

# Detection and deterrence of fish mislabelling in South Africa

– Harnessing the power of DNA Barcoding

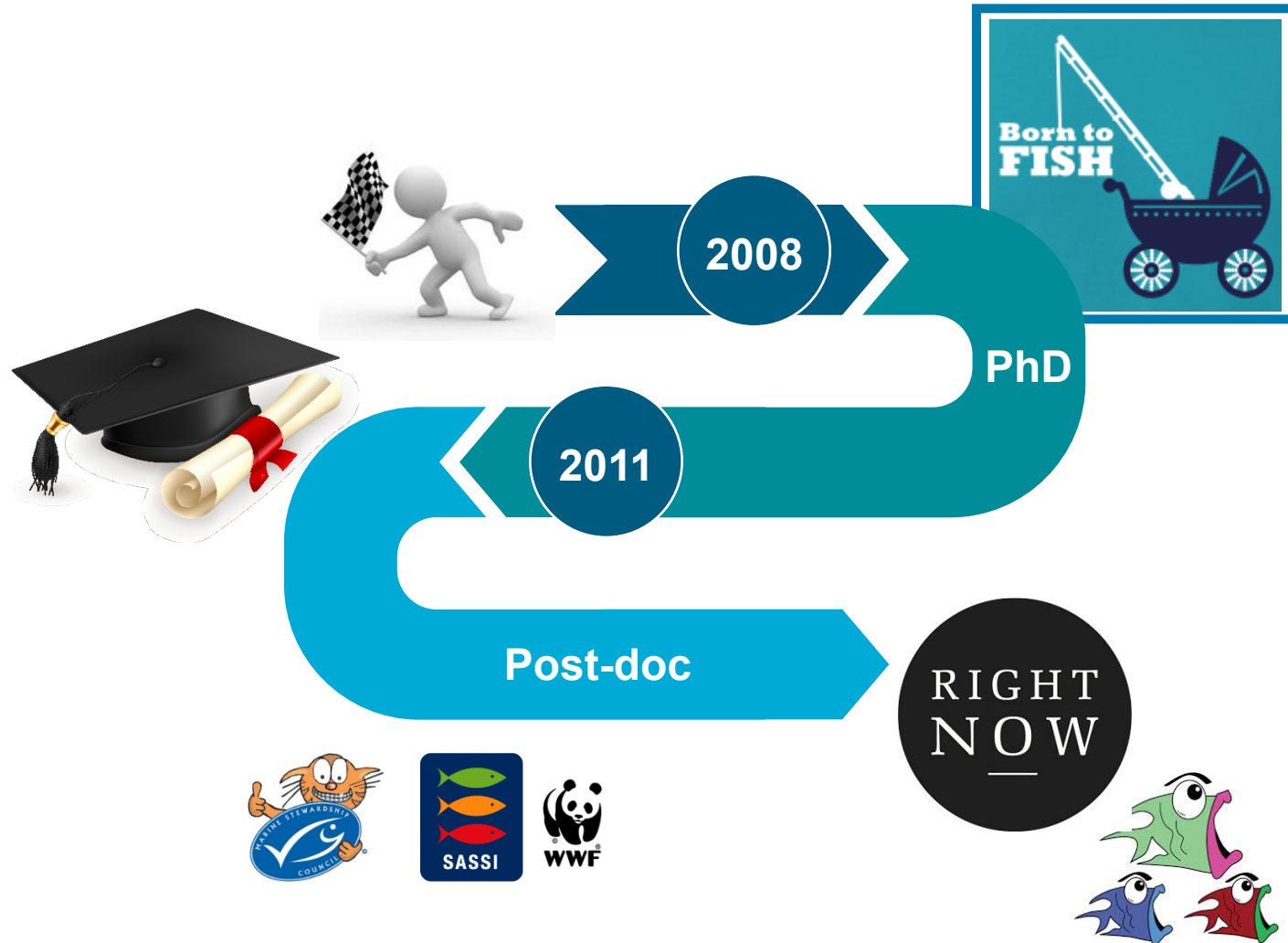


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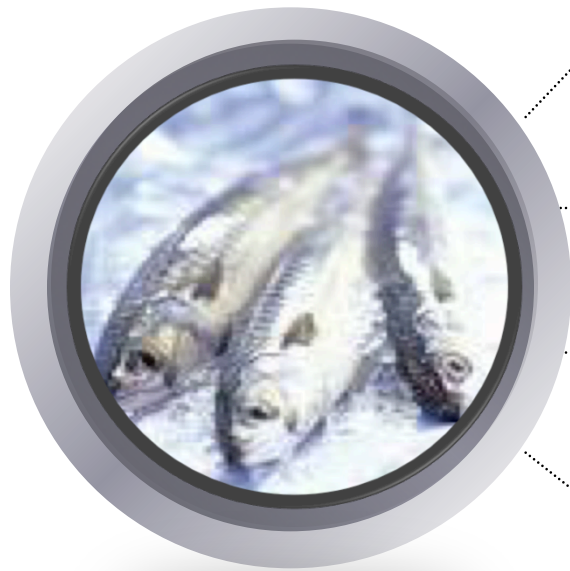
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# The trip thus far...



# On the menu...



Background

The research

The results

The way forward?

# BACKGROUND



# Background



Once viewed as the ultimate wilderness with an inexhaustible supply of fish....

# Background



UN Food and  
Agriculture  
Organisation  
(2014):



~~Fully~~-fished

~~Over~~-fished

Global fish stocks



# Background

South Africa has not escaped  
wrath of overfishing

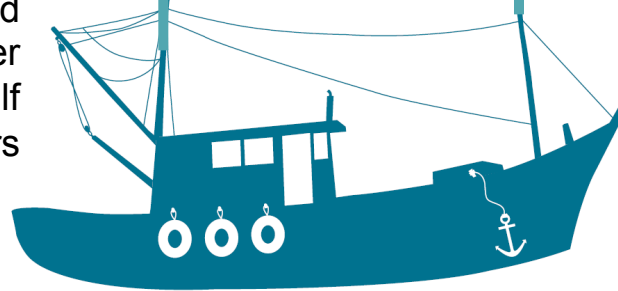
## SA linefish

**20%**  
**Overexploited**

Yellowbelly rockcod  
Carpenter  
Shad/Elf  
Harders

