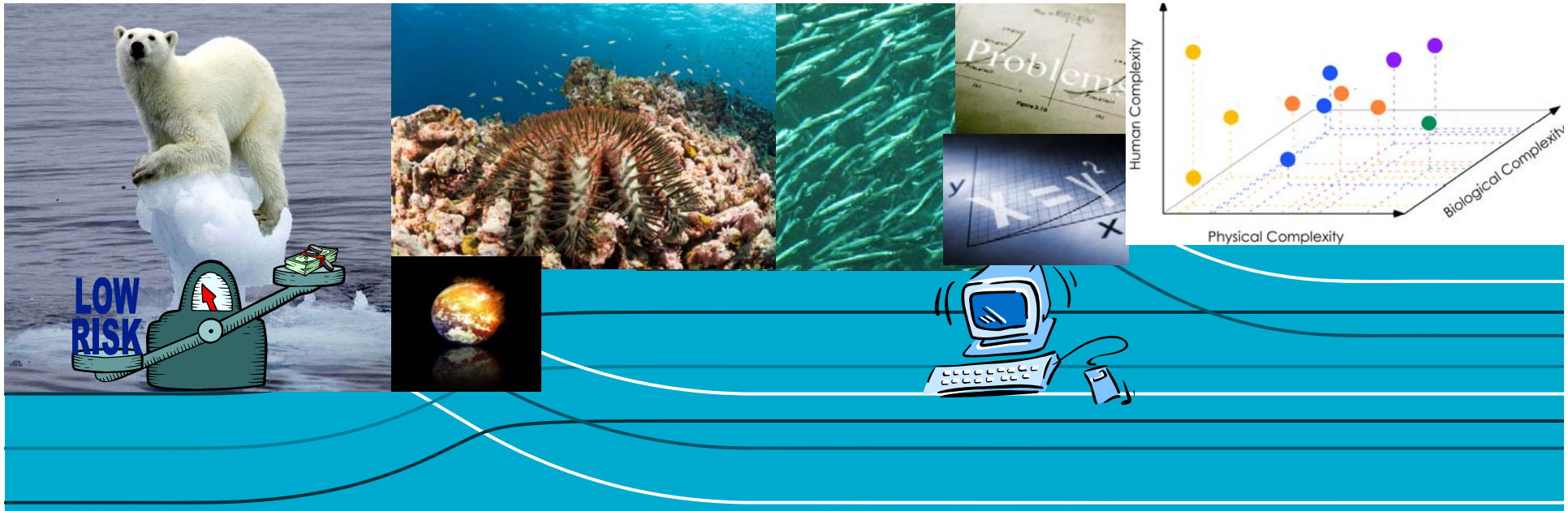

Quantifying climate-smart management responses to shifting marine species distributions

Éva Plagányi, Vivitskaia Tulloch*, — CSIRO, Brisbane; UQ
Ingrid van Putten, Alistair Hobday — CSIRO, Hobart
Laura Blamey, Doug Butterworth, William Robinson — University of Cape Town

