# Responses of estuarine and inshore fish and fisheries to climate change

Stephen Lamberth & Sven Kerwath


agriculture,
forestry & fisheries
Department:
Agriculture, Forestry and Fisheries
REPUBLIC OF SOUTH AFRICA

## Estuary and shore fisheries

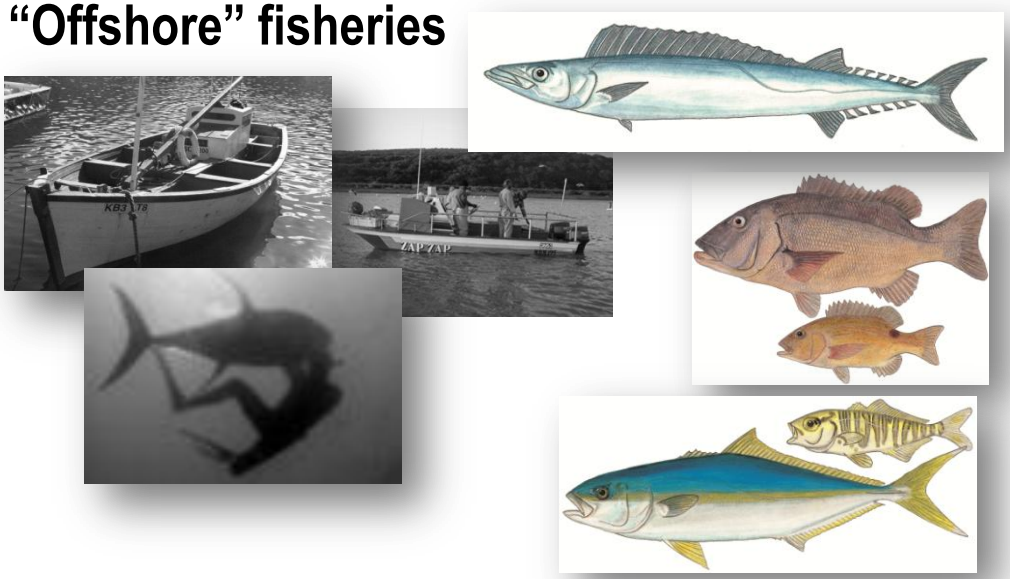

Recreational & subsistence angling, cast-netting, artisanal, commercial beach-seine & gillnet fisheries

500 000 fishers

15 000 t per year

99 % of catch comprises estuary-associated fish

## "Offshore" fisheries




Boat-based commercial & recreational linefishery, recreational spear-fishery

100 000 fishers

20 000 t per year

<10 % of catch comprises estuary-associated fish

# Estuary and nearshore responses to climate change

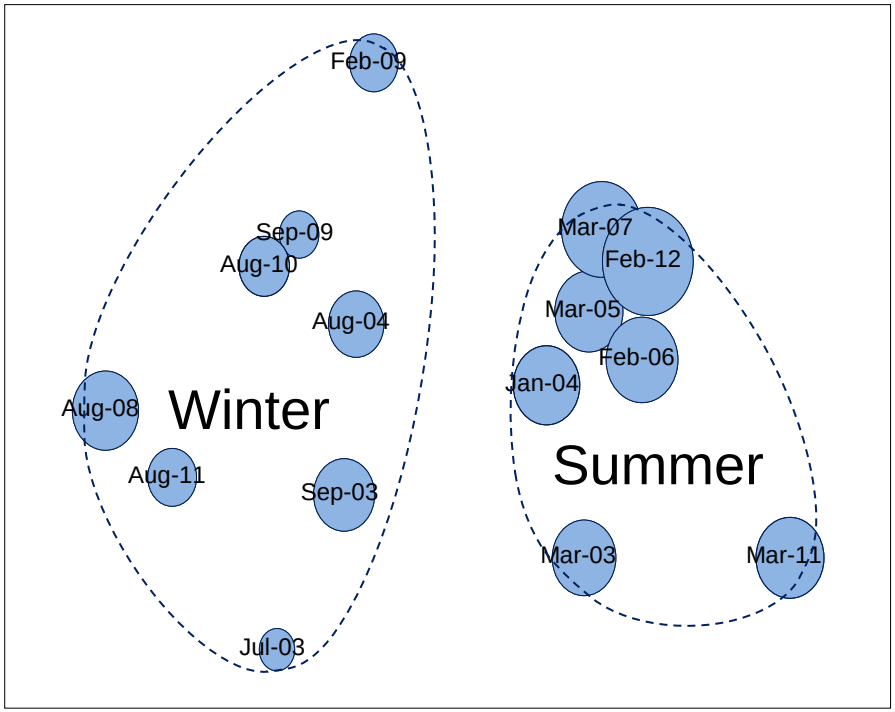
| Drivers | Response | Subtropical | Transition zone | Warm temperate | Transition zone | Cool temperate |
|---|---|---|---|---|---|---|
| Ocean circulation | Current speed | | | | | |
| | Current position | | | | | |
| | Upwelling | | | | | |
| Precipitation | Runoff | | | | | |
| | Estuary mouth closure | | | | | |
| | Salinity | | | | | |
| | Nutrients fluxes | | | | | |
| | Floods & sediment | | | | | |
| | Flushing of pollutants | | | | | |
| Sea level rise | Salinity | | | | | |
| | Increased tidal prism | | | | | |
| | Mouth closure | | | | | |
| Rising temperatures | Species range | | | | | |
| | Community composition | | | | | |
| Acidification | Calcifying organisms | | | | | |
| Coastal storms | Estuary mouth closure | | | | | |
| | Overwash | | | | | |
| | Marine sediment | | | | | |