**34%**  
**collapsed**

Silver kob  
Dusky kob  
Geelbek  
Red steenbras  
White steenbras  
Englishman  
White stumpnose



(Mann, 2013)

# Background

- **Marine resource scarcity**
- **Poorly-enforced regulations**
- **Potential to accrue greater profits**

⌘ Global increase in the mislabelling of fish as higher-valued / palatable-sounding species

- 41% in North America (Hanner et al., 2011)
- 32% – 80% in Italy (Filonzi et al., 2010; Barbuto et al., 2010)
- 25% in Dublin (Miller & Mariani, 2010)





# Background

## The problem...

- ✍ >30 000 fish species
- ✍ Identification of fish at species level a challenge:
  - Industry, consumers, regulators
- ✍ Globalisation of trade / increased processing



# Background

## A solution...

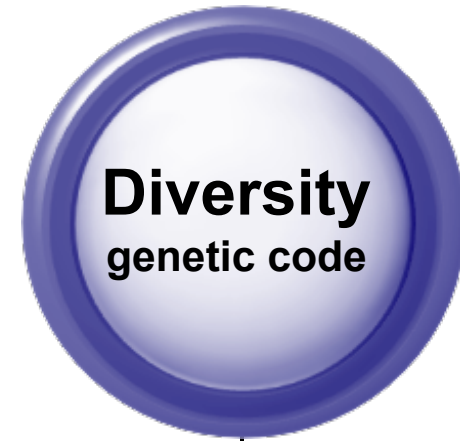
DNA sequencing methods for species identification



