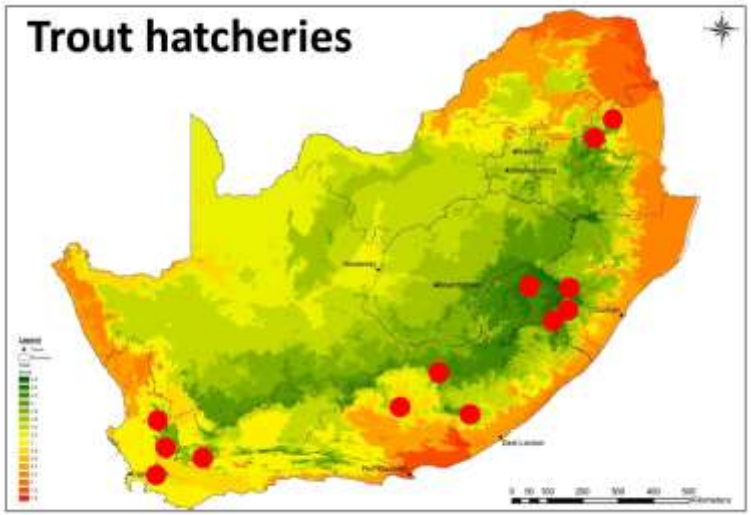
(Rainbow and Brown)

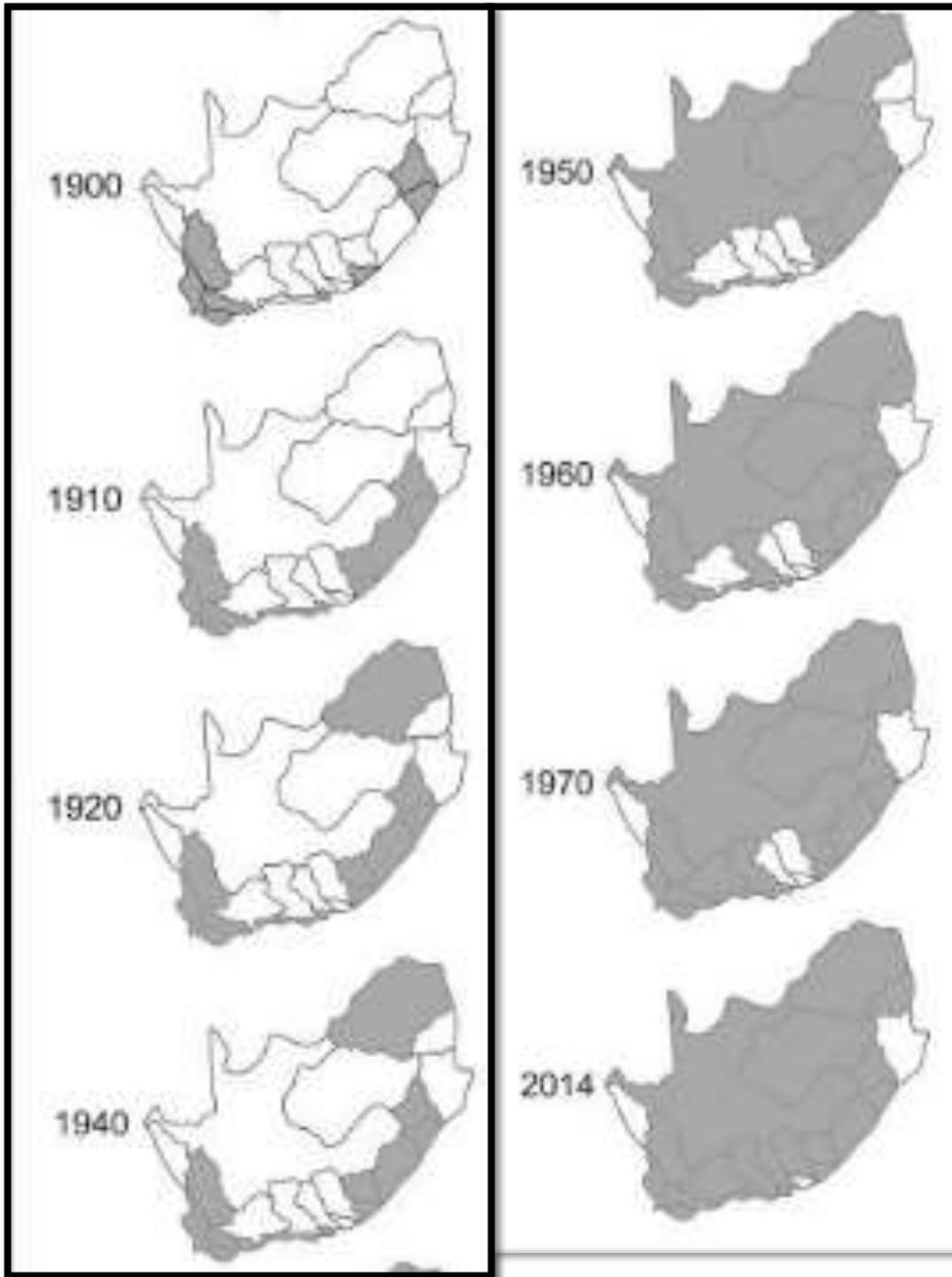
Date	Country
1890	South Africa
1905	Kenya
1906	Malawi
1907	Zimbabwe
1914	Lesotho
1914	Swaziland
1926	Madagascar
1934	Tanzania
1964	Marion Island
1967	Ethiopia



