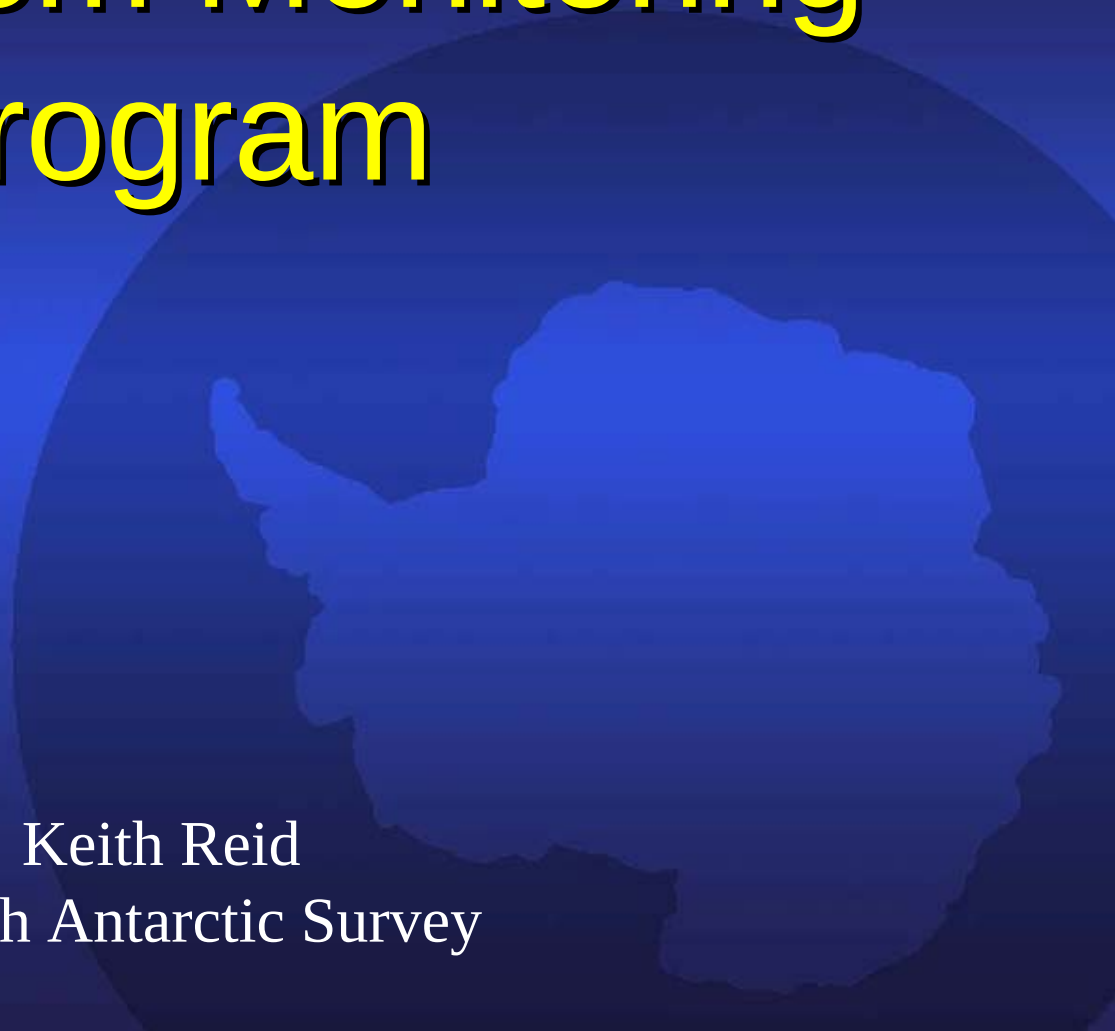
The CCAMLR Ecosystem Monitoring Program



Keith Reid
British Antarctic Survey

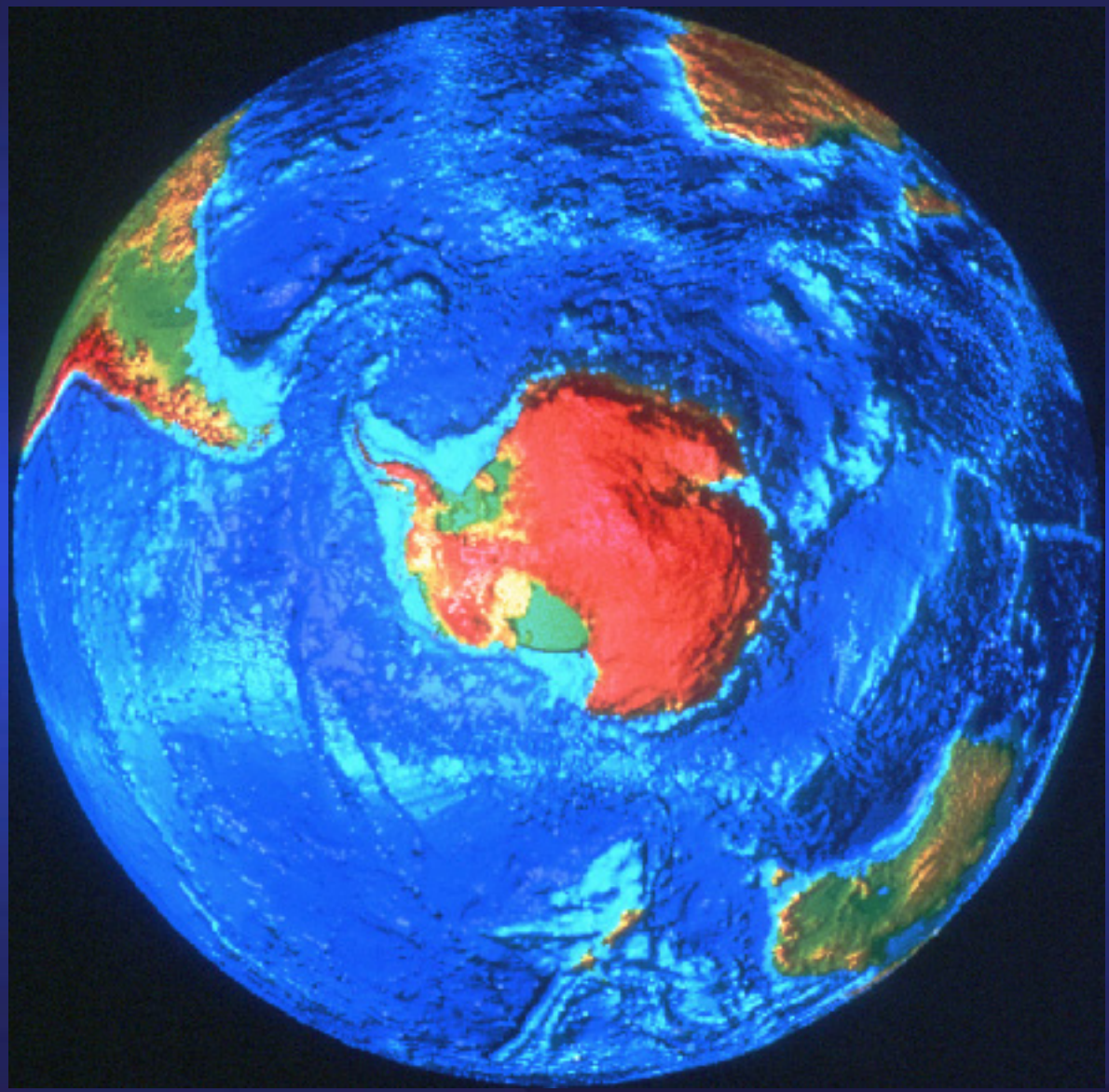
OUTLINE

Antarctic and CCAMLR

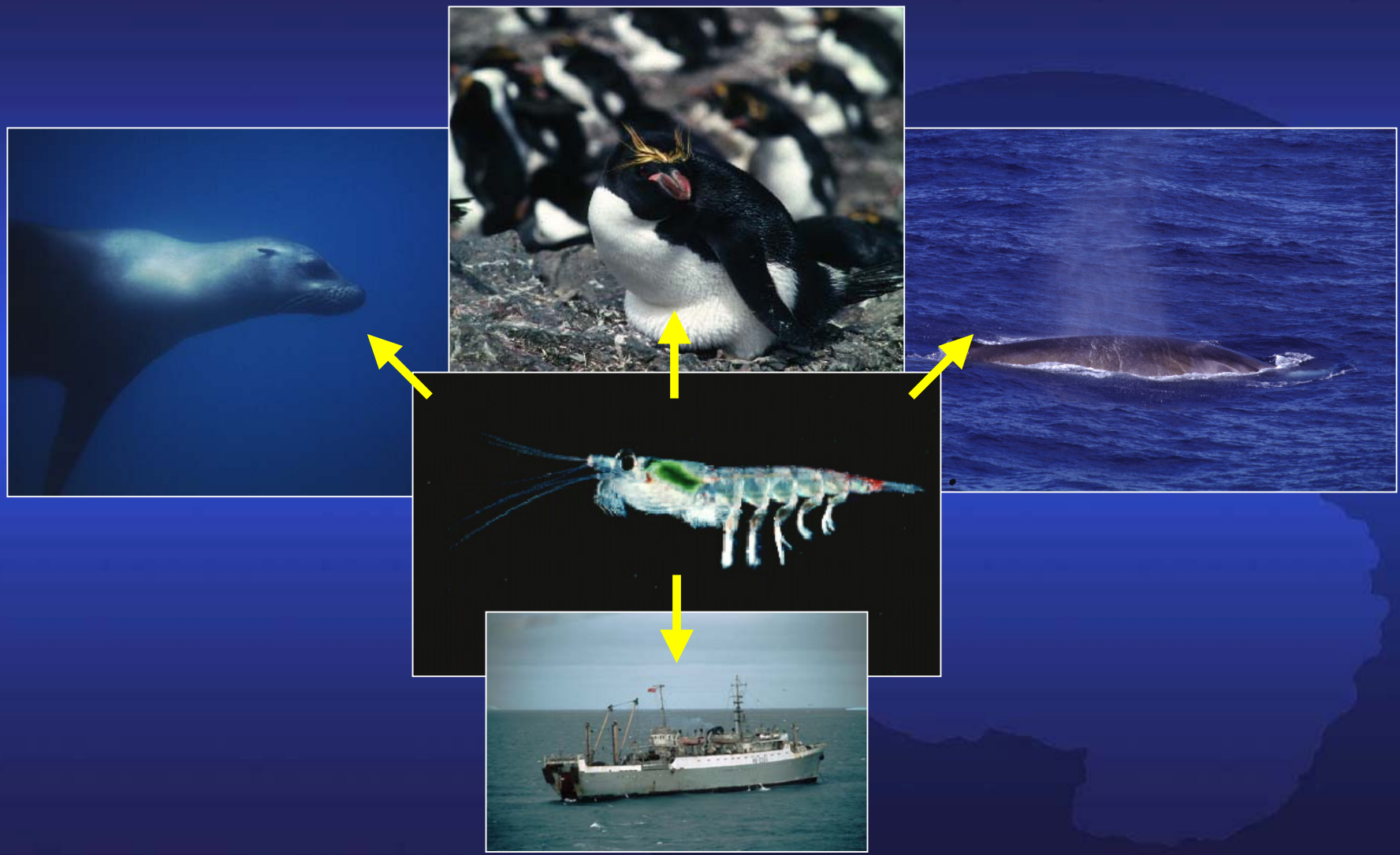
Predator based ecosystem monitoring