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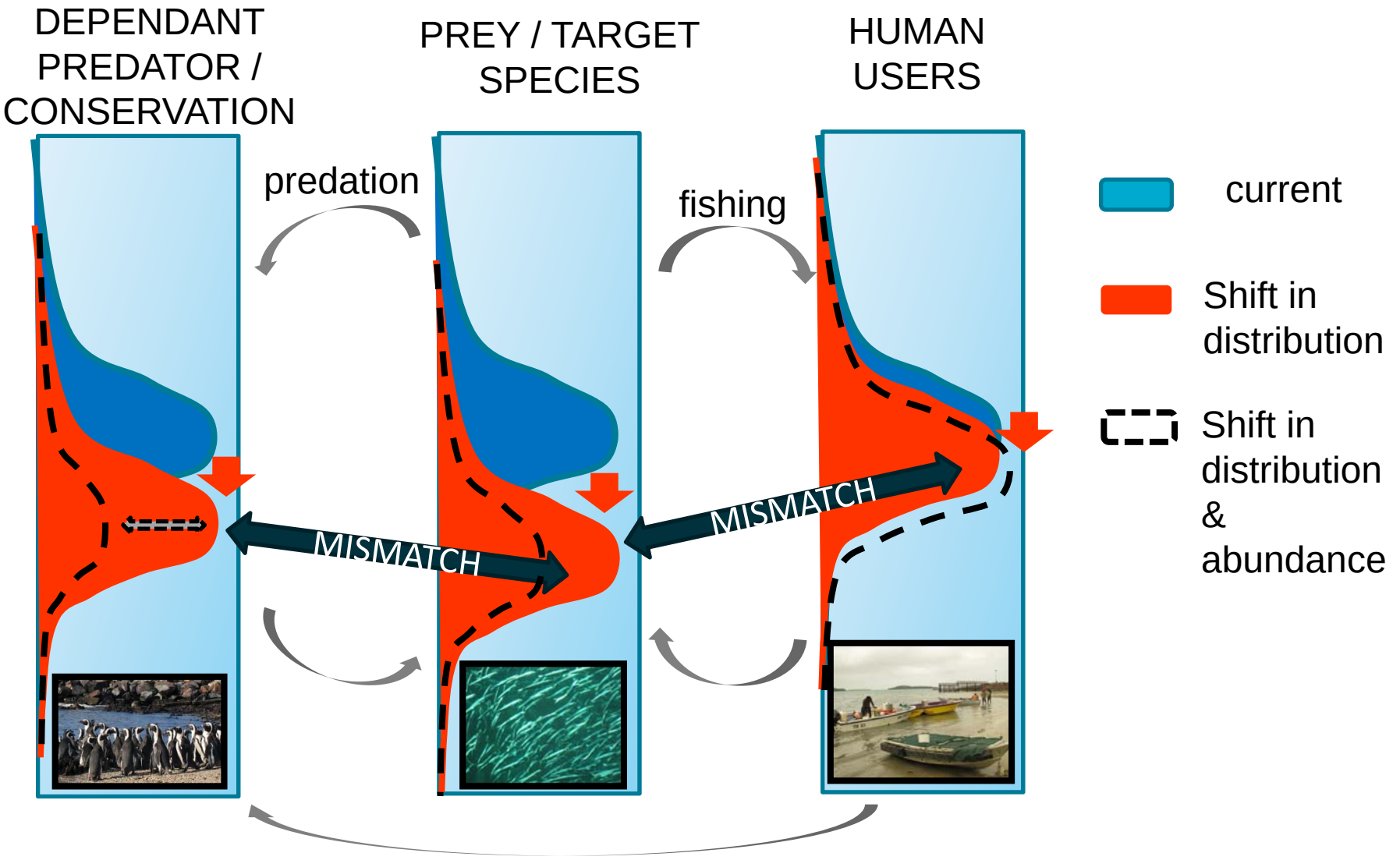
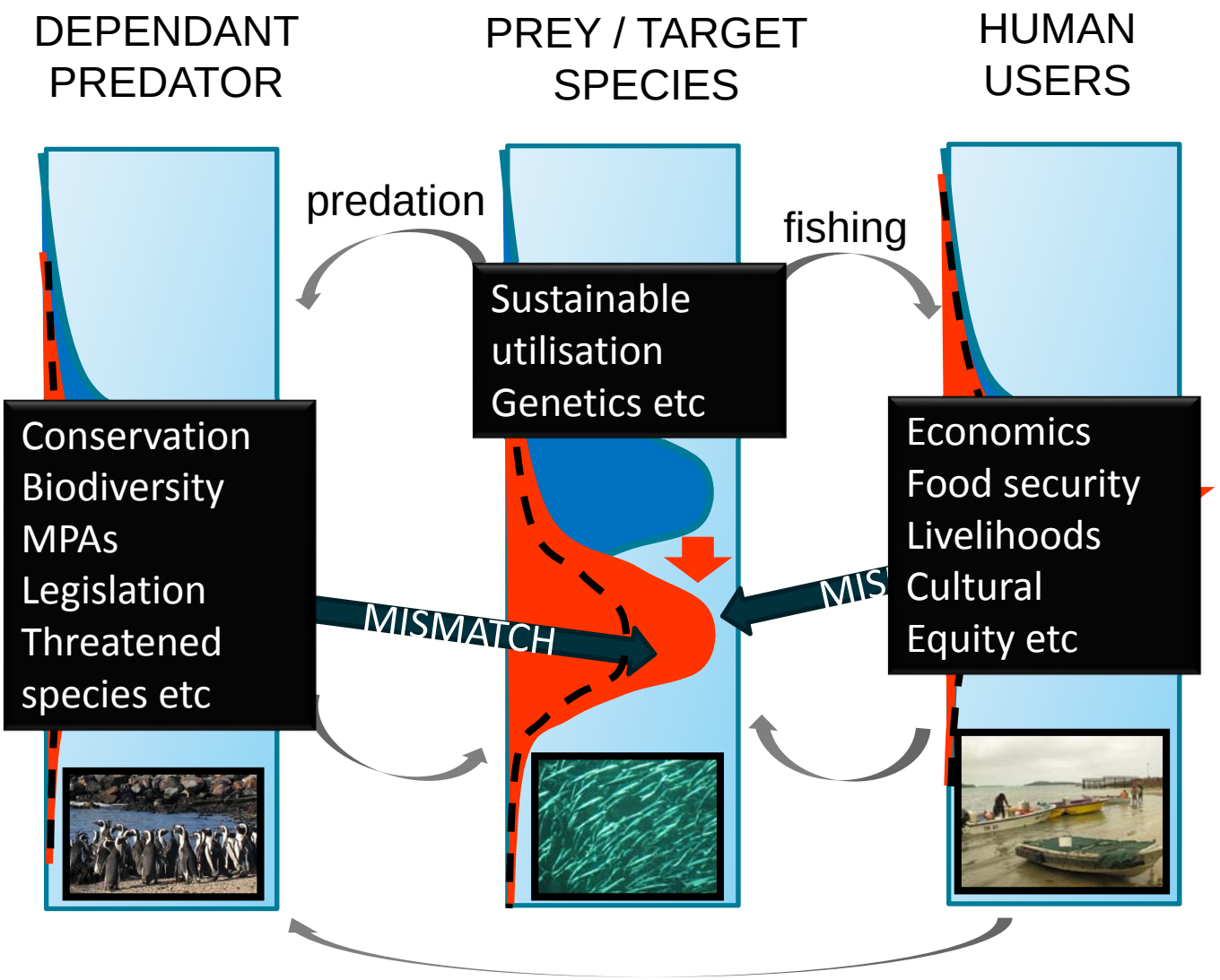
CSIRO

Species on the Move, Feb 2016
Theme 10 - Management strategies for multiple objectives and benefits

CLIMATE-SMART MANAGEMENT STRATEGIES?



MULTIPLE OBJECTIVES?



Need management strategies capable of sustaining fisheries, fishers and dependent predators into the future

Some examples…

TARGET SPECIES

SHIFTING LOBSTERS

Could a regime shift be avoided through a climate-smart strategy?

DEPENDANT PREDATOR

PENGUINS IN PERIL

Is fishing pressure responsible for regional declines in penguin populations?

HUMAN USERS

SOCIO-ECOLOGICAL

Can we model 2-way feedbacks between changing biological systems and linked socio-economic systems?

MICE and MSE : developing climate-smart management responses

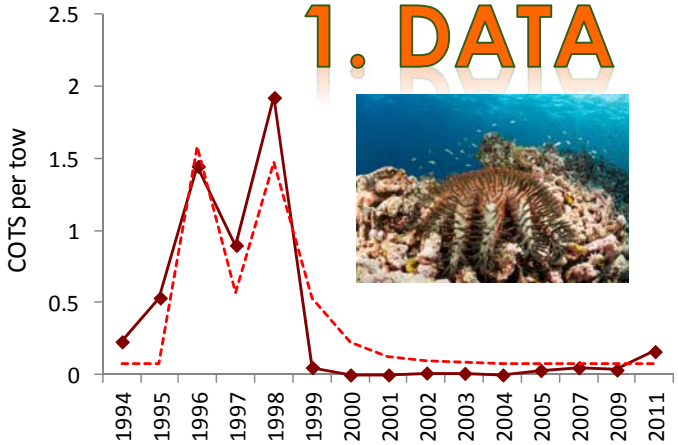
Models of **I**ntermediate **C**omplexity for **E**cosystem assessments