Rapid spread

- Government stocking programmes aided by Piscatorial Societies.
- 1947 Protected by law.
- Managed by Nature Conservation





1970s – Conservation staff began reporting impacts!

> *"What was very apparent, however, was that nowhere where there was an established population of exotics could endemic species be found"* (Gaigher 1973; p76)

Observations were later coroborated

Predatory impact of non-native rainbow trout on endemic fish populations in headwater streams in the Cape Floristic Region of South Africa

Jeremy M. Shelton · Michael J. Samways · Jenny A. Day

ORIGINAL PAPER

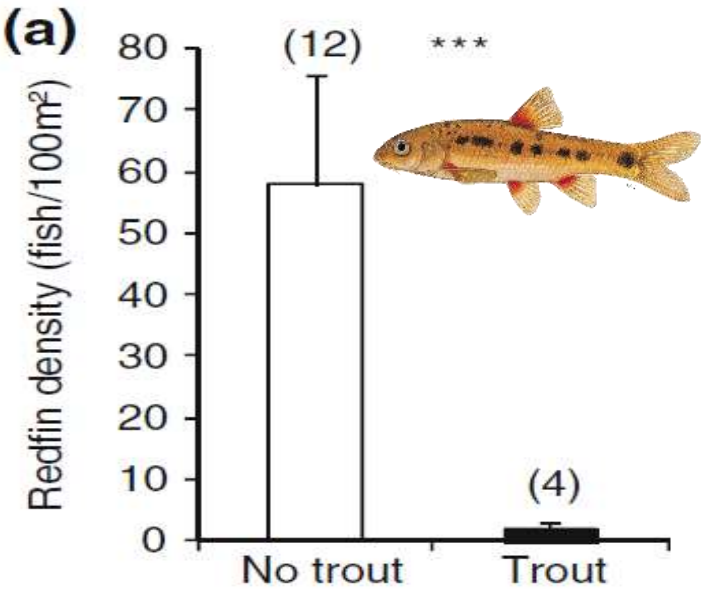
Influence of waterfalls on patterns of association between trout and Natal cascade frog *Hadromophryne natalensis* tadpoles in two headwater streams in the uKhahlamba Drakensberg Park World Heritage Site, South Africa

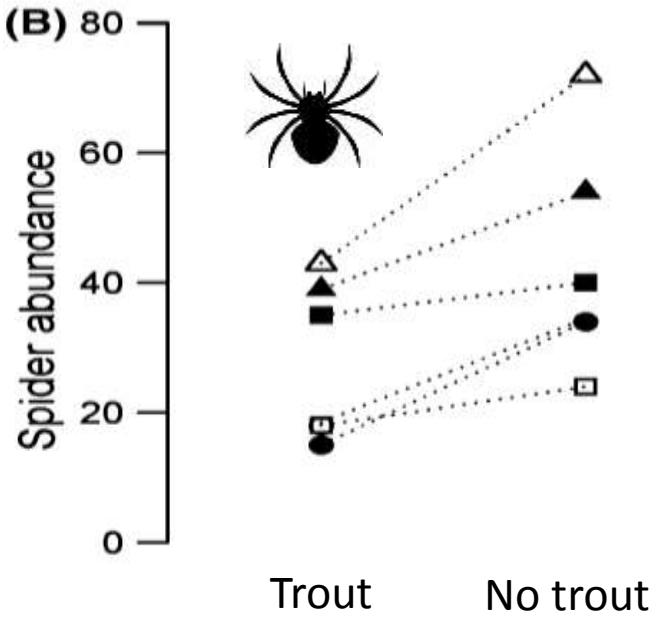
Impacts of trout on aquatic macroinvertebrates in three Drakensberg rivers in KwaZulu-Natal, South Africa