(After Van Niekerk et al. 2012 - NBA)

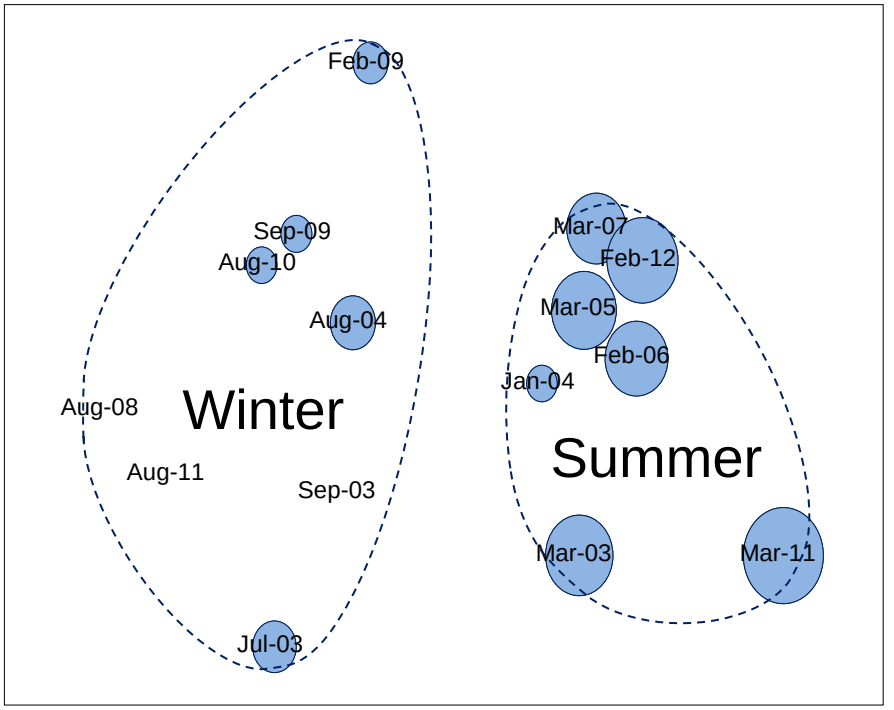
# Range expansion

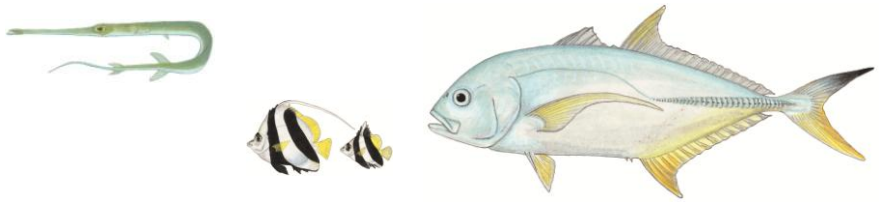
## MDS of fish abundance (*cpue* ) in the Breede Estuary 2003-2012