Present and  
same



Resistant to  
processing



Discriminate closely-  
related species



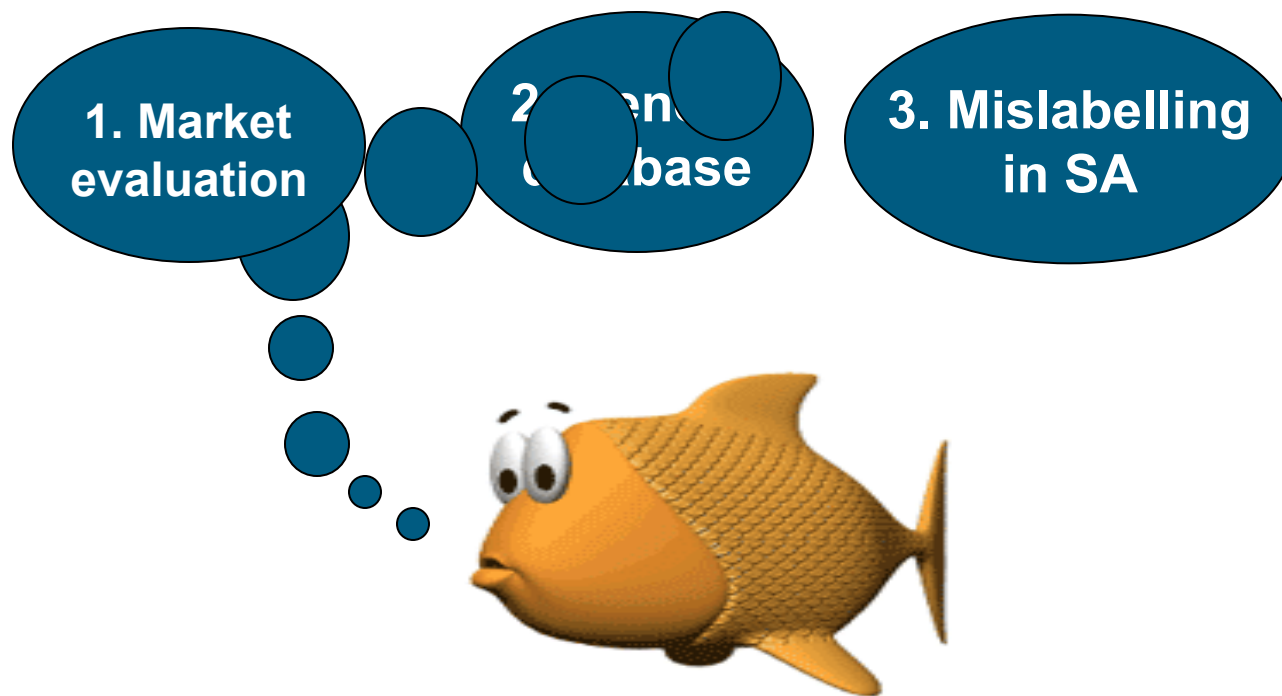
# Background

## South African fish species



- ⌘ In spite of utility of DNA-based methods...
  - ⌘ Lack (or complete absence) of reference genetic sequence data
  - ⌘ Many fish species commercially available in South Africa, including conservation concerns
- ⌘ Precludes accurate species identification!

# Aims of research



# Establishment of a reference DNA sequence database





## Establishment of reference DNA sequence database

- ℘ Results from surveys & catch data
- ℘ 53 commercially available fish species
  - 49 domestic species and 4 were imported
- ℘ At least 3 individuals per species
- ℘ Morphologically identified (fish taxonomists)
- ℘ Vouchered