Ecology and Evolution

Open Access

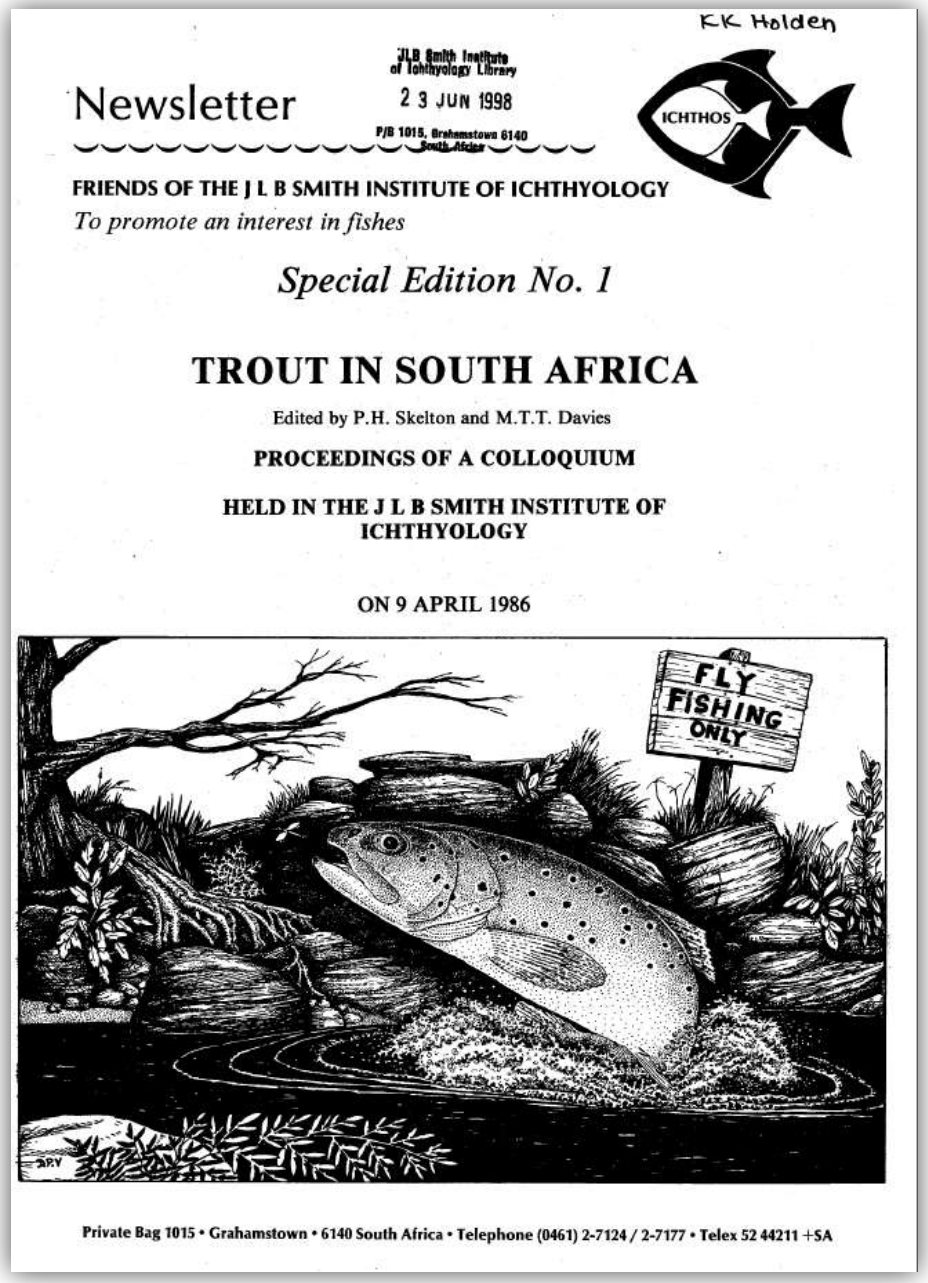
Trophic overlap between fish and riparian spiders: potential impacts of an invasive fish on terrestrial consumers





National colloquium (1986)