### Tropical estuarine species




### Tropical marine species



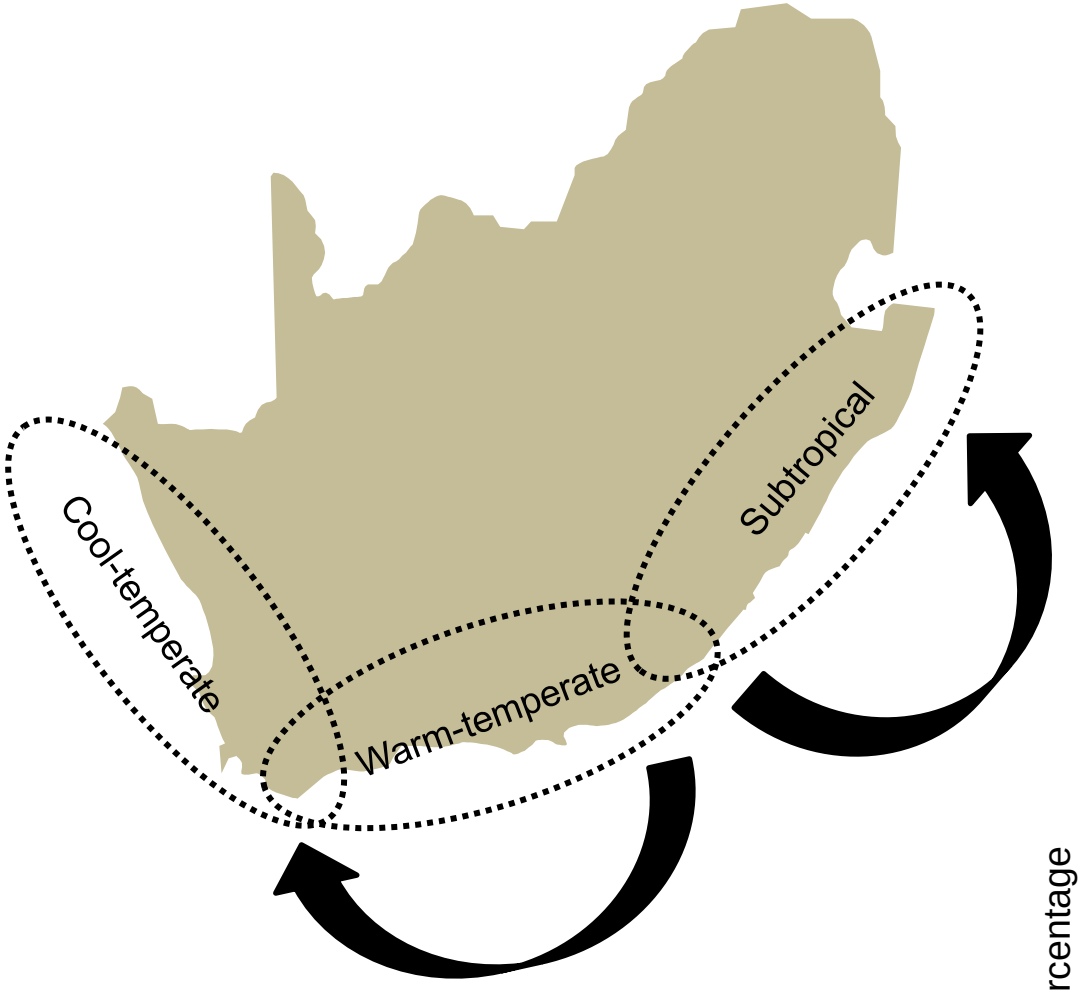



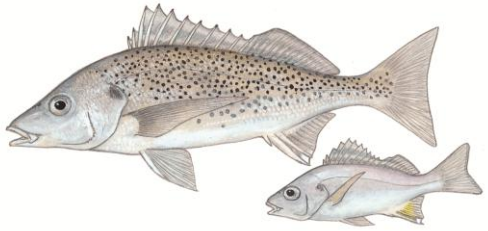
agriculture, forestry & fisheries

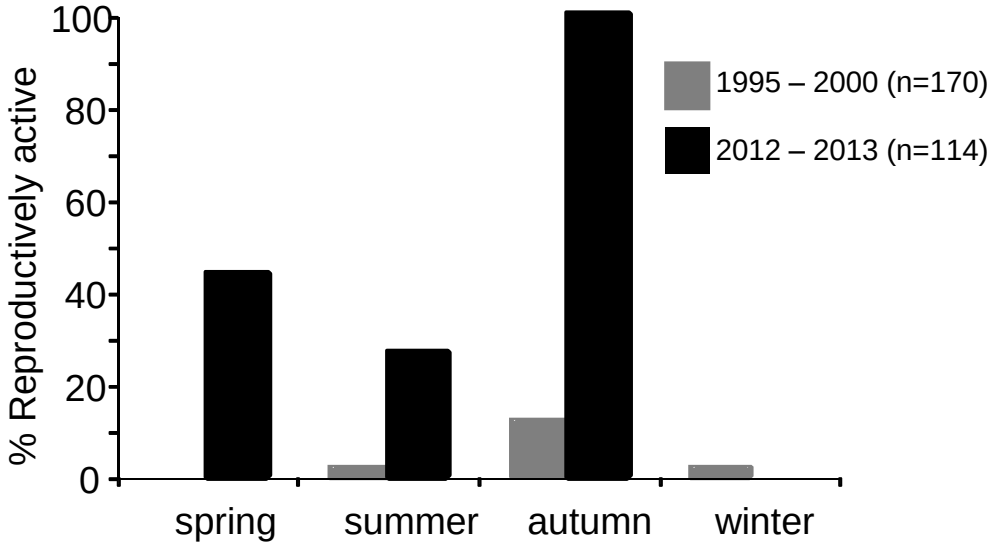
Department:
Agriculture, Forestry and Fisheries
REPUBLIC OF SOUTH AFRICA