Presenting and utilising monitoring data

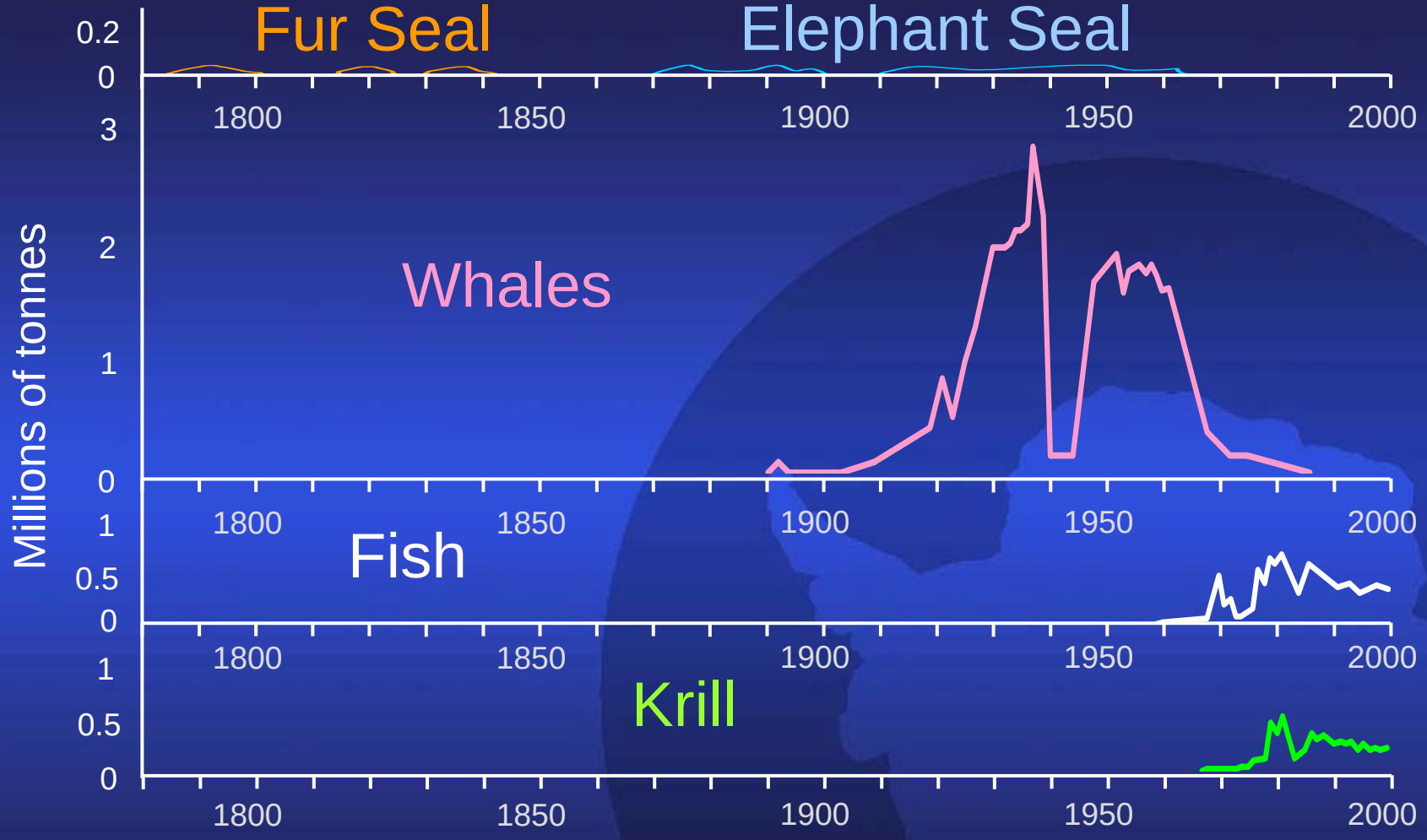
The Southern Ocean



Generates nutrient rich conditions which sustain one of the world's greatest concentrations of marine resources and their dependent species



Antarctica- the pristine wilderness ?