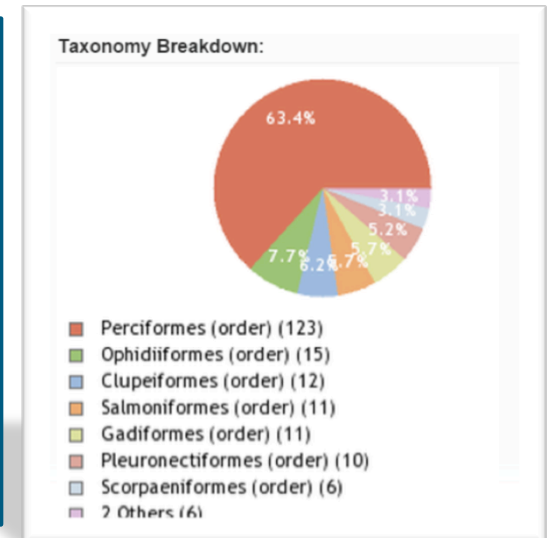
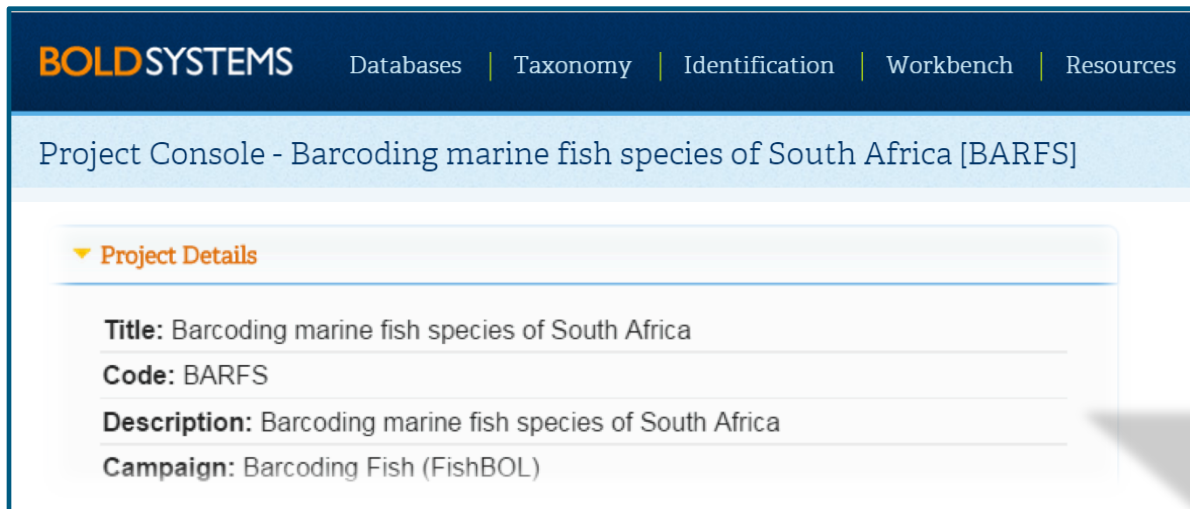
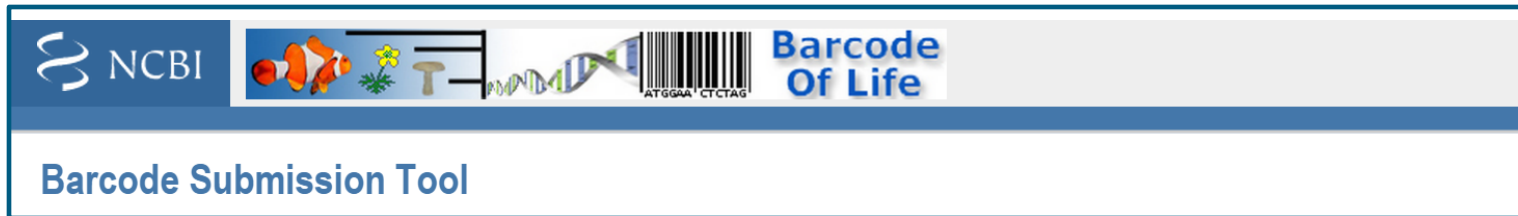


# Establishment of reference DNA sequence database

194 Full-length COI barcode records

- Many for the first time

Submitted to GenBank and BOLD





# Establishment of reference DNA sequence database

## Prominent findings - DNA barcoding



⌘ DNA barcoding – discriminated 96% of species

⌘ Only species not readily differentiated:

= ***Thunnus* spp.**

[mtDNA control region (faster evolving) more suitable]



⌘ DNA barcoding: **Barracouta (NZ)** and **Snoek (SA)**, both currently classified as *Thyrsites atun*

⌘ Sufficient variation - could constitute **two distinct species**








# Fish mislabelling in SA



# Fish mislabelling study (2010)

## Collection of market samples

- 
- 
- 
- 248 fish samples collected over 2-year period (2008 - 2010) from 4 provinces (EC, WC, KZN, GP)
    - 108 (42%) - fish distributors/wholesalers
    - 140 (58%) - retail (supermarkets & fish markets)
  - DNA sequencing – mostly COI