Management **S**trategy **E**valuation

Lobster image – Wikipedia commons

TOOLBOX

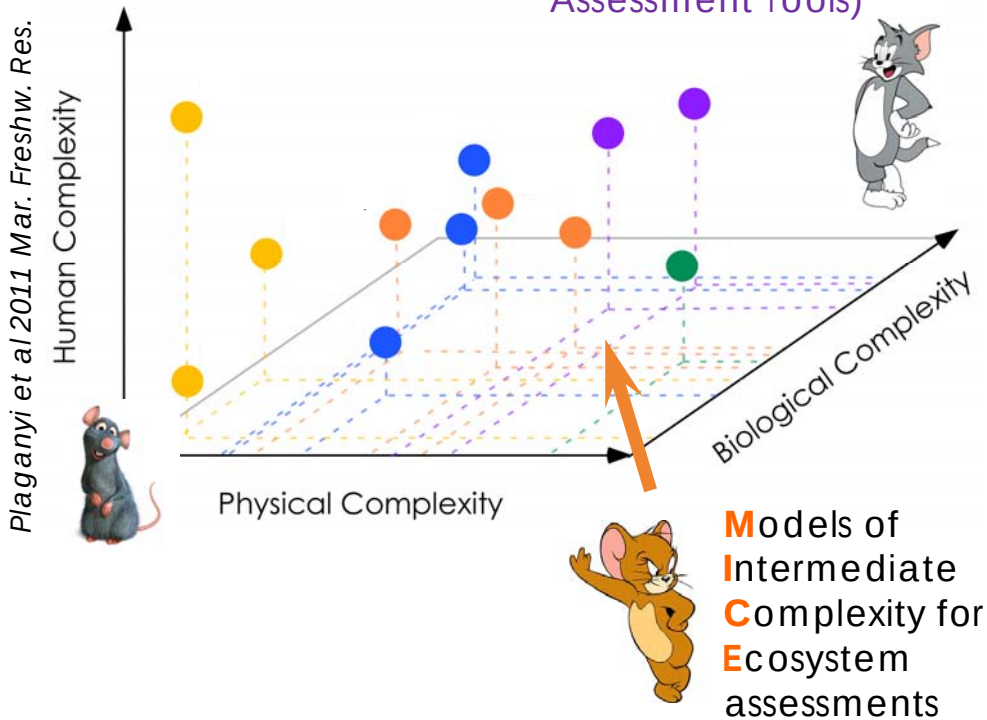
1. DATA



Courtesy: AIMS

2. MICE

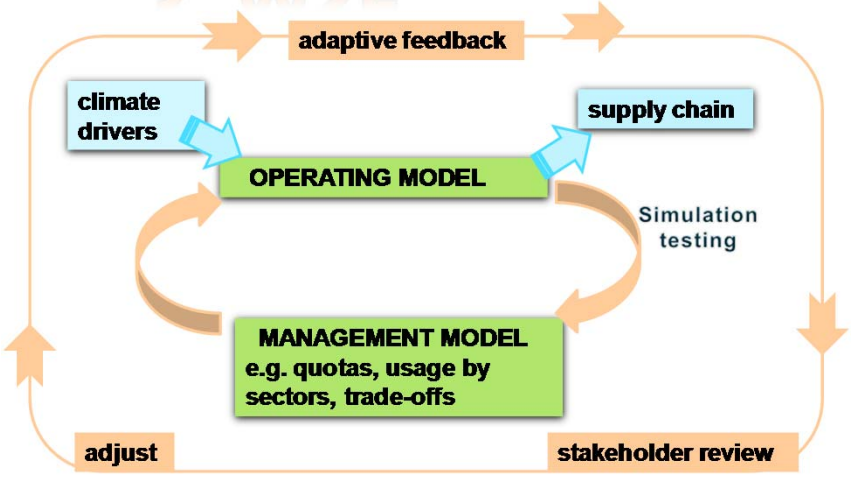
CATS (Complex Assessment Tools)



Models of
Intermediate
Complexity for
Ecosystem
assessments

3. MSE

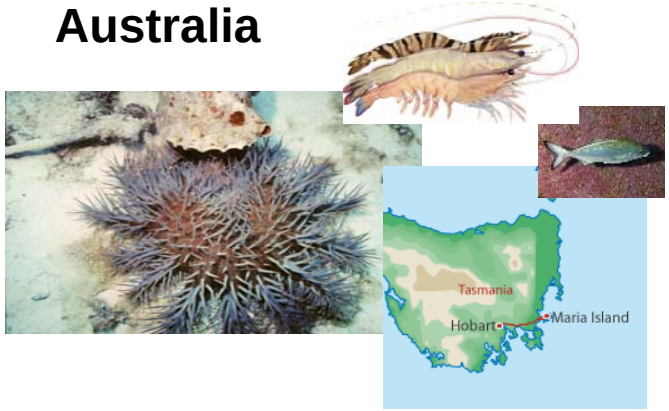
Management
Strategy
Evaluation



MICE Examples

Models of Intermediate Complexity for Ecosystem assessments

Australia



Antarctic (Viv Tulloch)

THURSDAY 4:45pm

India (GULLS, Belmont)

Brazil (GULLS)

South Africa (Laura Blamey)

FRIDAY 9:15am

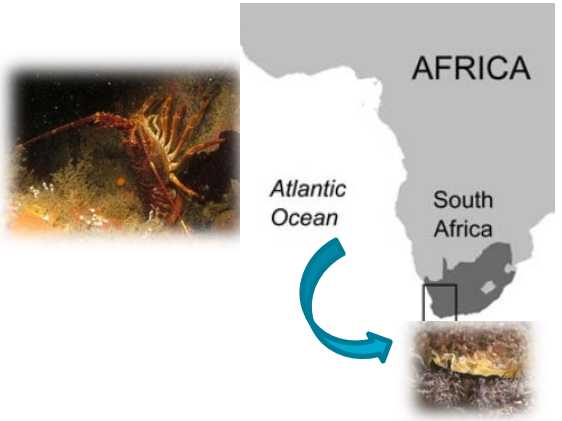
Italy (Angelini et al. 2015)