Long history of human harvesting

Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR)

Response to potential consequences of krill harvesting

'Ecosystem Approach'

Initiated at Antarctic Treaty Meeting in 1977
Convention came into force in 1982

CCAMLR
Principles of Convention (1982)

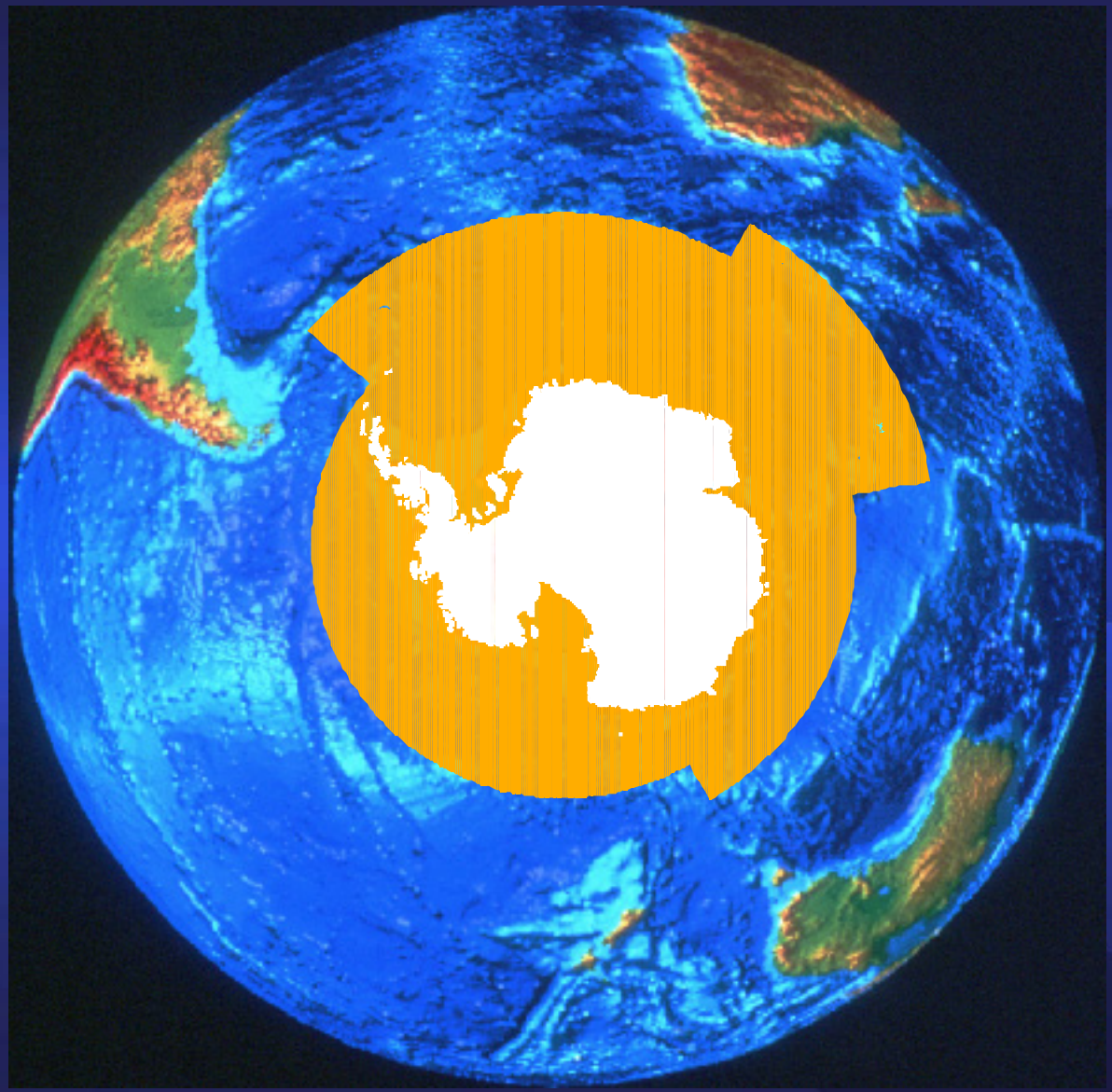
3. Any harvesting … shall be conducted in accordance … with the following principles of conservation:

(a) prevention of decrease in the size of any harvested population to levels below those which ensure its stable recruitment….

(b) maintenance of the ecological relationships between harvested, dependent and related populations and the restoration of depleted populations and

(c) prevention or minimisation of the risk of changes in the marine ecosystem which are not potentially reversible over two or three decades,

The CCAMLR Area



- 32 million km^2
- Similar size to the North Atlantic Ocean

Members of CCAMLR

- New Zealand
- United Kingdom
- France
- South Africa
- Australia
- Japan
- Chile
- USA
- Argentina
- India
- Italy
- Spain
- Brazil
- Sweden
- Namibia
- Russia
- Uruguay
- EC
- Korea
- Belgium
- Germany
- Norway
- Poland
- Ukraine