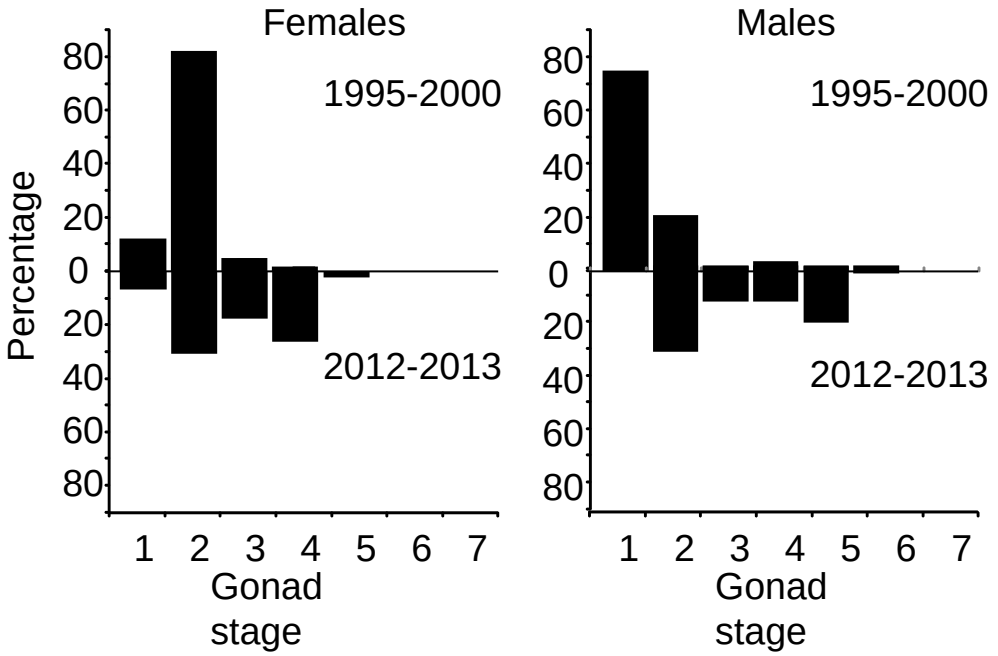
After Lamberth, James et al. 2012

# Range expansion & stock separation: Spotted grunter *Pomadasys commersonnii*



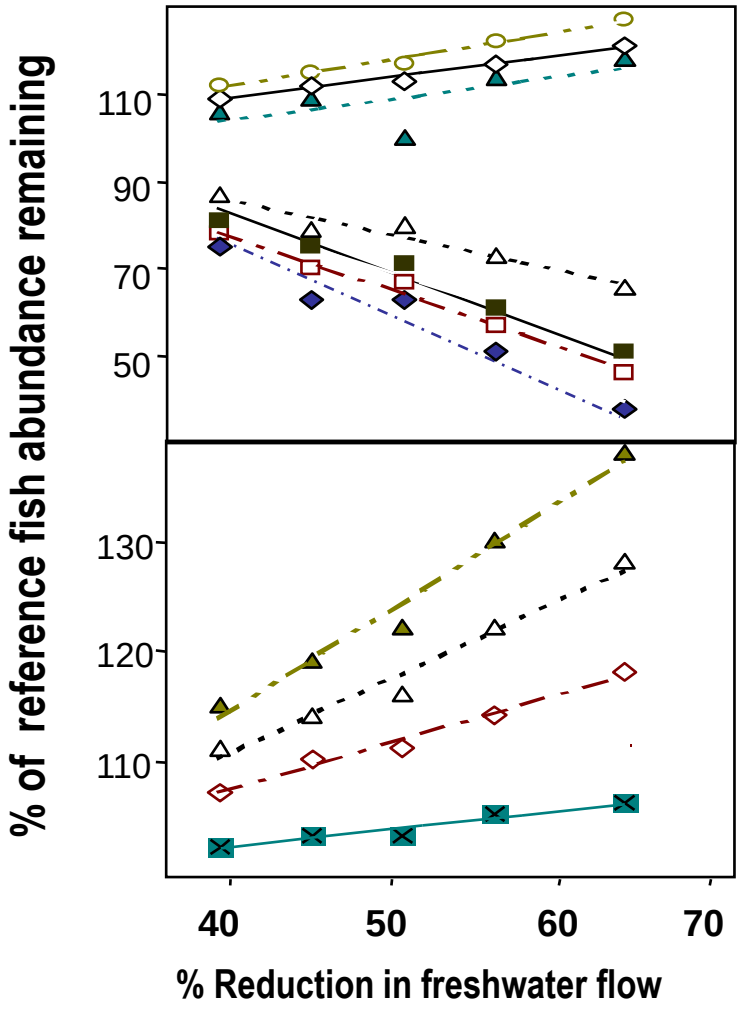


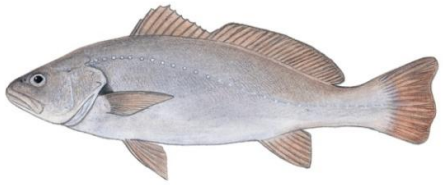




agriculture, forestry & fisheries

Department:
Agriculture, Forestry and Fisheries
REPUBLIC OF SOUTH AFRICA

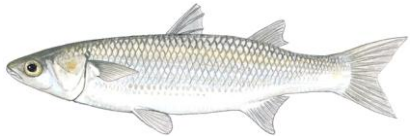
# Estuarine fish response to altered freshwater flow - cool / warm temperate transition zone



**Obligate estuarine dependents**

- Dusky kob
- Leervis
- White steenbras
- Cape moony
- Flathead mullet
- Spotted grunter
- Cape stumpnose



**Marine opportunists**

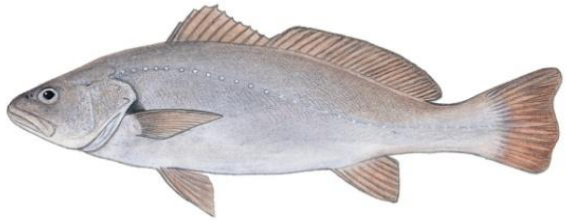
- Dassie
- Harder mullet
- Elf
- White stumpnose

These fish have to spend the first year of life in estuaries

These fish follow optimum conditions between estuaries & sea

Dependence categories after Whitfield (1994)