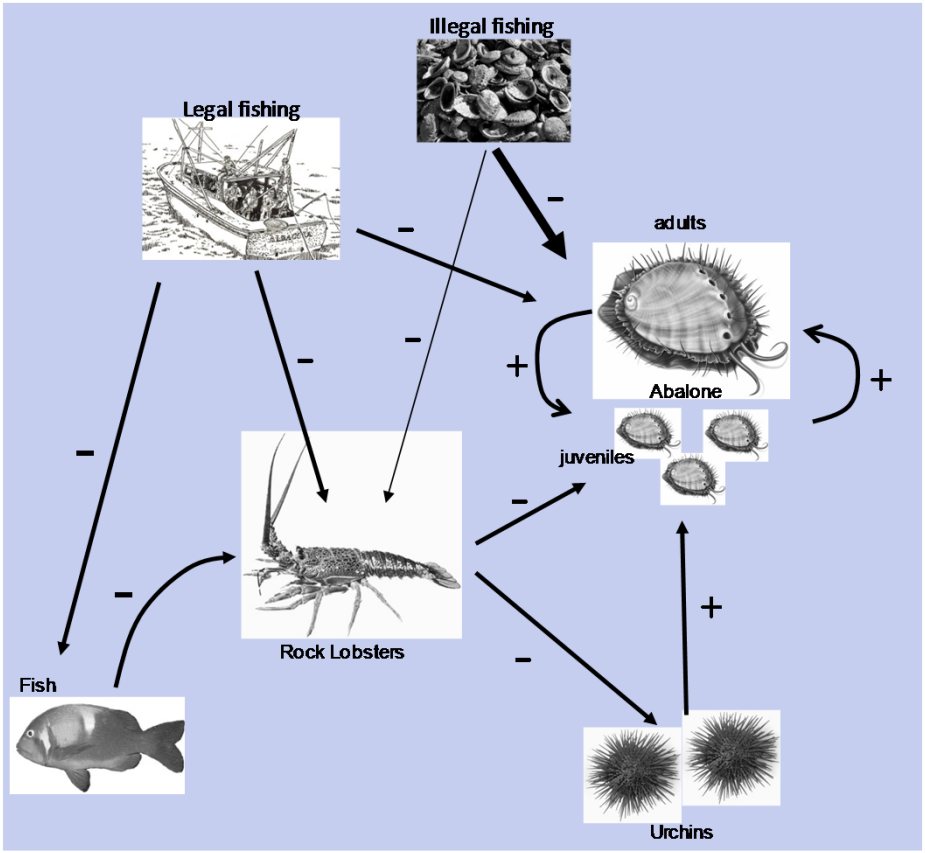
Madagascar (GULLS; GLORIA)

Photo credits: abalone – Rob Tarr; Indian mackerel - Dr Alex Tattersall, National news & pictures

ABALONE-URCHIN-LOBSTER MODEL

Lobster (*Jasus lalandii*) shifted its distribution

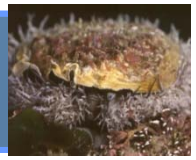




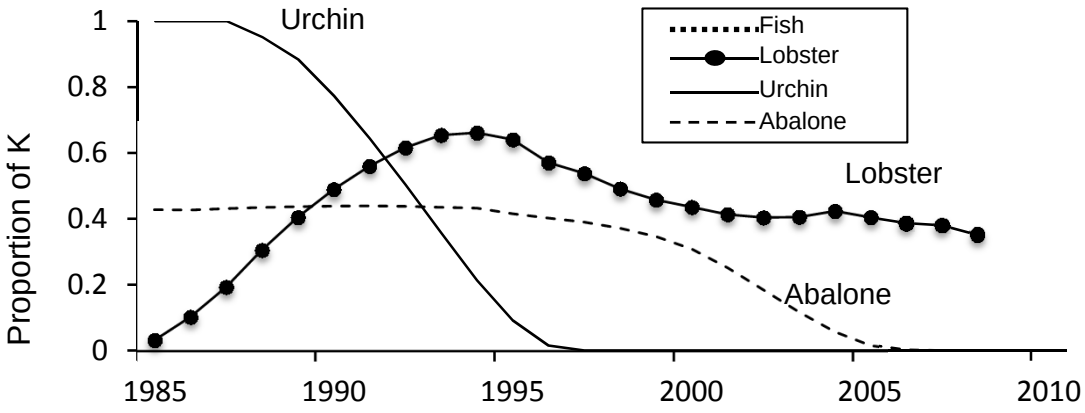
1. What can we learn about system resilience from studying a system impacted by a shifting species?

Source: Blamey et al (2014) Ecol. Mod.

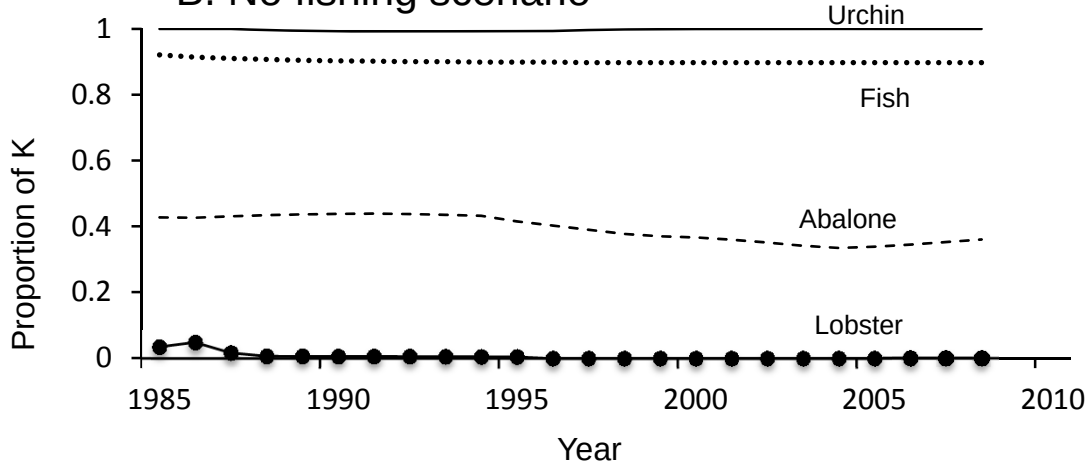
Simulation testing climate-smart strategies



A. With historic overfishing



B. No fishing scenario



Overfishing scenario:

Lobsters invade range of abalone, deplete urchins, change benthos and crash abalone population

RESILIENCE

Sustainable fishing scenario:

Lobsters invade range of abalone, but are kept in check by fish hence system resilient to changes

From Blamey, Plaganyi, Branch 2014. Ecol. Mod.