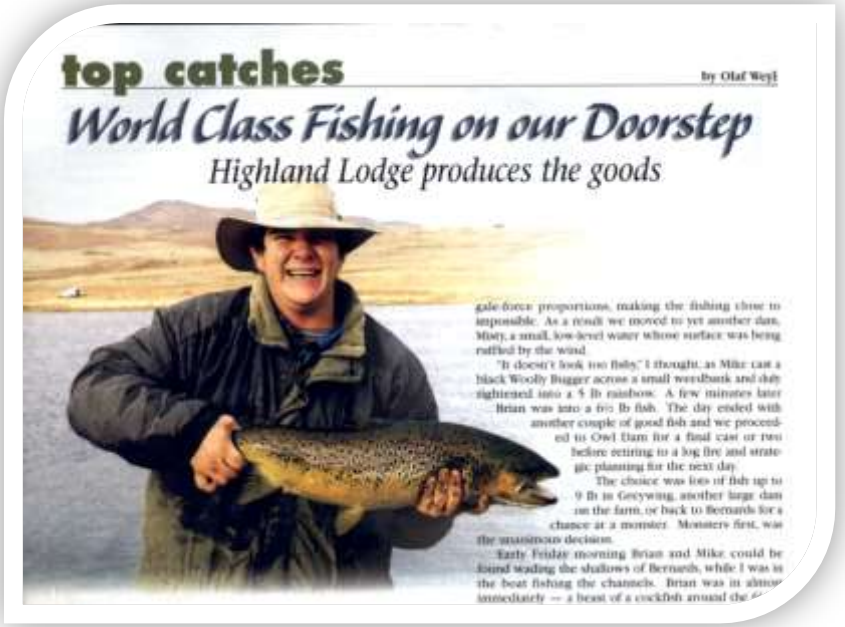
- Conservation departments announced their decision to wind down their role in sport fisheries.
- Federation of South African Flyfishers was formed to protect trout interests.
- State hatcheries stopped alien fish production by 1990.
- This role was taken up by private concerns and even some academic institutions.
- No protection for alien sport fishes.
- Some Departments devolved power to angling organisations such as the Cape Piscatorial Society.




HIGHLANDS
TROUT
Advance Africa
Lesotho and South Africa Produce
ca. 3000 tons/year

Recreational angling

- 1.5 million recreational anglers.
- Economic impact = US $ 500 million/year. Bigger than rugby and cricket (Leibold and Van Zyl 2000)
- Examples of support to rural economies e.g., “ In Rhodes Village EC (pop. 600 people) 85 people are employed by the trout fishery” (DuPreez & Lee, 2010), make politicians happy


top catches

by Olaf Weyl

World Class Fishing on our Doorstep

Highland Lodge produces the goods

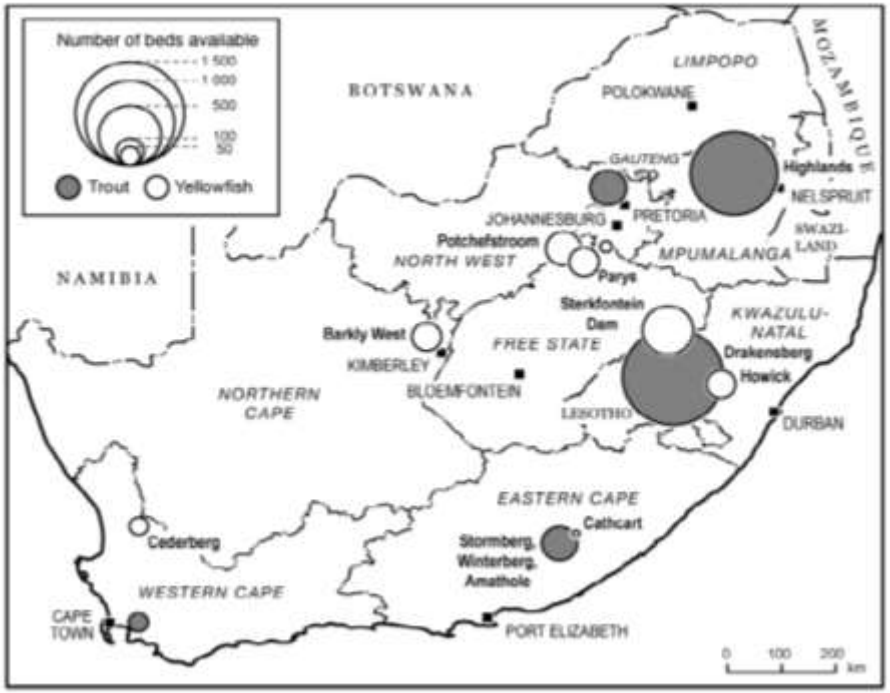
gale-force proportions, making the fishing close to impossible. As a result we moved to yet another dam, Misty, a small, low-level water whose surface was being ruffled by the wind.

"It doesn't look too fishy," I thought, as Mike cast a black Woolly Bugger across a small weedbank and duly tightened into a 5 lb rainbow. A few minutes later Brian was into a 6½ lb fish. The day ended with another couple of good fish and we proceeded to Owl Dam for a final cast or two before retiring to a log fire and strategic planning for the next day.