# Components of freshwater flow to the sea

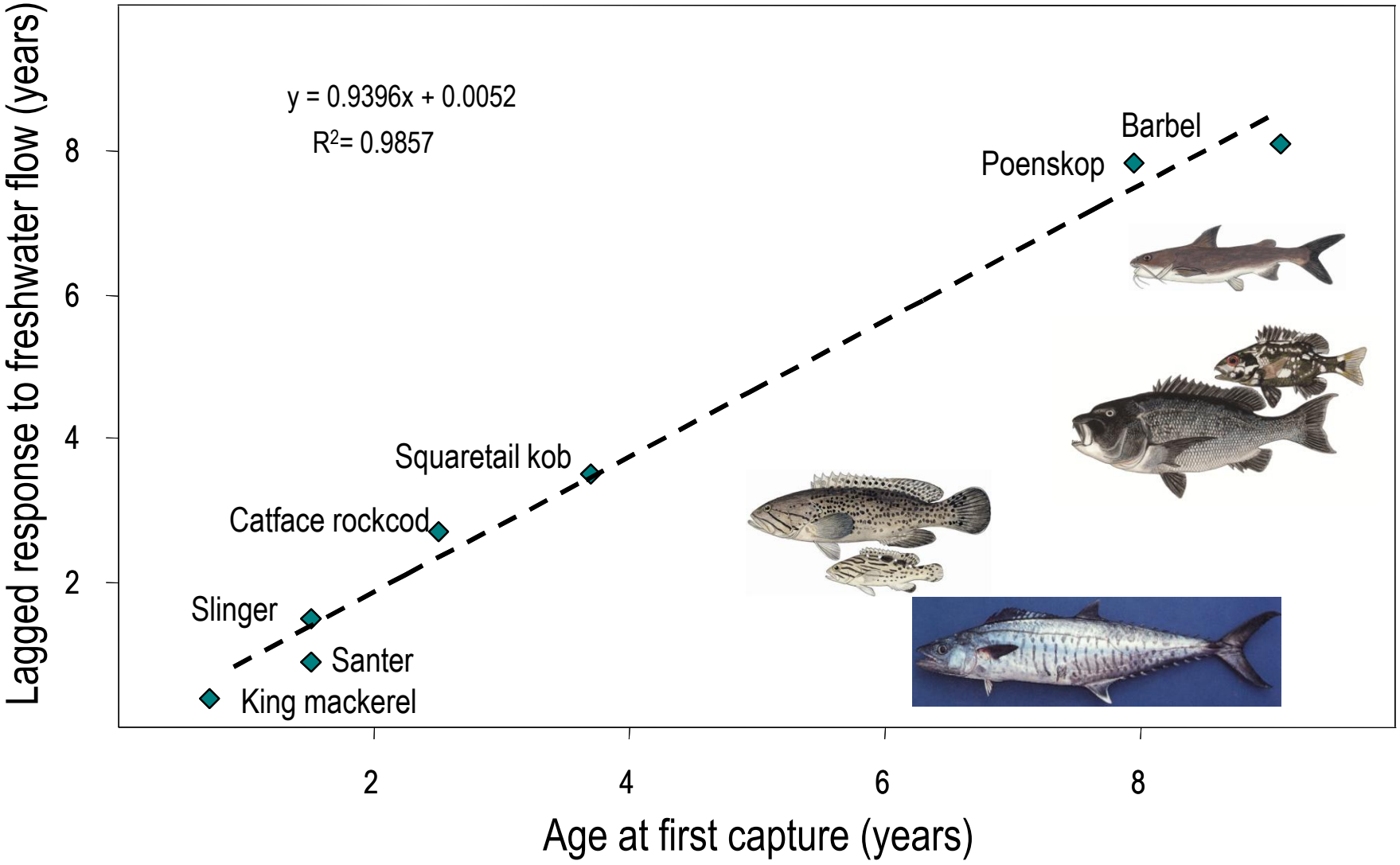


- Export of nutrients sediment and detritus
- Turbidity
- Productive plumes / fronts (S, T, turbidity)
- Temperature refugia
- Migration, spawning cues
- Coastal connectivity
- Debris ►nurseries / refugia, “natural” fish aggregating devices (FADs)

Cause changes in:

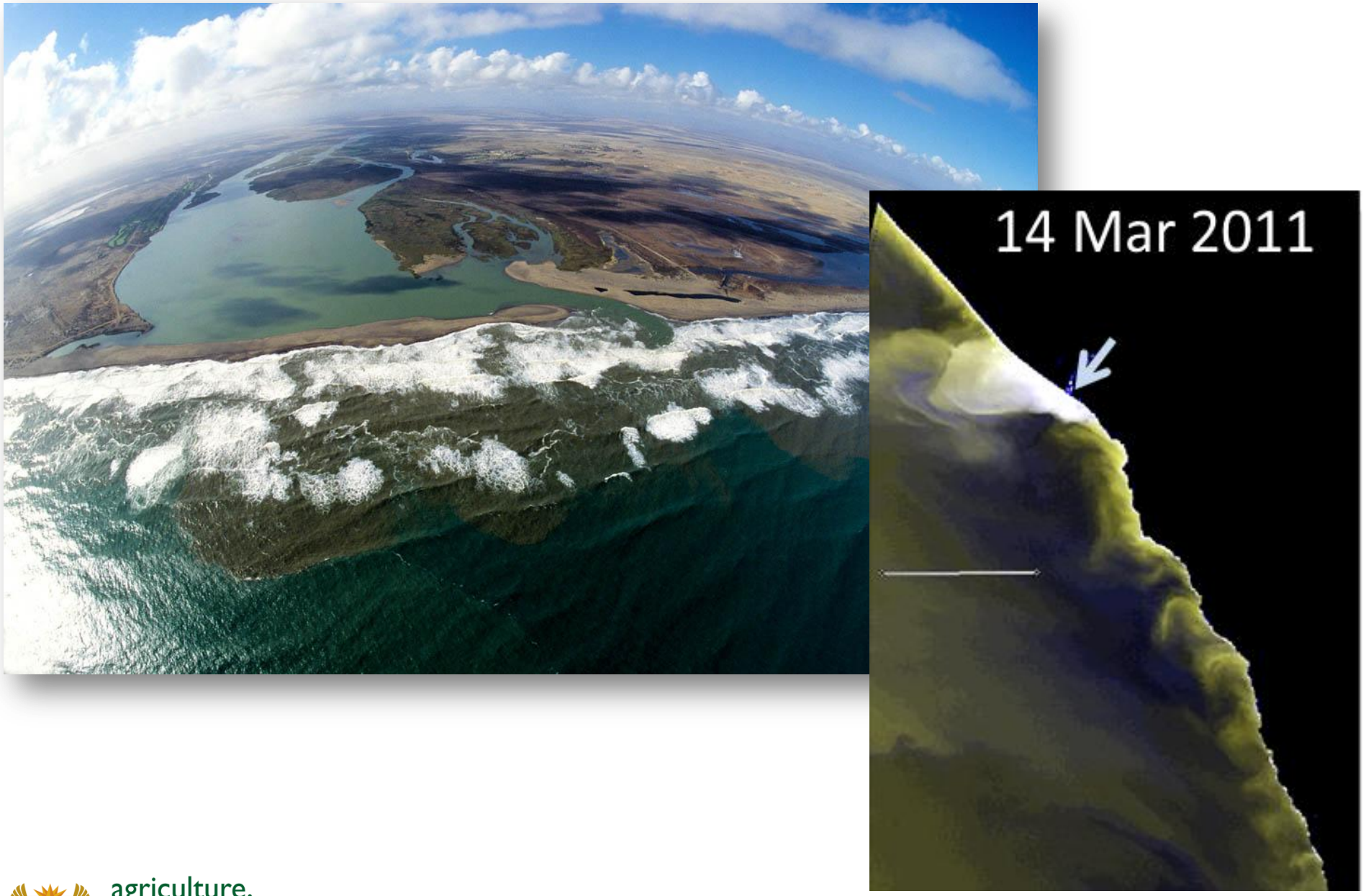
- Fleet structure
- Changes in catch per unit effort
- Spatial and temporal distribution of effort
- Economic value of the fisheries concerned