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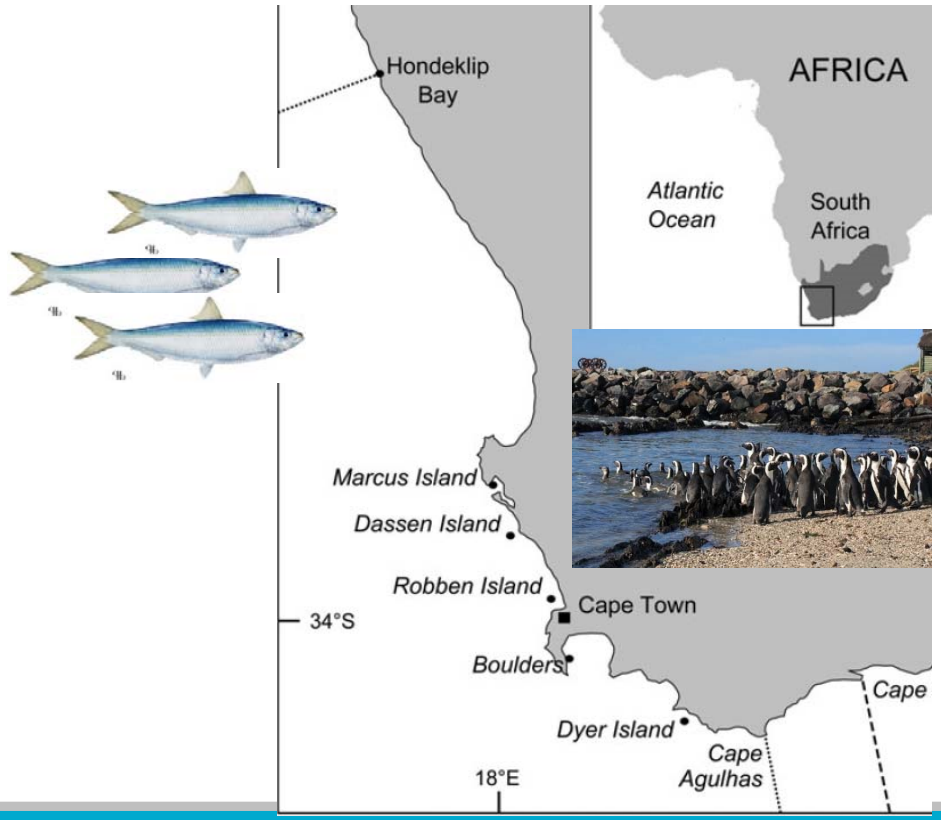
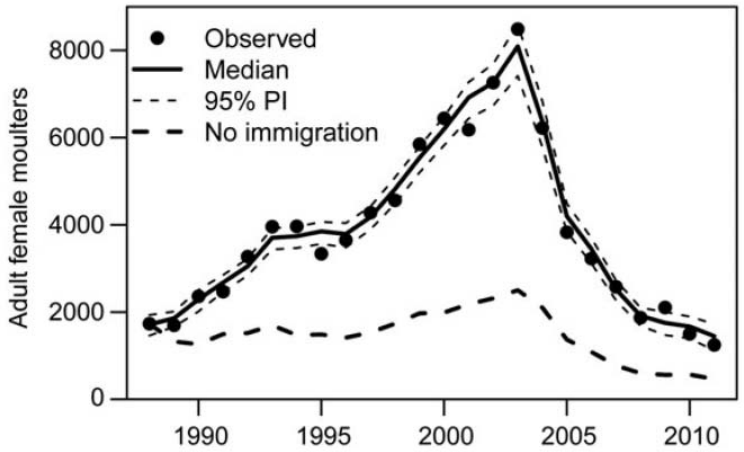
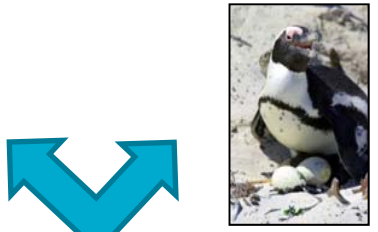
SEPARATING EFFECTS OF FISHING & CLIMATE