The choice was lots of fish up to 9 lb in Greywing, another large dam on the farm, or back to Bernards for a chance at a monster. Monsters first, was the unanimous decision.

Early Friday morning Brian and Mike could be found wading the shallows of Bernards, while I was in the boat fishing the channels. Brian was in almost immediately — a beast of a cockfish around the

Figure 1: Bed nights available for trout and yellowfish fly-fishing in South Africa



Amatola Wild Trout Flyfishing wins SEED Award

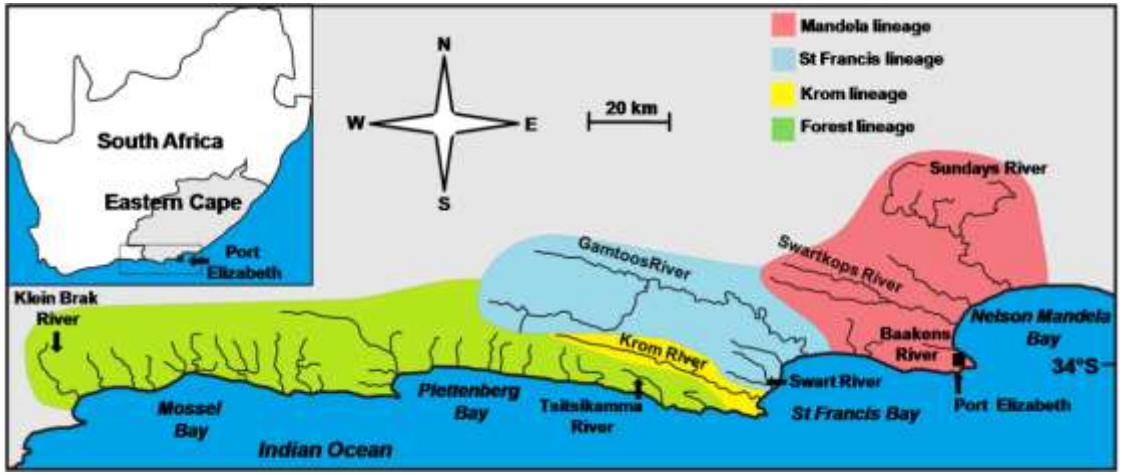
SEED Awards 2010 WINNER

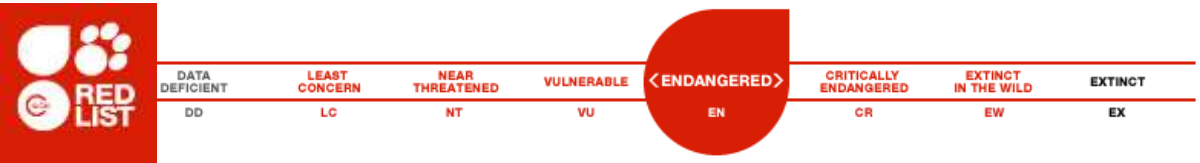
The SEED Initiative identifies and supports promising small-scale social and environmental entrepreneurs around the globe, entrepreneurs that while working towards a greener economy also tackle poverty, marginalisation and social exclusion.

Click here for more info >>

Conservation concerns

- Endemic, diverse, isolated, range restricted, endangered.
- Multiple threats including pollution, habitat destruction and AIS.
- Last strongholds are headwater streams.