# Marine fish response to altered freshwater flow – Thukela Banks line-fishery





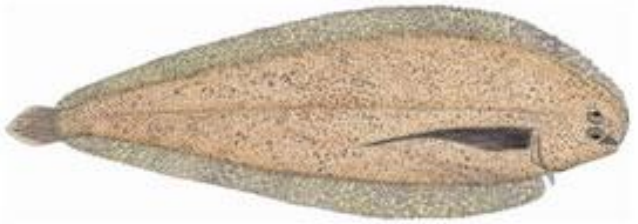

After Lamberth et al. 2010




agriculture,
forestry & fisheries

Department:
Agriculture, Forestry and Fisheries
REPUBLIC OF SOUTH AFRICA

# West coast sole and freshwater flow

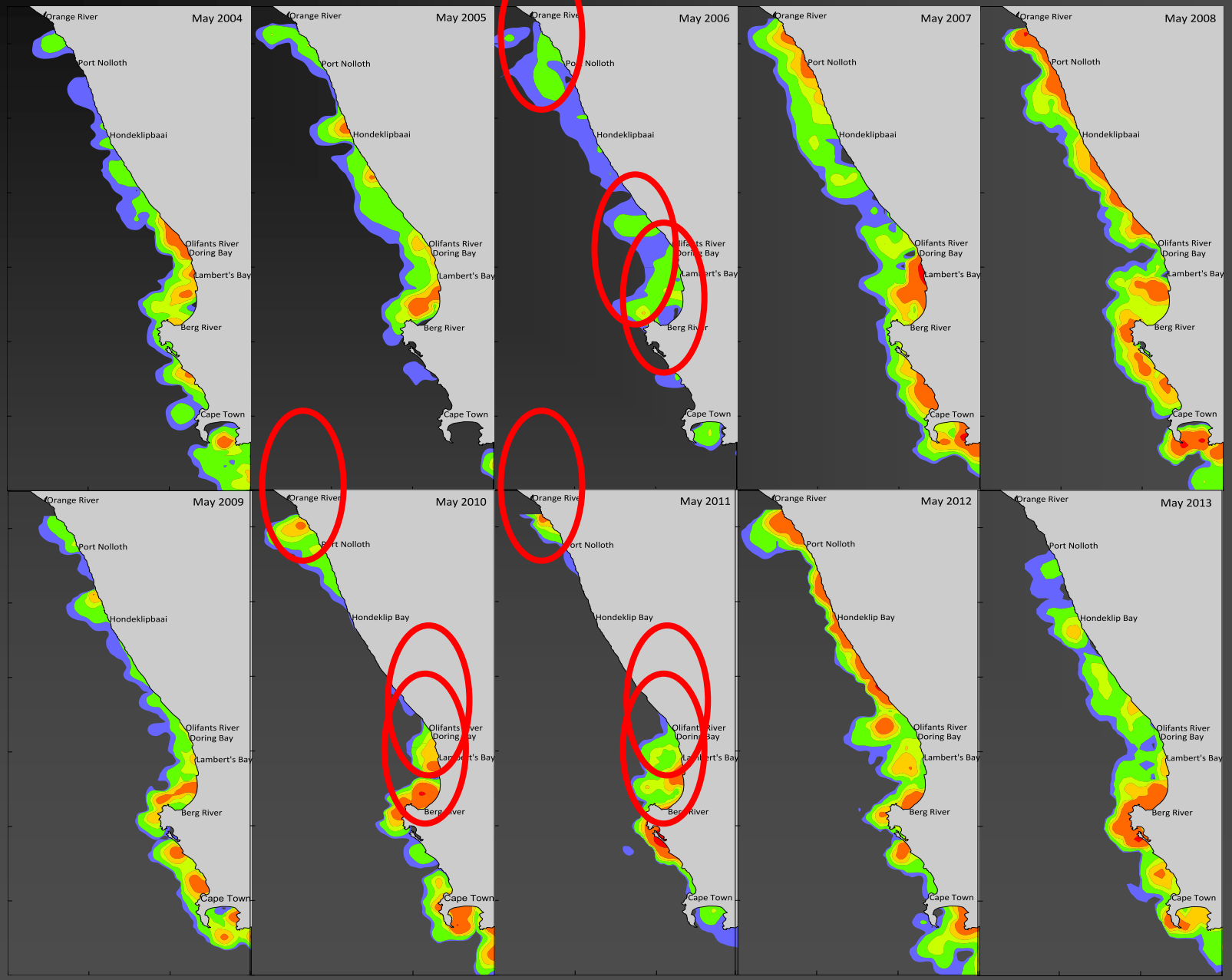


- West coast sole *Austroglossus microlepis* are targeted in South African and Namibian waters whereas east coast sole *Austroglossus pectoralis* are caught on SAs eastern seaboard
- The west coast sole fishery collapsed in the 1970s whereas the east coast one has remained stable.
- The sole trawl industry have long used rainfall (terrestrial runoff) as a predictor of catches in the following season
- From 1970 to 1980, dam storage capacity on the Orange-Senqu rose from 10% to 90% of that in the present day
- The west coast sole fishery collapsed in the mid 1970s
- Demersal trawl survey data (DAFF 1984-2011) indicate a weak but positive relationship between Orange-Senqu flow and biomass estimates.
- However, there are stronger but negative relationships between sole and their predators e.g. gurnard
- Damming saw sediment discharge into the sea change in composition from predominantly silt to cohesive clays
- Hypothetically, this influenced the burying ability and crypsis of juvenile sole leaving them more exposed to predators on the sediment surface and abrupt stock collapse
- Changes in nutrient and food availability may also have played a role



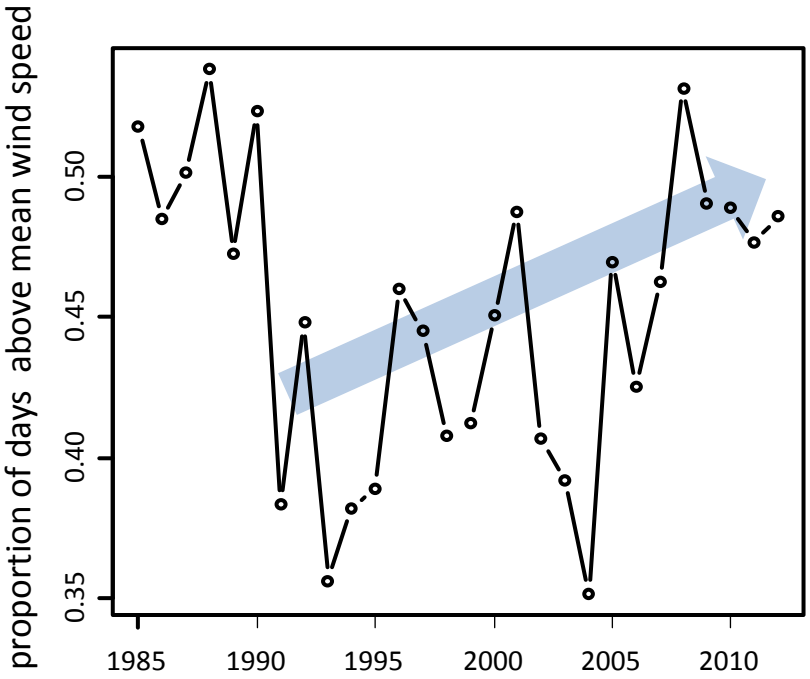
After Van Niekerk et al. 2014.
UNDP – GEF Orange–Senqu Basin Strategic Action Programme