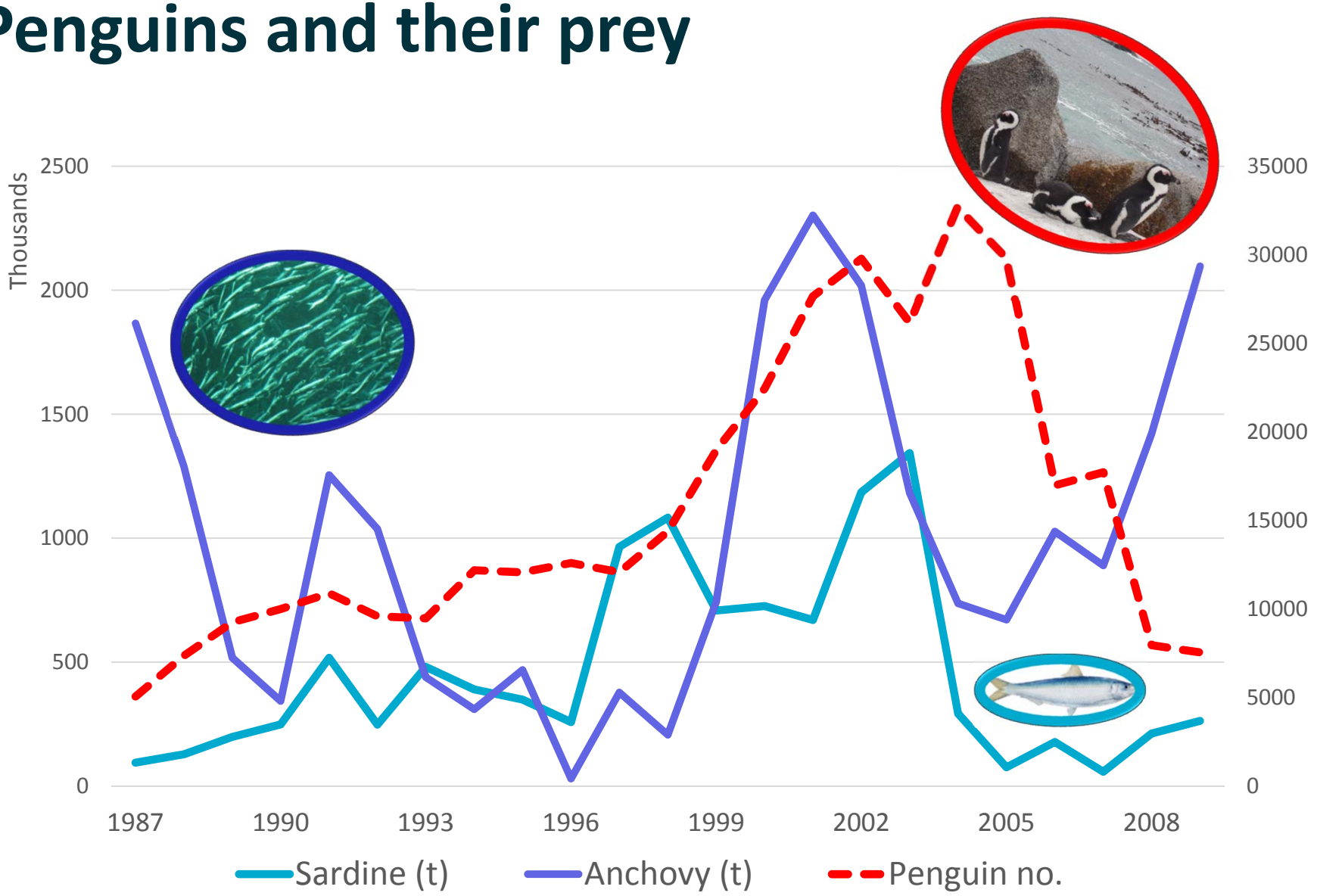
- South Africa pelagic fishery (sardine and anchovy) – recognition that food requirements of predators such as African penguins need to be accounted for in the management process