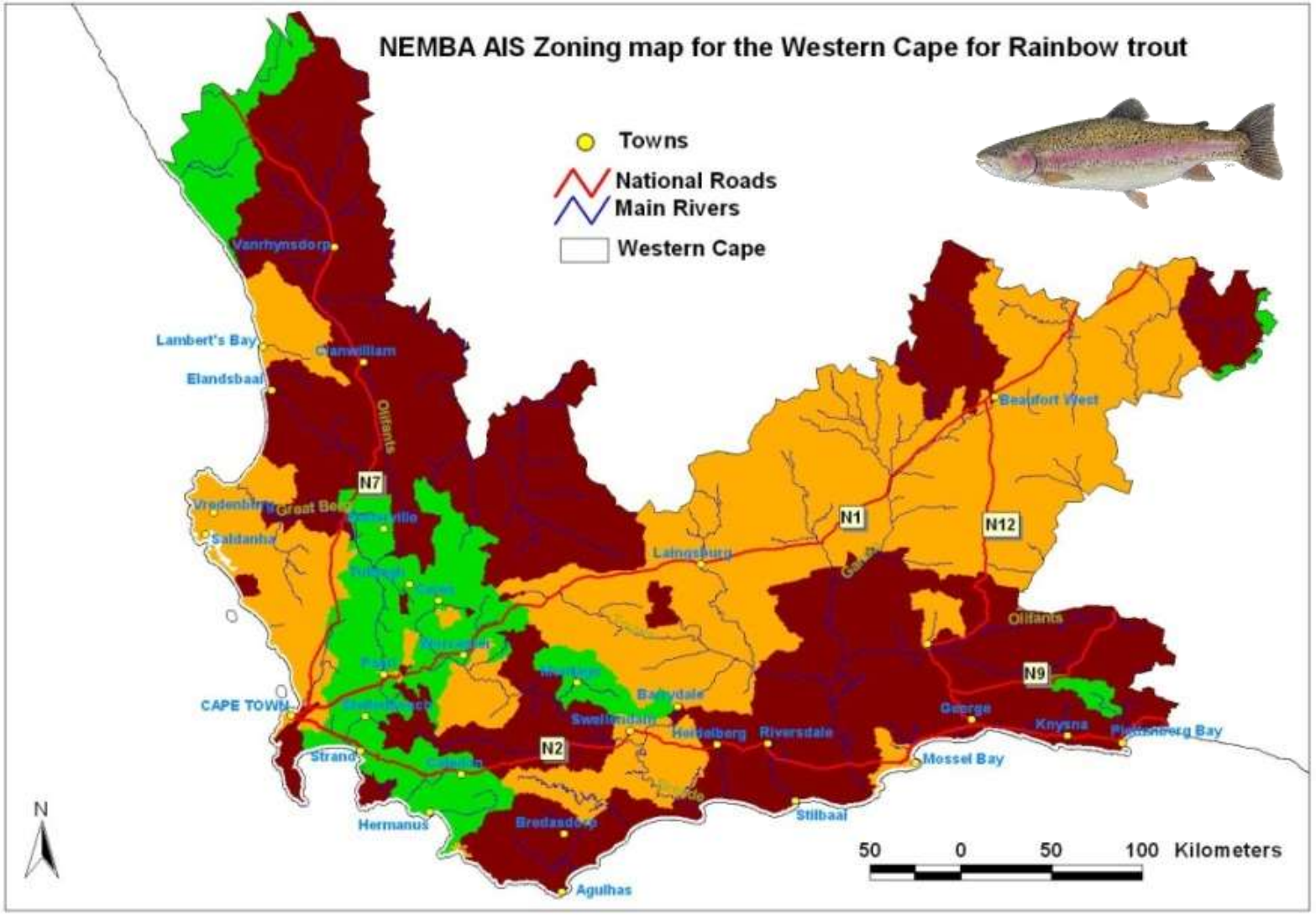
South Africa's Invasive Species Regulations

- **AIS are part of South Africa's policy and legislative framework for biodiversity**
  - The National Environmental Management: Biodiversity Act (Act 10 of 2004).

CONTENTS · INHOUD

Conflict species regulated by area (2009)

SANBI
Biodiversity for Life
South African National Biodiversity Institute



Aquaculture facilities, angling organizations and tourism operators.

- Legislation was overly restrictive.
- Strategy was to get trout de-listed as an AIS.
  - Solicit support from various constituencies.
  - Attack the Department of Environmental Affairs (DEA) decision on all fronts while building a case for the benefits trout had to offer.
  - Get the Department of Agriculture Fisheries and Forestry (DAFF) to realise that the DEAs policy was destructive of its plans for the aquaculture industry.

The Survival of Trout in South Africa

Do you know that if the proposed alien and invasive species regulations under the current NEM:BA legislation becomes law, you could be at risk of criminal prosecution if caught fishing for trout without a permit? Ian Cox looks at the facts and says it is an attack on the constitutional rights of every South African.

Trout SA

Do you know that if the proposed alien and invasive species regulations under the current NEM:BA legislation becomes law, you could be at risk of criminal prosecution if caught fishing for trout without a permit? Ian Cox looks at the facts and says it is an attack on the constitutional rights of every South African.

species occurring on their land.

• Section 75 says that the methods employed to control and eradicate a listed invasive species must also be directed at the offspring, propagating material and regrowth of such invasive species in order to prevent such species from producing offspring.

• Furthermore, lest there is any doubt, the term "control" is defined in NEM:BA as meaning to combat or eradicate an invasive species or, if that is not possible, to

The old regime mind-set that pervades the DEA prevents it from being able to get its mind around the fact that NEM:BA is a human rights legislation. NEM:BA is not aimed at protecting biodiversity for its own sake. Our environmental laws look at environmental impacts in terms of the effect they have on human health and wellbeing. The environment as it is understood in law is not the world devoid of human beings; it is an anthropocentric term that sees the environment as it affects human beings.