States party to the convention but not members of the commission

- Canada
- Peru
- Greece
- Bulgaria
- Finland
- Netherlands
- Vanuatu

Antarctic krill

Population

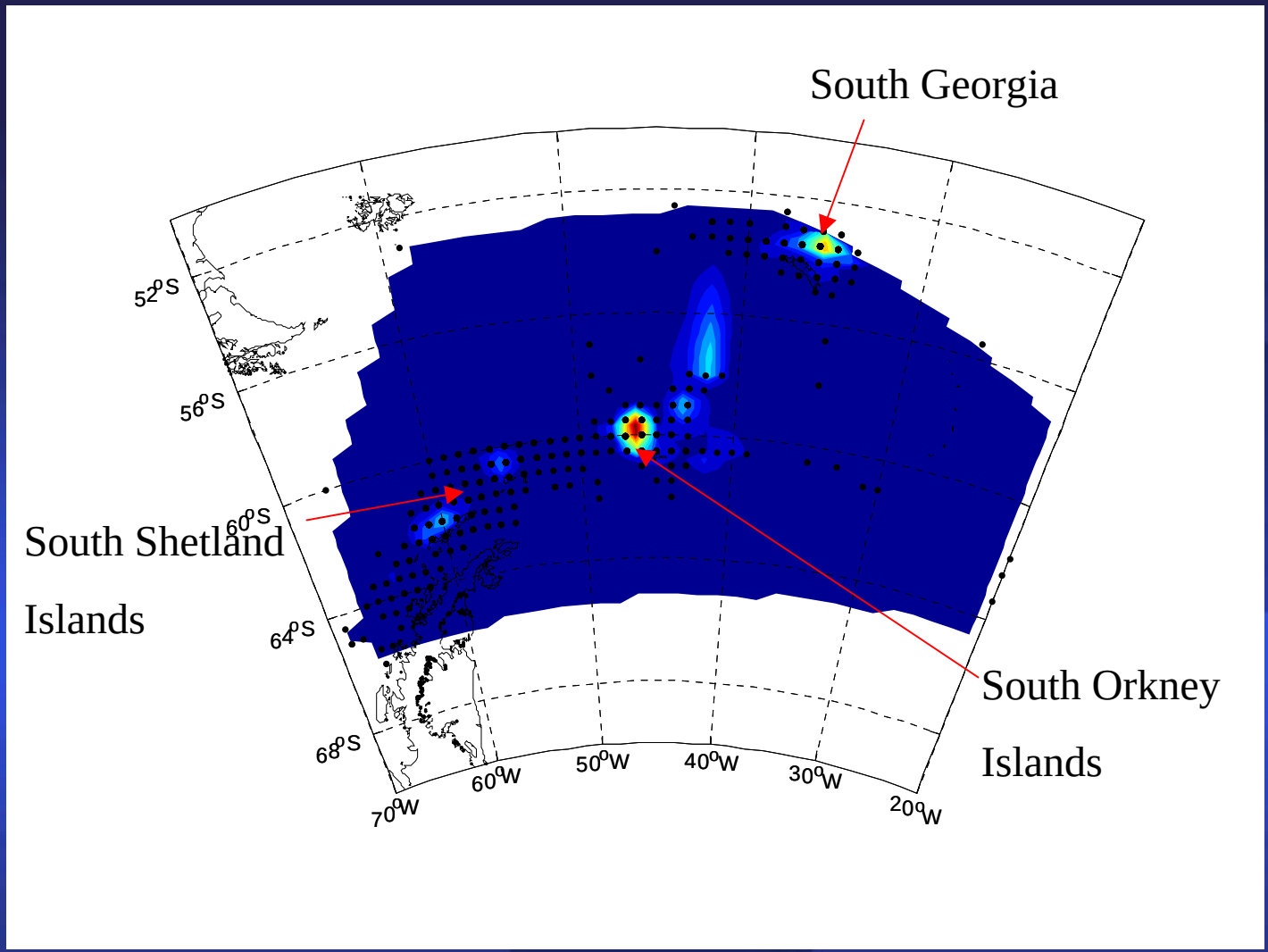
Large stock

- highly aggregated in space and time
- high interannual variation
- epipelagic: diel vertical migrant

Fishery

Relatively small trawl fishery

- highly localised in space and time
- summer at Antarctic Peninsula
- winter at South Georgia



Krill fishery in the southwest Atlantic

CCAMLR Ecosystem Monitoring Program (CEMP)

- To detect…significant changes in critical components of the ecosystem…
- To distinguish between changes due to harvesting…and changes due to environmental variability

What to monitor ?

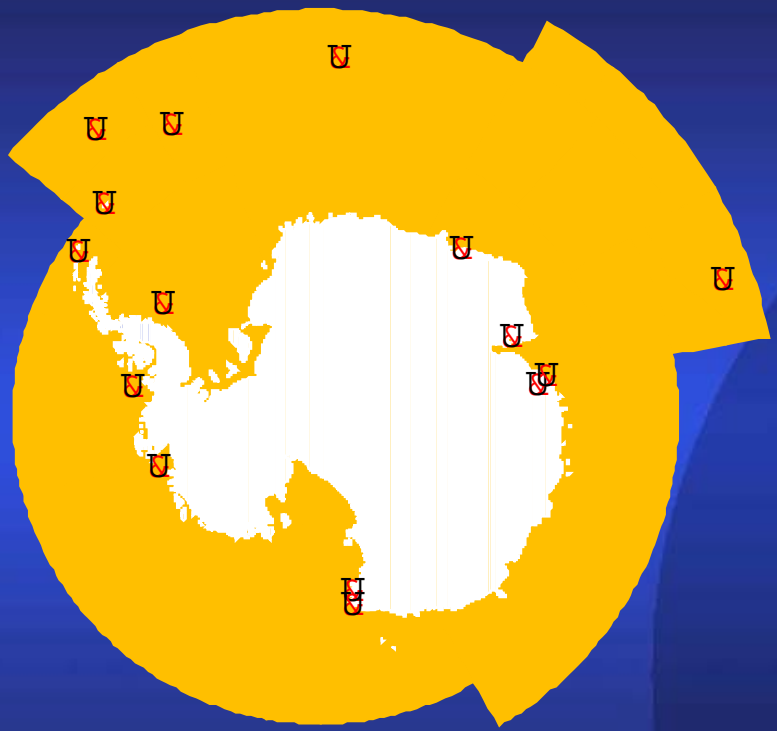
Requirements for a monitoring tool

Reflect ecosystem processes at range of scales
Amenable to repeated measurement
Availability of existing time-series
Integration into science programs

Upper-trophic level predators

CEMP species and sites

Network monitoring sites



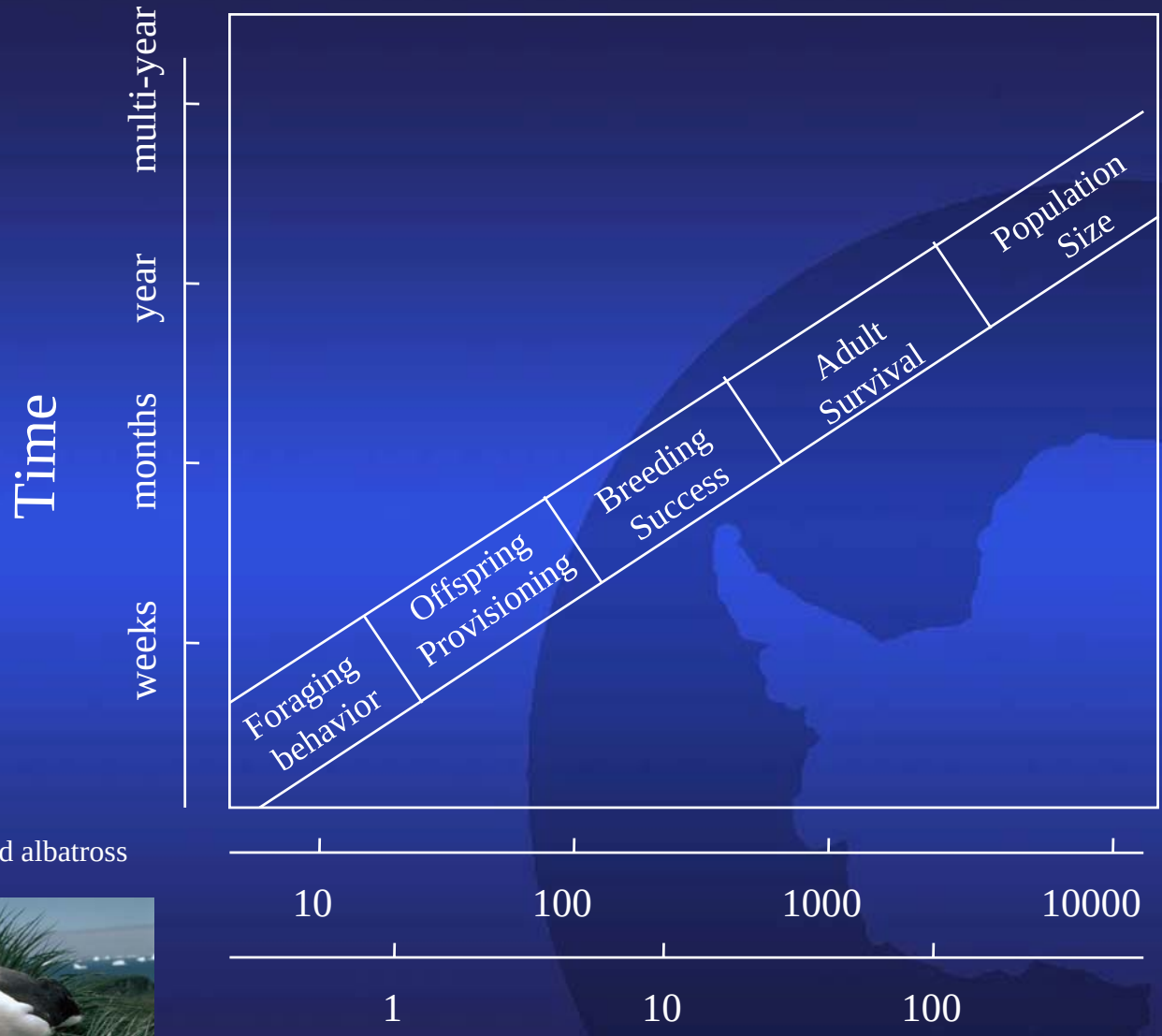
Monitored predatory species

CEMP Parameters

- Breeding population size
- Adult arrival mass
- Foraging trip duration
- Provisioning
- Diet
- Offspring mass
- Breeding success