# Fish mislabelling study (2010)

## Results

### Distributor/wholesale samples:

- 10 of 108 mislabelled

9%

### Retail samples:

- 43 of 140 mislabelled

31%

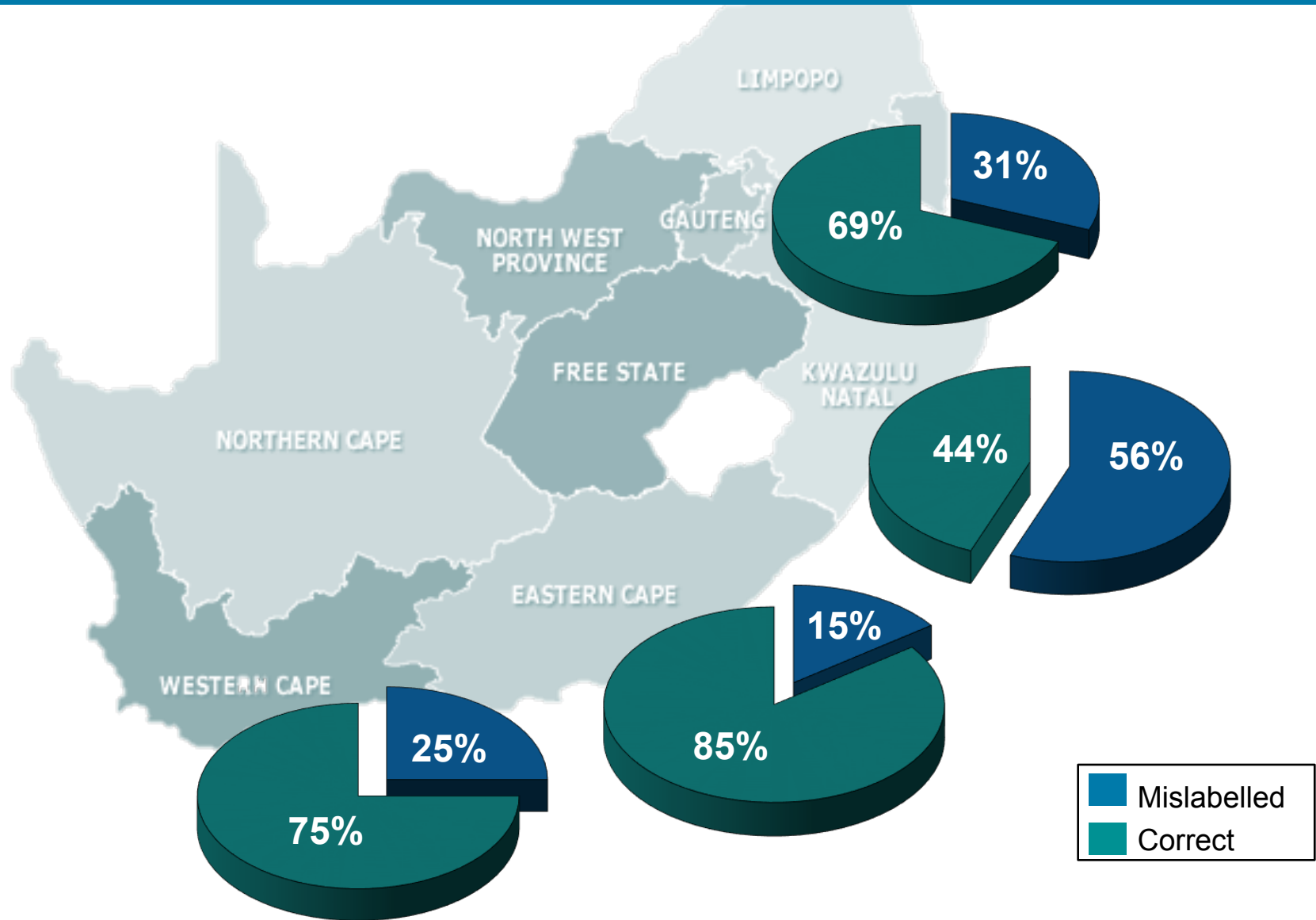
### Overall:

- 53 of 248 mislabelled

21%



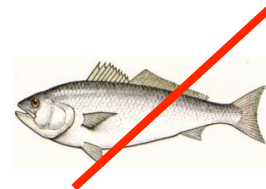
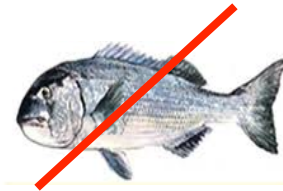
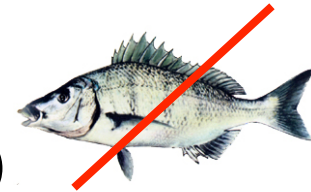
# Mislabelling in retail outlets by province



# What DNA testing showed...

## Fresh fish market KZN: 10 of 15 samples mislabelled

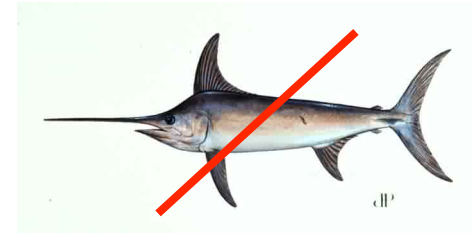
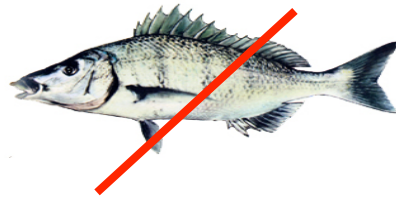
- Fillets marketed as “white steenbras”
  - Big-scale pomfret (*Taractichthys longipinnis*)
- Fillets marketed as “white musselcracker”
  - Pelagic armorhead (*Pseudopentaceros richardsoni*)
- Fillets marketed as “Cape salmon”
  - Actually shortbill spearfish (*Tetrapturus angustirostris*)



# What DNA testing showed...

## Health concerns...

- Fillets marketed as “white steenbras” and “swordfish”



- Oilfish (butterfish) (*Ruvettus pretiosus*)
- Health implications



# What DNA testing showed...

## Environmental concerns...

- 🔗 In GP, 18% of outlets sold fish as 'red snapper'



- 🔗 DNA analysis showed on more than one occasion this was actually **river snapper** (*Lutjanus argentimaculatus*)

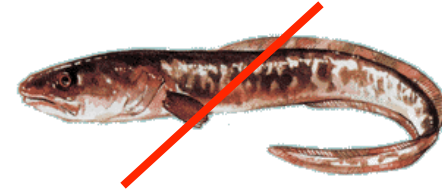


- 🔗 A species which is illegal to sell in South Africa
- 🔗 Other whole 'red snapper' – identified as panga and Roman

# What DNA testing showed...

## Economic concerns...

- 3 of 12 retail samples sold as “kingklip”
  - NZ ling (*Genypterus blacodes*)



❧ Fish labelled as “barramundi”



❧ Actually common warehou (*Seriollevella brama*)



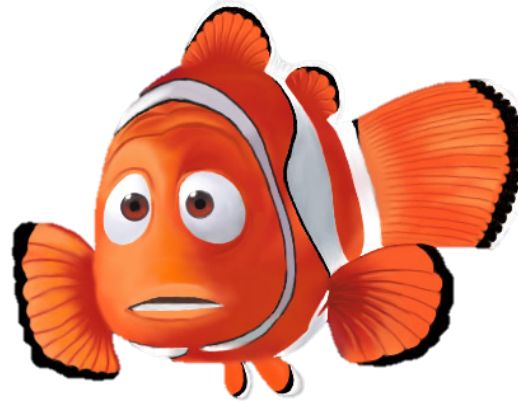
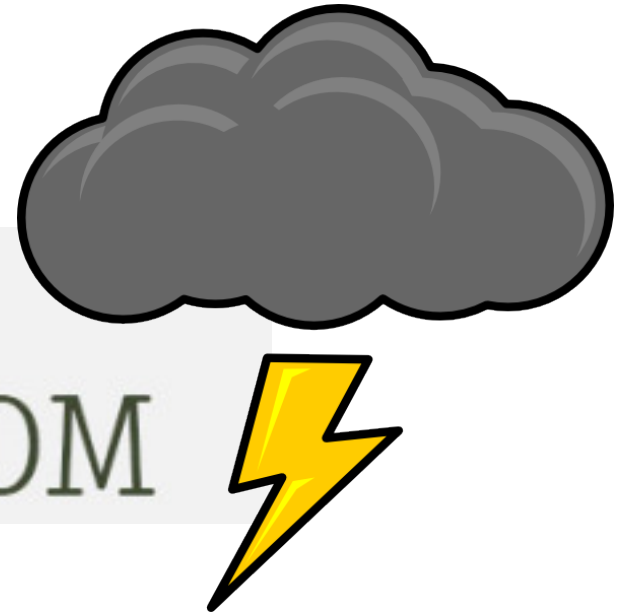
❧ Countrywide recall of the product