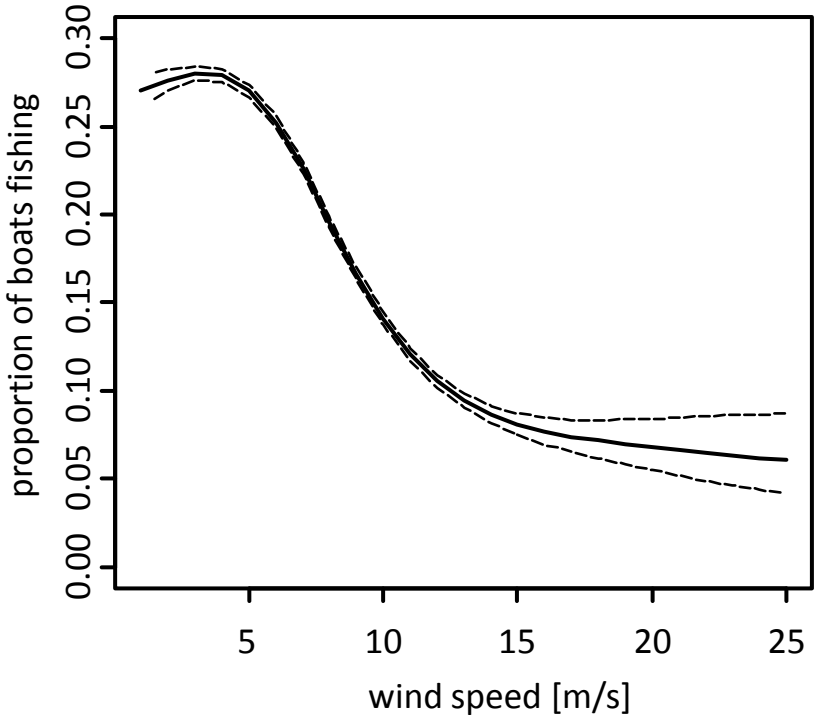
# UNDP-GEF Orange-Senqu River Basin Strategic Action Programme

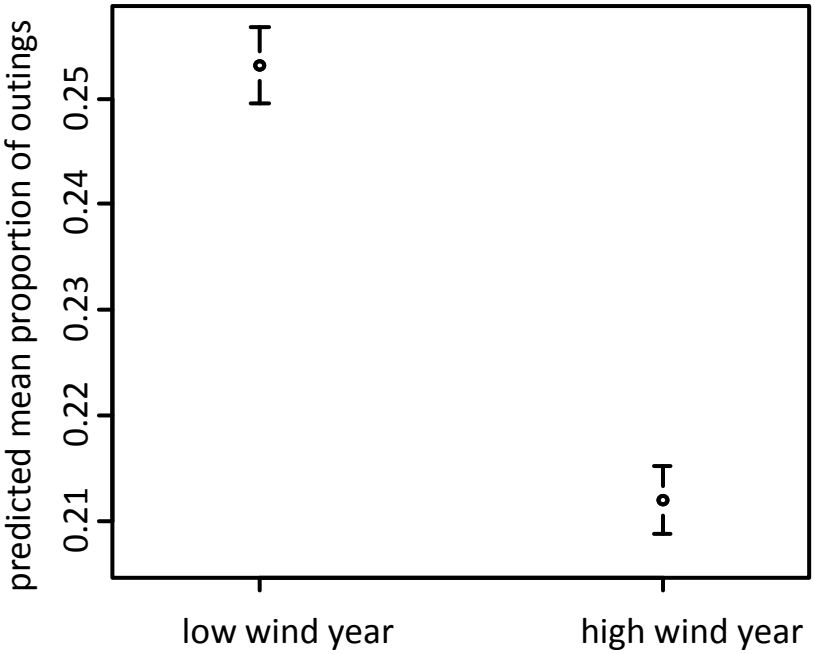



1 Juvenile anchovy densities g.m$^{-2}$ on the west coast of South Africa during May of each year from 2004 - 2013. Data and map source Dagmar Merkle, DAFF Small Pelagic Acoustic Survey.

# Changes in wind speed and direction are influencing fleet behaviour

# Summary observations

- More than 40 range extensions of tropical fish into estuaries in the warm/cool temperate transition zone
- Mostly erratic summer occurrences of marine species with high mortalities
- Estuary-dependent species have persisted, some establishing new breeding populations
- Fish with specialist niche requirements or subject to life-history bottlenecks (e.g. estuary dependence, late maturity) are more sensitive to change than opportunistic generalists
- Fish populations under intense exploitation more susceptible to change than those under low fishing pressure
- Estuarine and marine fish and fisheries are influenced by freshwater flow

- Increases in wind speed over the past two decades have led to a significant decline in sea-days by the line-fishery (but without a concomitant increase in *cpue*)

- Spatial planning in fisheries will become more important in the future
- Small-scale fisheries' resilience rests in their ability to move
- Distributional changes not compatible with *Small Scale Fisheries Policy* and shift towards local-level fisheries management


Acknowledgements: DAFF Fisheries Research, CSIR, SAIAB, DWS, Cape Nature, SANParks, SANBI, East Cape Parks, Dwesa-Cwebe, Lower Breede River Conservancy, DEA Oceans & Coasts, Eden District Municipality

Thank you