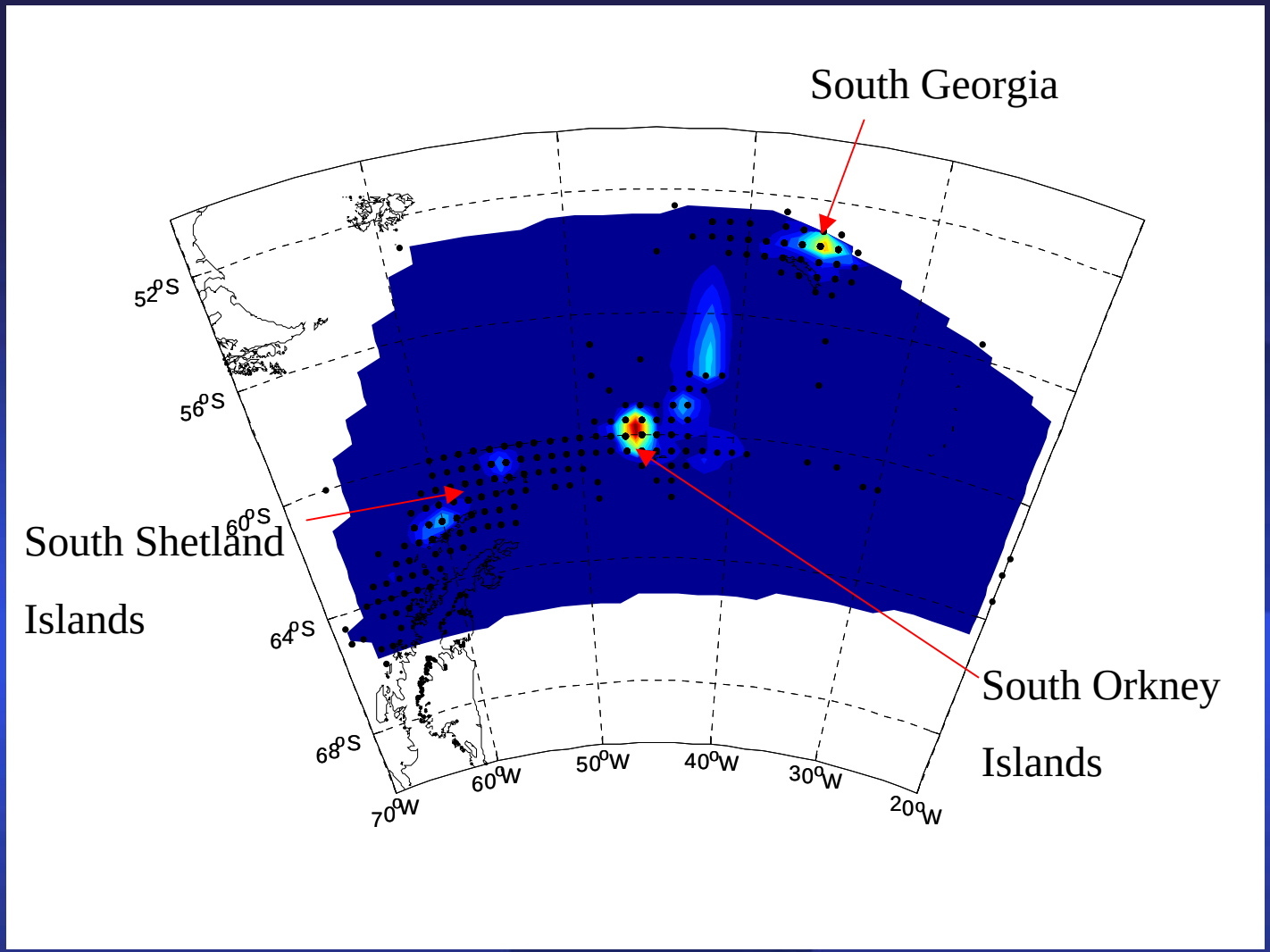
CCAMLR Standard Methods

Scales of monitoring



Black-browed albatross

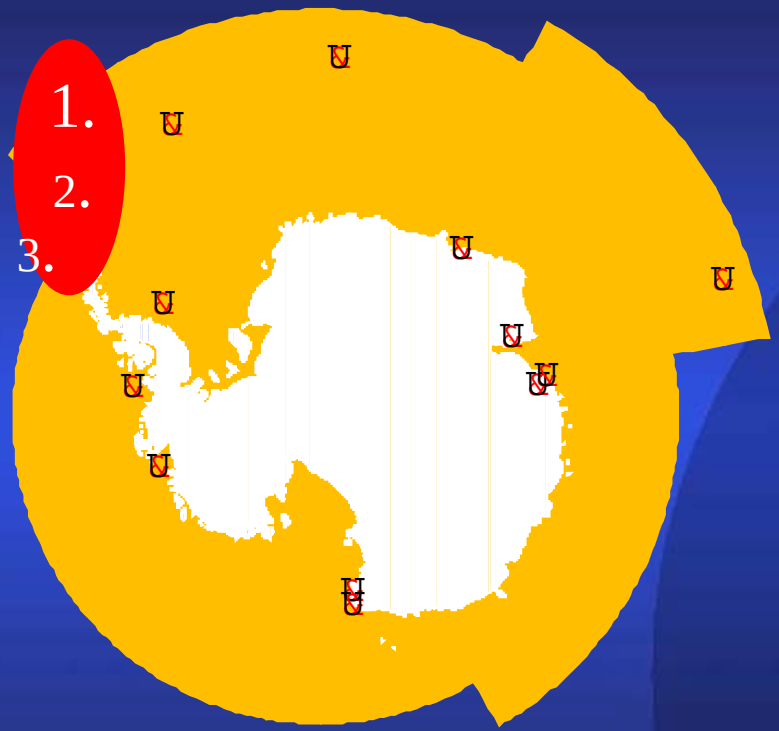
Gentoo penguin



Overlap between fishery and predators of krill

CEMP species and sites

Network monitoring sites



1. South Georgia
2. South Orkney Islands
3. South Shetland Islands