# The need for re-appraisal...

But it's not all

DOOM & GLOOM

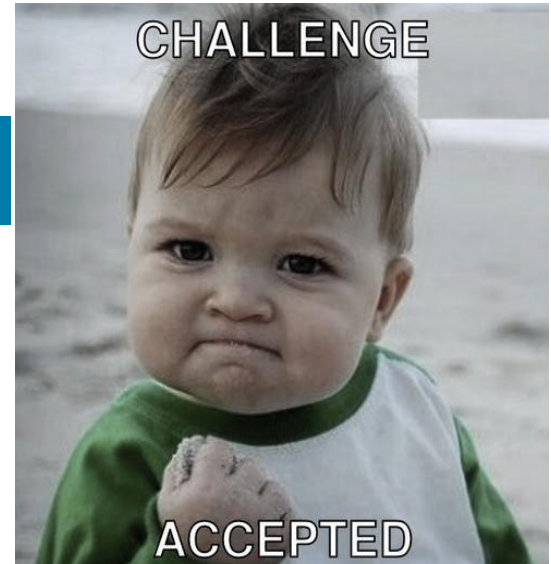


# The need for re-appraisal...

## Numerous initiatives to address mislabelling

Since 2011

- Increased public / industry / gov. awareness
- DNA database established: local species
- New food labelling regs (R.146) promulgated
- NGOs – improve seafood labelling
- ‘Standardised seafood naming list’ – in process