TROUT, WITCHES, & MONTY PYTHON

Exploring the thinking behind attempts to eradicate trout in South Africa

By Ian Cox and Ilan Lax

YOU'VE probably heard the old saying, "If it looks like a duck, swims like a duck and quacks like a duck, then it probably is a duck." However, it has a counterpart invented by Monty Python to parody the application of science in law; it ends something like this: "If you can contrive that she weighs the same as a duck she's made of wood and is therefore a witch."

The skit had to do with the belief that prevailed in the middle ages that you could determine truth through a process of trial by ordeal. It sounds absurd now, but back then people really believed that trial by ordeal was a scientific way of proving guilt.

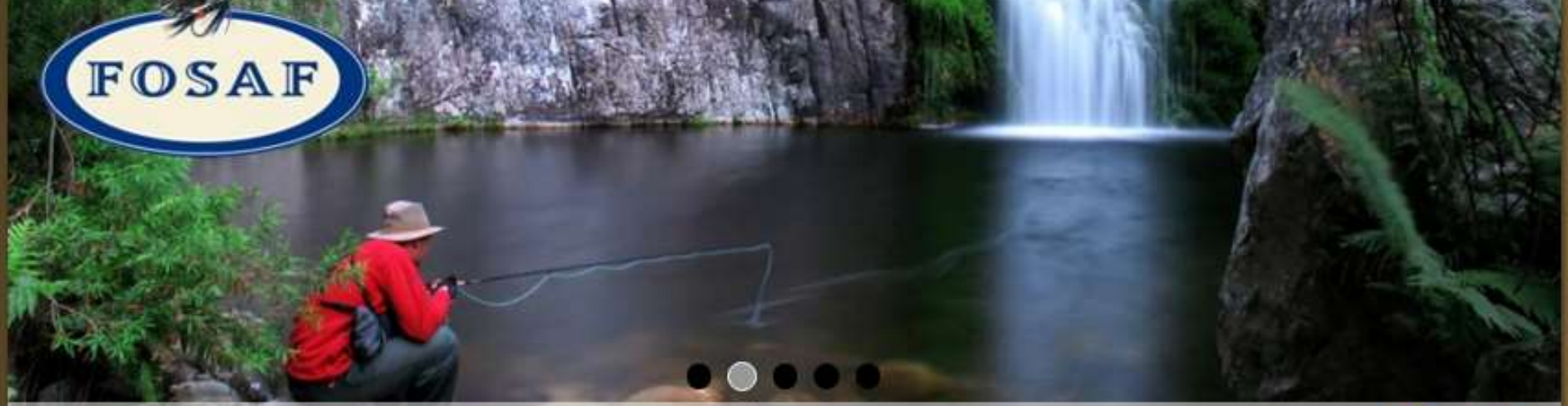
The point Monty Python makes which is still relevant today, is that one must not assume that science is infallible; the opposite is in fact true. Science is valuable, but it is not infallible. Scientists know this and therefore continue to question the validity of scientific "facts" in the search for truth. So, for example, it is normal for scientists to tell you that the consumption of red wine and animal fats is unhealthy, only to later change their minds. Science is inherently uncertain. This is especially true of the very new field of environmental science.

The opposite is true of law. Laws must be certain otherwise they don't work. Effective law making requires a cautious approach, even to rapid change. Law-makers have learnt that it is wise to let things settle down before rushing in with new laws lest people fall victim to the unintended consequences of hastily conceived laws. Unfortunately the science-based environmental law-making in South Africa and freshwater aquatic scientists believe that trout, and indeed all of South Africa's alien freshwater fish species, do not belong in this country.

It is not a good thing to be called an alien. The word alien is commonly used to describe foreigners or something that is unfamiliar, disturbing or distasteful. Being alien implies that you do not belong. We instinctively react defensively and cautiously towards aliens, especially in South Africa where we were conditioned to discriminate against people and things that are different. It is generally accepted that our future as a nation lies in us fighting off this conditioning. We must engage in South Africa is that most agricultural species have conveniently been listed as "exempt aliens".

The trouble is that when you attack alien species by making their possession or use unlawful, you also attack human beings who possess and use them and, by extension, the basic constitutional right we enjoy to freedom, equality and dignity. This attack is the antithesis of the constitutional values upon which we are trying to build our nation.