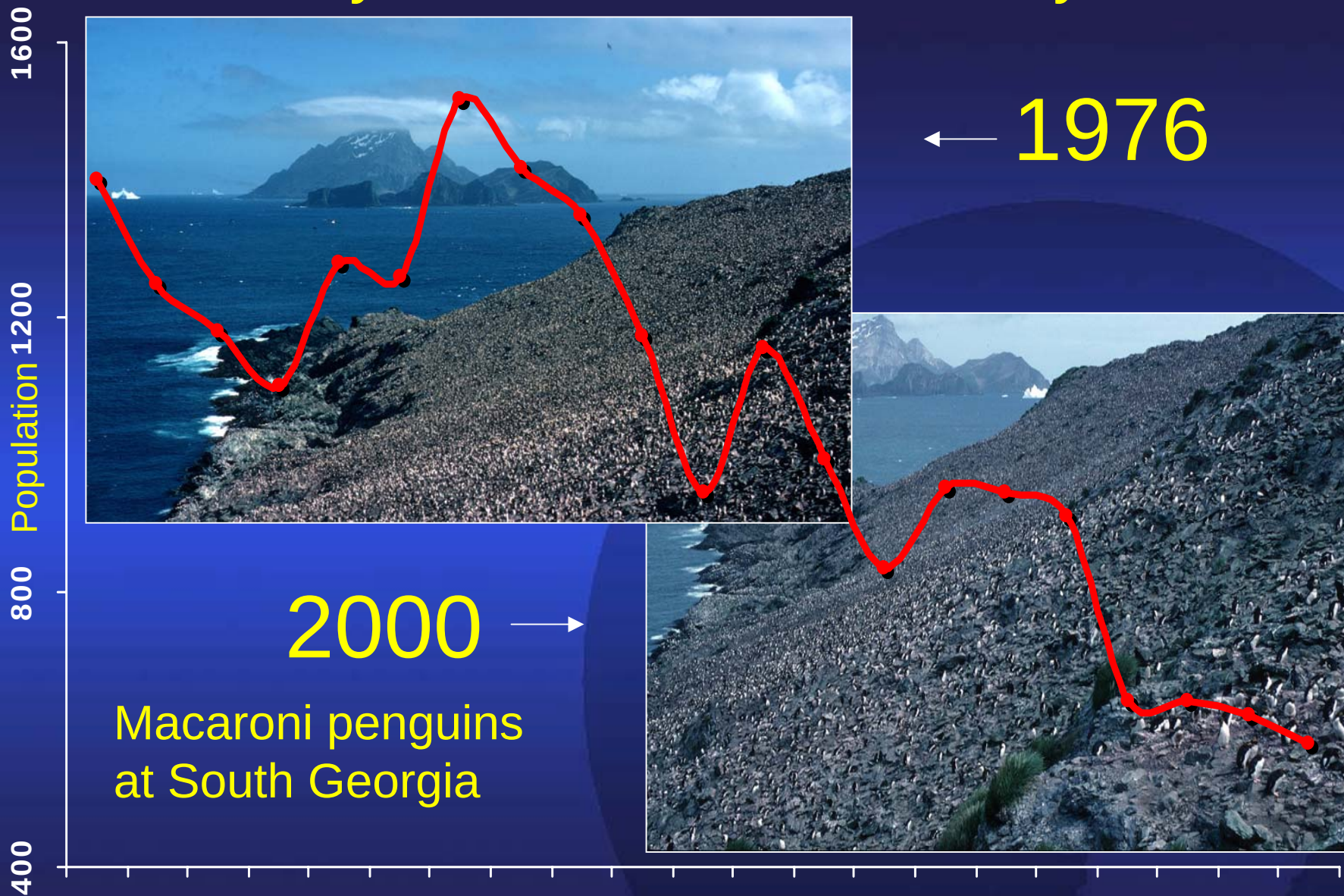
Monitored predatory species

Dynamic decadal variability

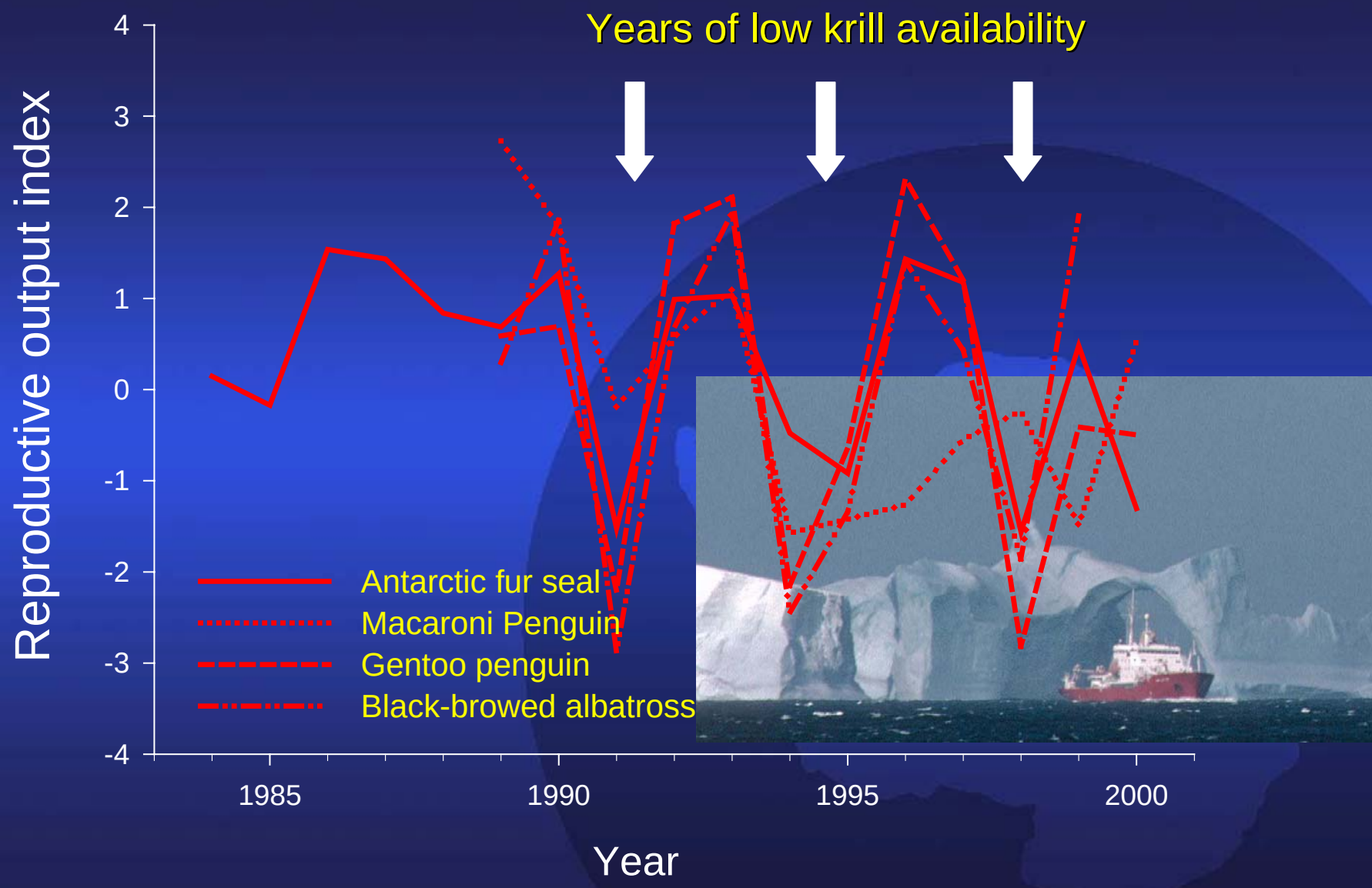
← 1976

2000 →

Macaroni penguins
at South Georgia



Dynamic inter-annual variability



Presenting CEMP data

Matrix of *n* parameters in *m* years

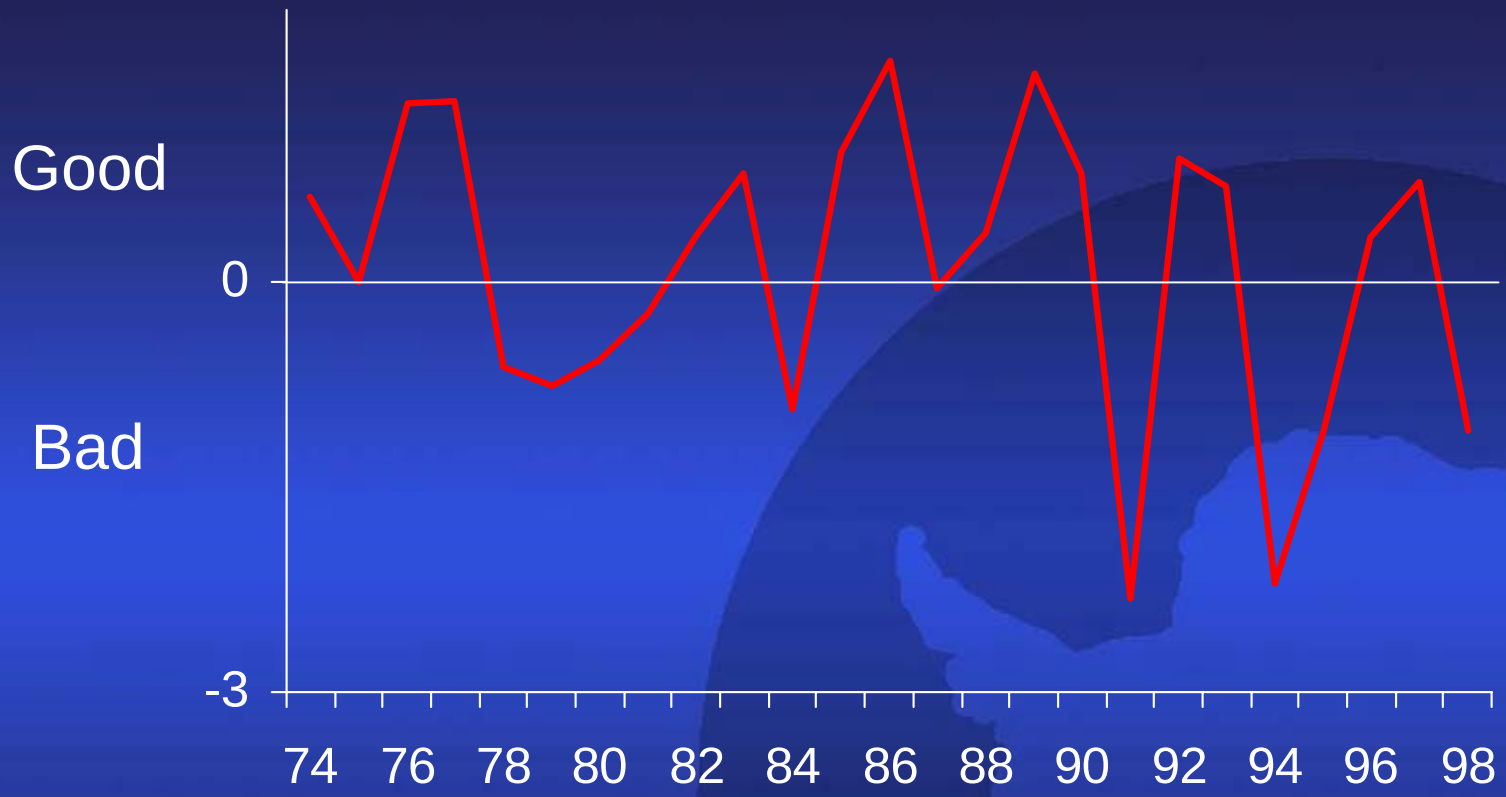
Too much information