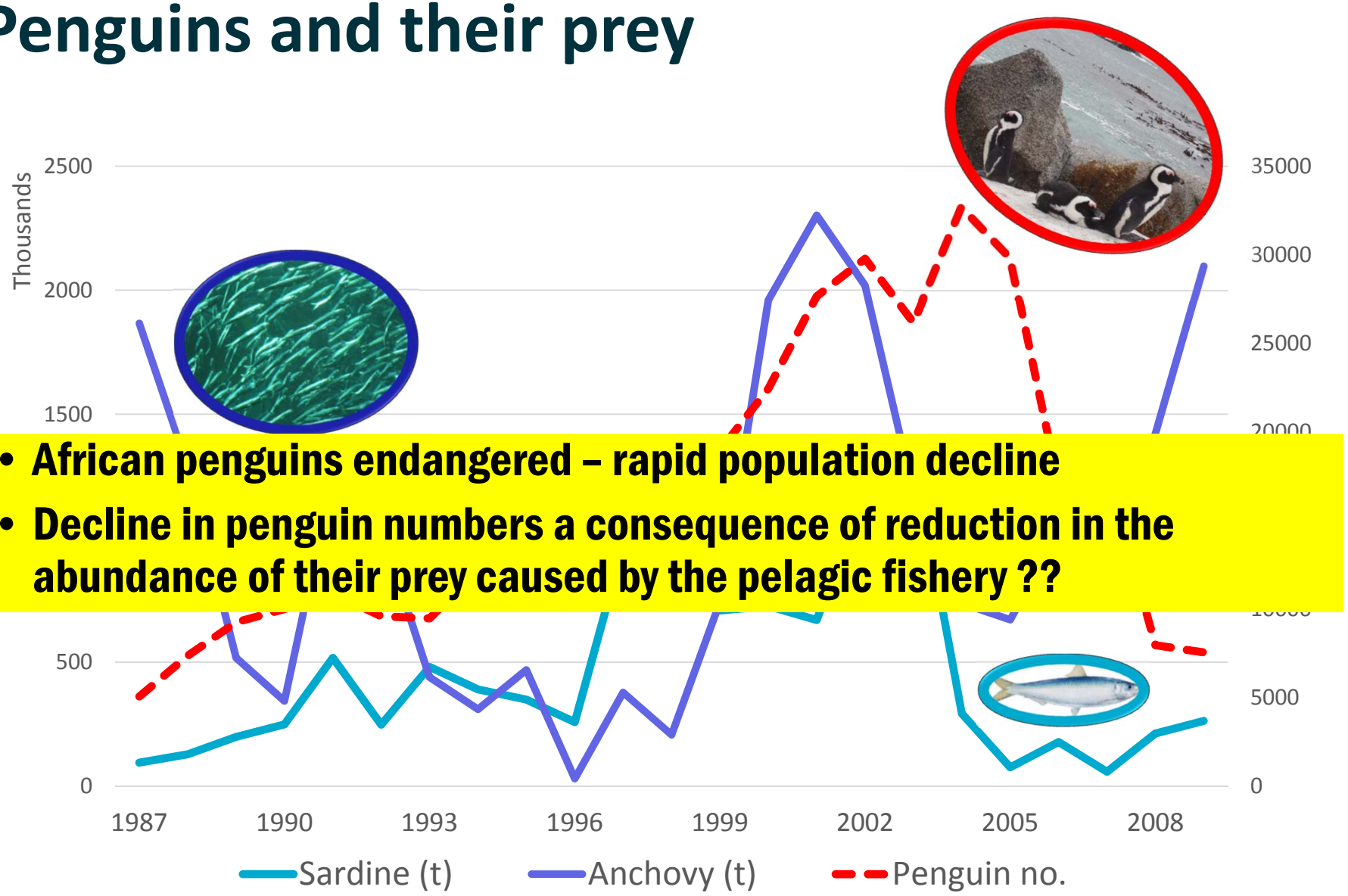




Penguins and their prey



Penguins and their prey

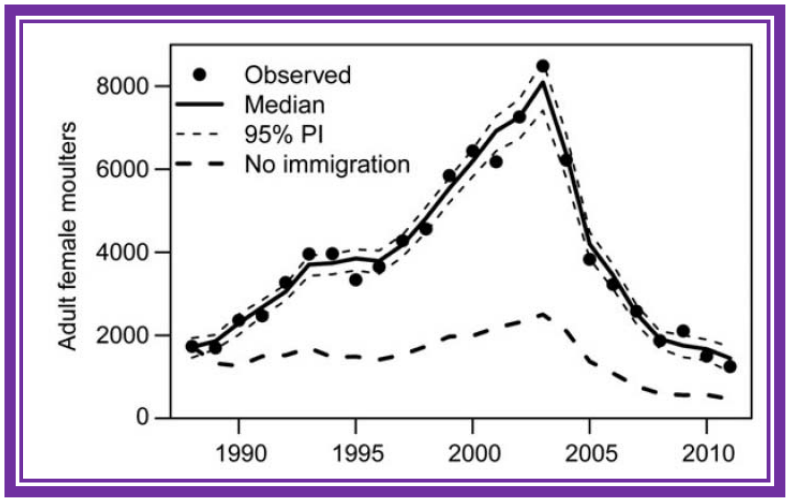


- **African penguins endangered – rapid population decline**
- **Decline in penguin numbers a consequence of reduction in the abundance of their prey caused by the pelagic fishery ??**

Management Strategies for industry and conservation

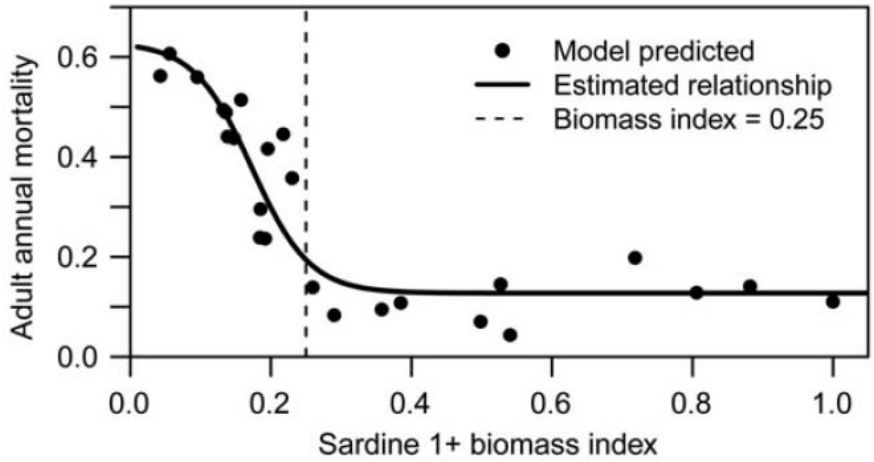
- Models and management (eg harvest control rules) need to account for both target species and dependent predator
- Link penguin population model with outputs of the operating models that underpin the testing of Management procedures for sardine and anchovy (de Moor and Butterworth, 2012)

Bayesian estimation fitting counts of moulting penguins and re-sightings of tagged penguins to estimate Robben Island penguin demographic parameters and link these to prey abundance data



MAIN FINDINGS NOT AS EXPECTED

- Model indicated a lack of impact of changes in anchovy abundance on penguin annual reproductive success
- Primary reason for the post-2003 penguin decline = increase in **adult natural mortality**
- Attributed to reduced abundance of sardine off the South African west coast



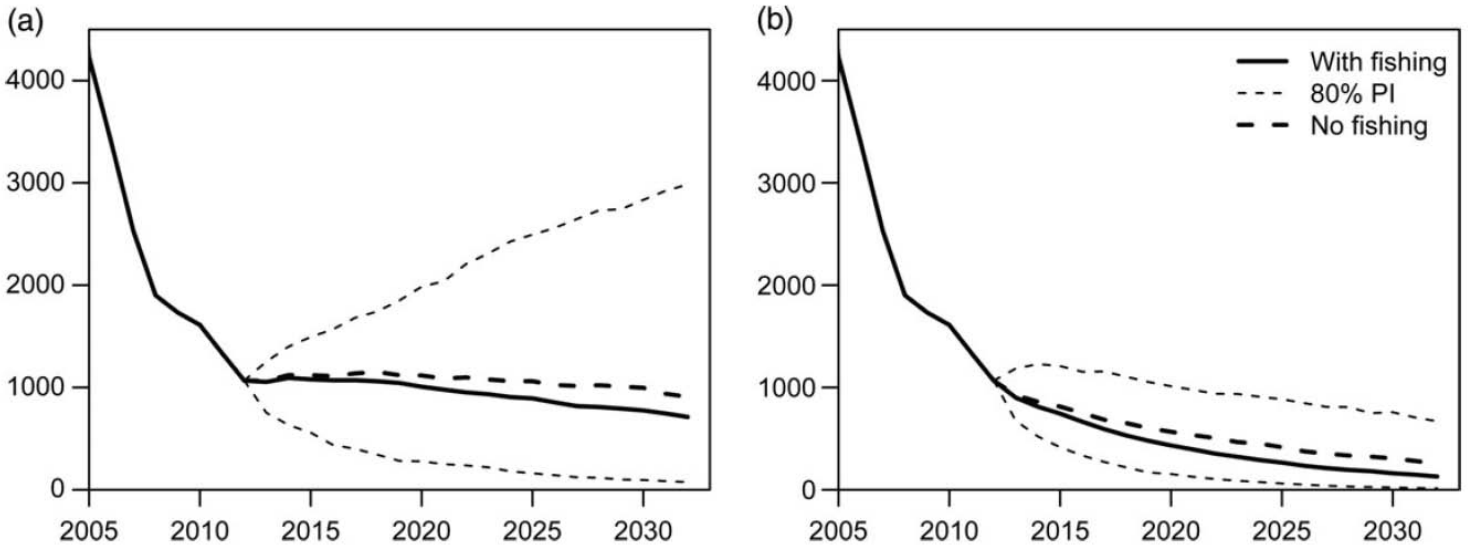
➢ Mainly a consequence of a recent **east-ward shift in the sardine distribution**

Ref: Robinson, et al. 2015. *ICES J Mar Sci*

IMPLICATIONS FOR MANAGEMENT

The impact of fishing on penguin numbers through the reduction in total sardine biomass by the fishery is rather small, especially when compared with other factors influencing the dynamics

Strategies for managing regional penguin populations?