Gauge effectiveness of initiatives – re-assess the situation

2014



# The follow-up study

## Fish mislabelling study 2014



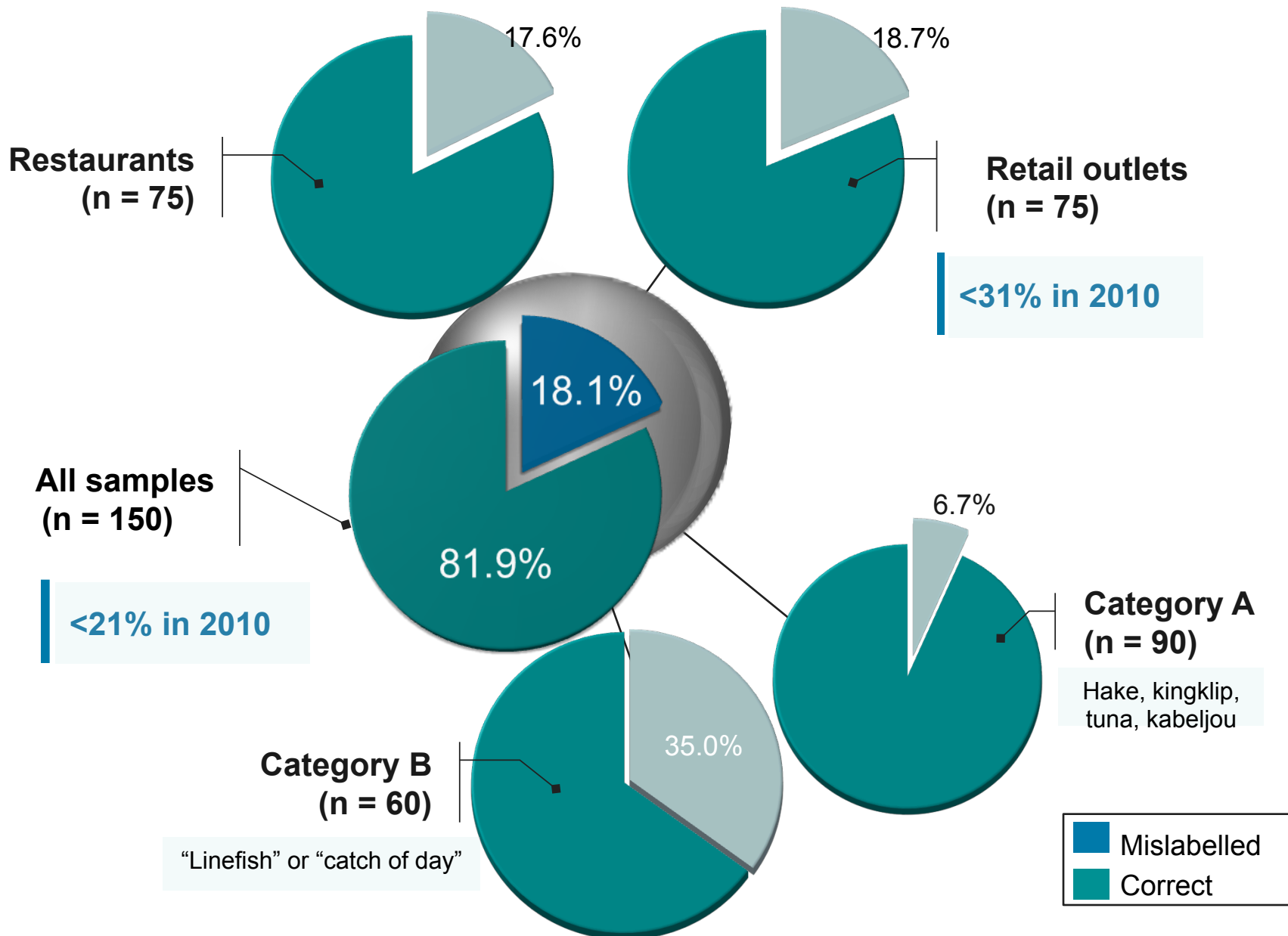
# Fish mislabelling study (2014)

## Collection of market samples

- ✧ **150 samples**, 9-month period (May 13 – Jan14)
- ✧ 3 provinces (WC, KZN, GP)
  - 75 samples from restaurants (N=25 per province)
  - 75 samples from retail outlets (N=25 per province)
- N = 90 'category A' priority species  
(N = 37 hake, N = 31 kingklip, N = 16 tuna, N = 6 kabeljou)
- N = 60 'category B' samples  
Sold as 'linefish' or 'catch of day'
- ✧ DNA sequencing



# Mislabelling (2014) – All



# Conclusion



- ℳ Fish mislabelling – reality on SA market
  - ℳ Economic, health, environmental repercussions
- ℳ DNA barcoding = powerful method for species authentication
- ℳ Strengthened by reference library / rigorous sampling plan
  - ℳ Regions where mislabelling problematic
  - ℳ Species most prone to mislabelling

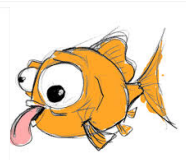
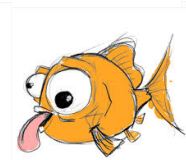
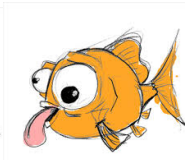
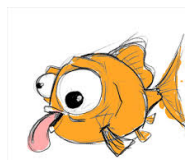
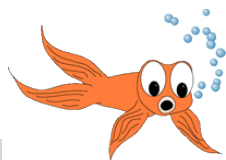


# Conclusion



- ✧ Appear to be some improvements in transparency
  - ✧ Underscoring efforts made over past few years

**But** 1 in 5  
Mis-described



**More work to be done...**

# Thank you!!

## Acknowledgements

### Academic support:

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- International Development Research Centre (IDRC)
- International Barcode of Life Conference