Reduce dimensionality

Seeing the wood for the trees

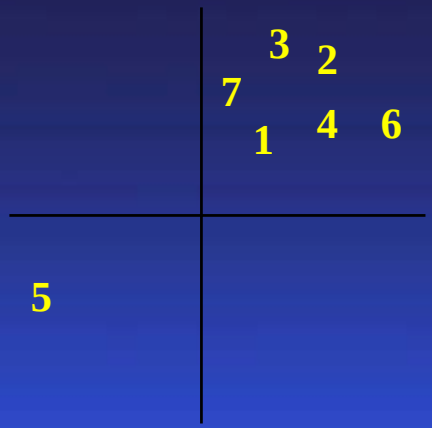
Combining Indices - Ecosystem Response

Combined Standardised Indices

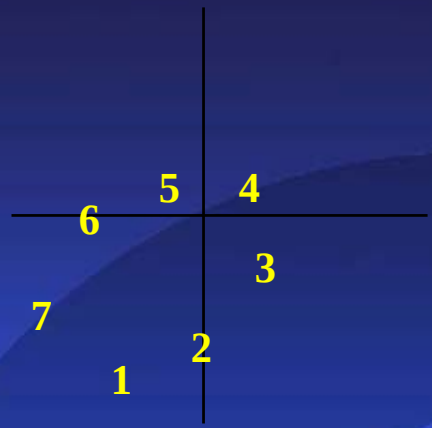


Combining data from 47 predator-performance variables indicates that there was less krill available in the 1990s compared with the 1980s