Ref: Robinson, et al. 2015. *ICES J Mar Sci*

Shifting species cause shifts in humans and socio-ecological systems too..

- Socio-economic impacts of changes in distribution of targeted species e.g. adaption planning needed re where future processing plants should be built

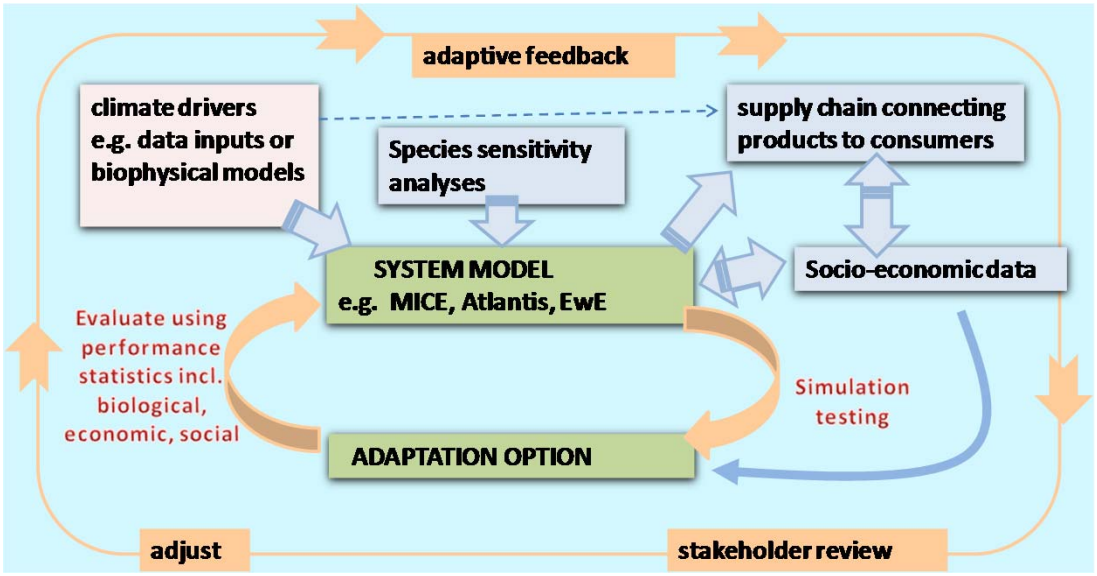
SPECIES ON THE MOVE

but humans move too..

Can we predict changes in the numbers and types (eg tourists, fishers) of humans moving in/out area together with 2-way feedback between humans and environment?

Making MICE social..

- e.g. high quality ecosystem attracts fishers with negative impact on ecosystem – if reduces system resilience, may increase sensitivity to regime shift, and degraded ecosystem in turn influences no. of tourists



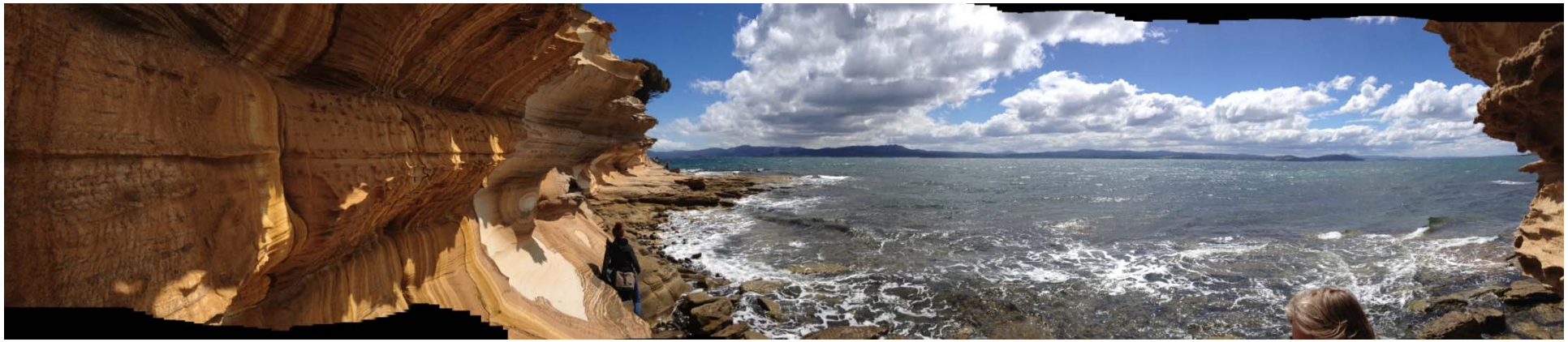
Maria Island, Tasmania, Australia

www.marinehotspots.org

Sense of Place

- Sense of Place Index (**SOPI**) – ecosystem quality influences participation eg in fishing, tourism
- Incorporating dynamic feedbacks in social-ecological models that take into account hard-to-quantify aspects such as the combination of characteristics or activities that make a place or activity special - Sense of Place Index (SOPI)
- Model feedbacks between changing environment and human uses

What is the sense of place?
It is a combination of characteristics that makes a place special and unique. Sense of place involves the human experience in a landscape, the local knowledge and folklore. Sense of place also grows from identifying oneself in relation to a particular piece of land on the surface of planet Earth.
http://www.artofgeography.com/info/the-sense-of-place



Quantifying climate-smart management responses

Under a changing climate need to pre-test climate-smart strategies that account for multiple objectives & complexities e.g. sustainable catches & system resilience; mismatches between predator & prey; humans on the move too

- Rigorous quantitative analyses:
  - understand and correctly attribute reasons for changes
  - check if planned management responses have the desired impact
- Socio-ecological models being developed in recognition of complex linkages between climate, human and natural systems

Models of Intermediate Complexity for Ecosystem assessments

Thank you

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Laura Blamey
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Doug Butterworth

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Belmont forum