> Xenophobia, even bio-xenophobia, should have no place in South Africa, yet extreme notions of "alienness" influence environmental thinking in this country. As far as we can ascertain,



FOSAF NEWS - SUMMARY OF SUBMISSIONS MADE BY ON BEHALF OF TROUT SOUTH AFRICA (TROUT SA) AND THE FEDERATION OF SOUTHERN AFRICAN FLY FISHERS (FOSAF) ON THE PROPOSED AMENDMENTS TO PART 2 OF CHAPTER 5 OF THE NATIONAL ENVIRONMENTAL MANAGEMENT BIODIVESRITY ACT, 2004 (NEMBA)

1. The President and our government have declared that growing South Africa's aquaculture sector is a strategic project that is vital to improving South Africa food security and growing the economy. Trout production is presently South Africa's largest aquaculture industry measured by volume and the second largest when measured by value. This industry moreover supports the valuable trout tourism and recreational fishing value chain that in turn contributes significantly to the economies of areas where trout occur in South Africa.

2. Operation Phakisa is intended to achieve this goal. The trout value chain spearheaded by Trout SA is working hard to give effect to operation Phakisa. However these efforts are being frustrated by the Department of Environmental Affairs (DEA) and some scientists employed at the South African Institute of Aquatic Biodiversity (SAIAB) who believe that fresh water aquaculture is harmful to South Africa's biodiversity. They are working hard to make it difficult if not impossible to engage in fresh water aquaculture. These efforts and their belief that trout are invasive are placing the trout value chain and the economies the communities this value chain supports at risk.

GENERAL NOTICES

NOTICE 78 OF 2014

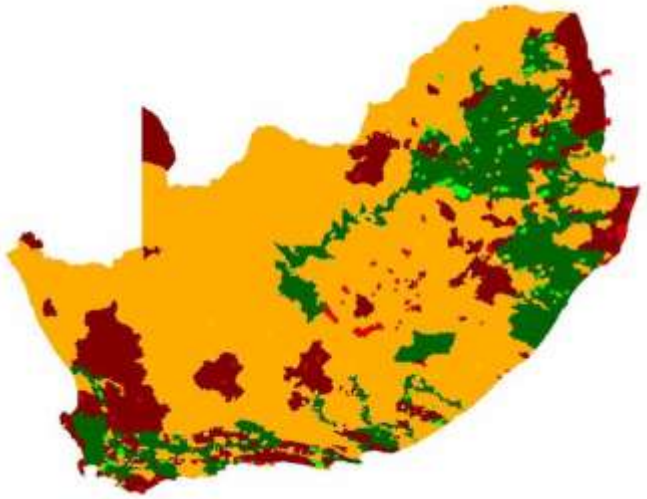
DEPARTMENT OF ENVIRONMENTAL AFFAIRS

NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY ACT 2004 (ACT NO, 10 OF 2004)
DRAFT ALIEN AND INVASIVE SPECIES LISTS, 2014

Trout are (temporarily) de-listed as invasive species

2016 – Meeting between the Director Generals of the DEA, DAFF and representatives of Trout SA and FOSAF.

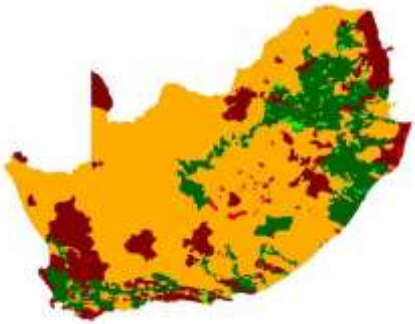
- It was agreed at that meeting that:
  - The management of the regulation of trout be devolved to DAFF.
  - DEA, DAFF and Trout SA will cooperate to establish a self-regulatory system for the management of the movement and stocking of trout.
  - The mapping of trout will be finalised by DEA and Trout SA.
  - Trout will not be listed as invasive in areas where they were deemed to already occur.



http://www.fosaf.org.za/read-Current-165.php

Did we loose?

- Not really – we are getting there!
- **Conservation priorities** in South Africa are headwater streams.
- **Conflicts are unavoidable.** Trout SA has now taken ownership of the process and we are well on our way to find resolution.
- Economic arguments are politically powerful and trump environmental concerns. **We cut our losses** conceding areas already invaded**.**
- **Need to be careful when setting priority areas for native fish conservation.**
- Mapping approach has gained acceptance and continued engagement is essential.
- Experiences gained from the trout process will hopefully help with mapping of other sport fishes (Bass & Carp) and aquaculture species (Nile Tilapia and Red Claw Crayfish)!



Thanks

science & technology
Department:
Science and Technology
REPUBLIC OF SOUTH AFRICA

MEIA
Manitoba Environmental Industries Association

Invasive Species Centre

C•I•B
DST-NRF Centre of Excellence for Invasion Biology

NRF National Research Foundation
SAIAB South African Institute for Aquatic Biodiversity