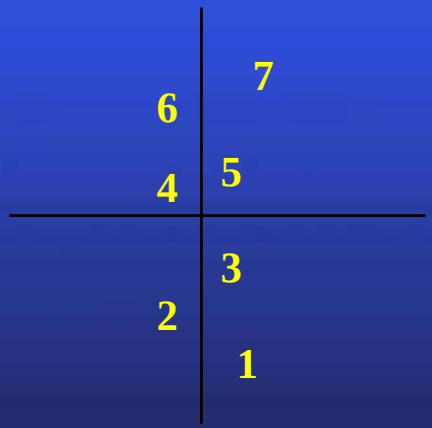
Multivariate ordination



Anomaly



Cycle



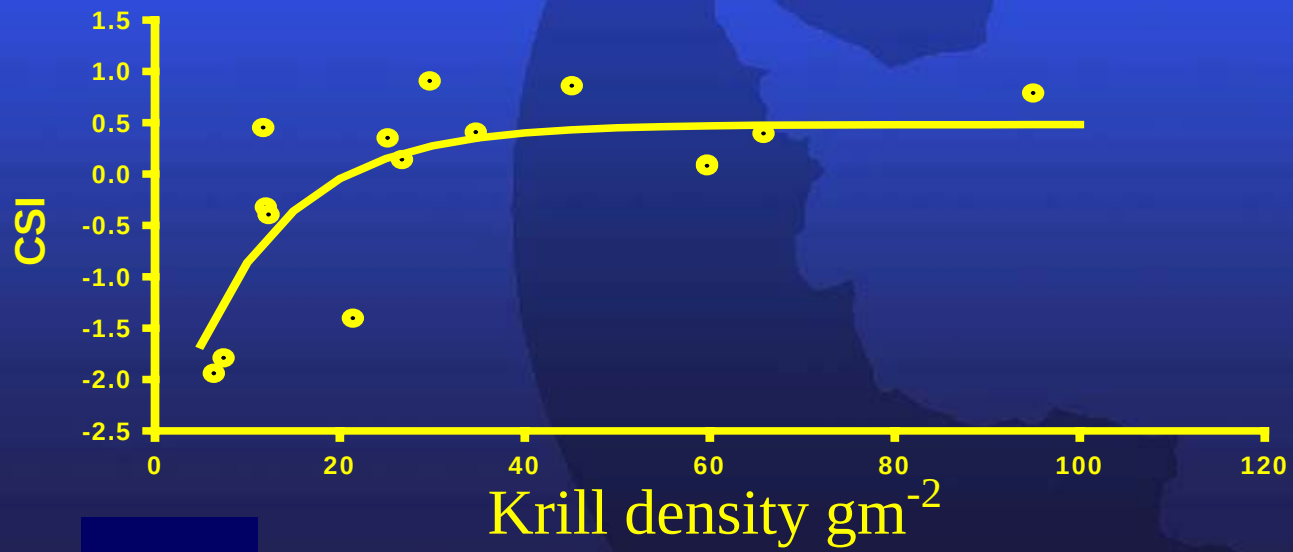
Trend

Shift

Incorporating CEMP data into Fisheries Management

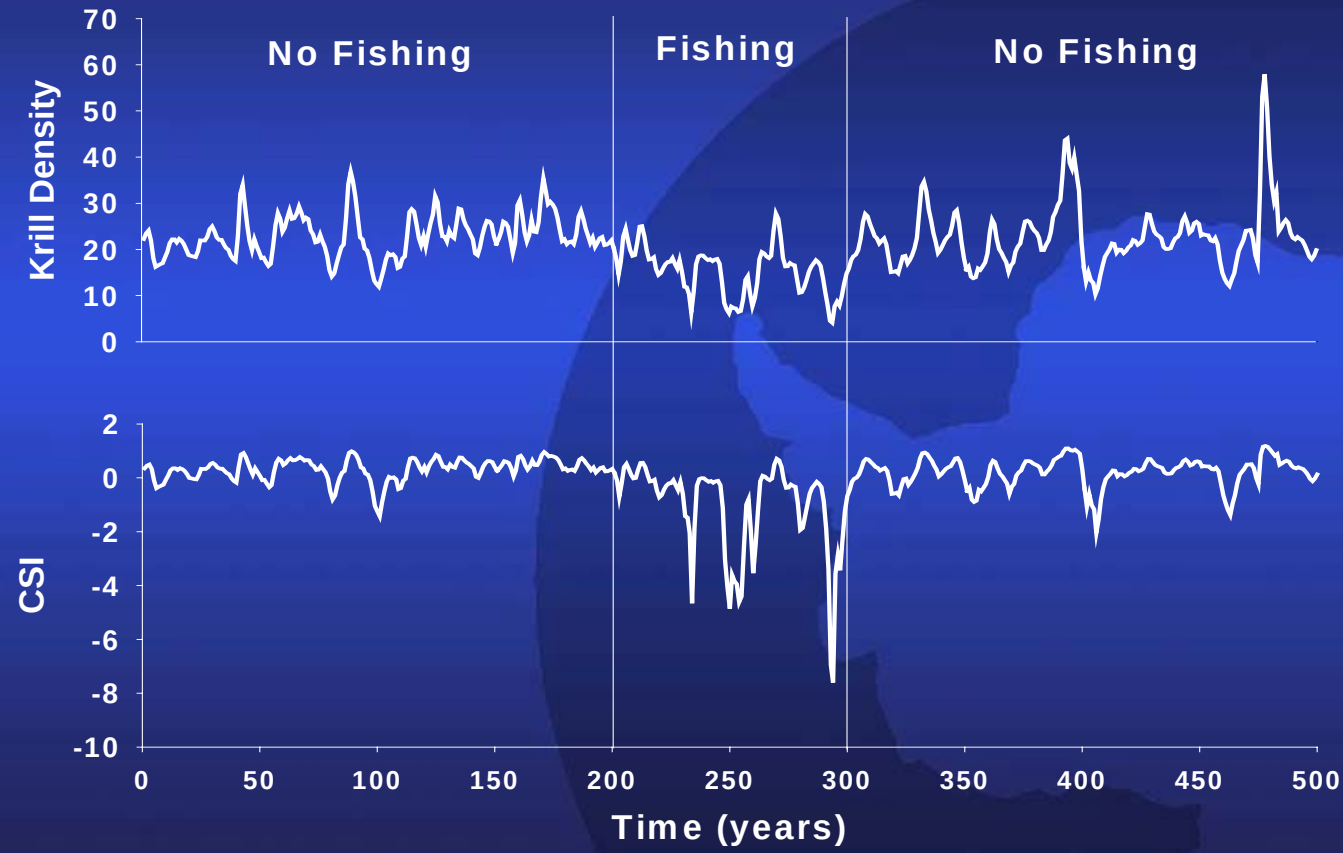
Functional/predator response relationship

Concurrent performance and prey availability



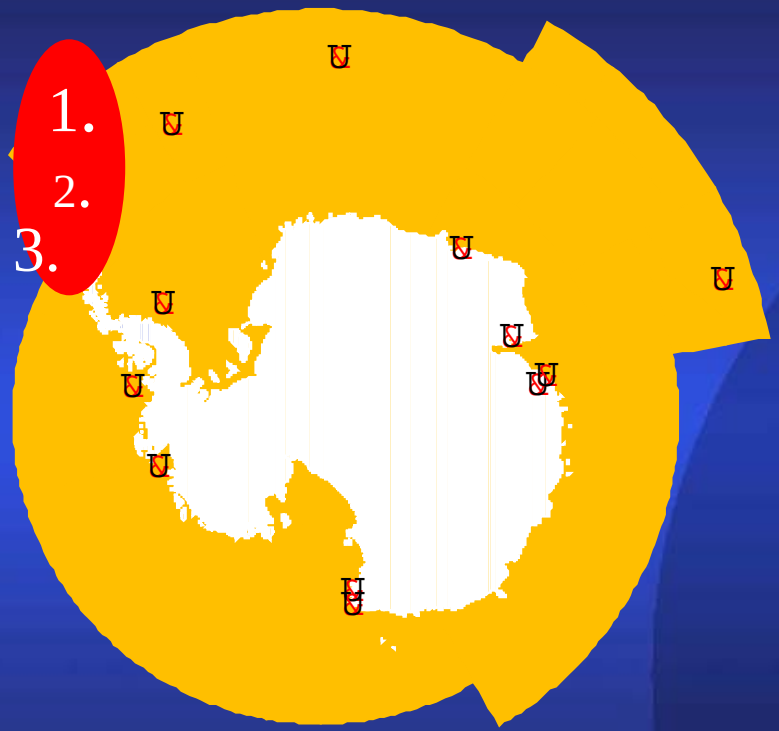
Incorporating CEMP data into Fisheries Management

Simulation framework



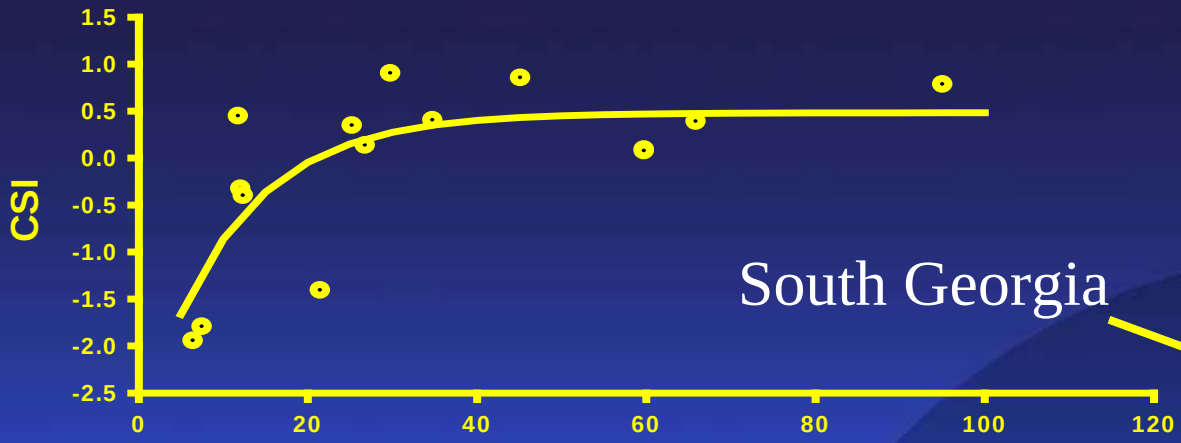
CEMP species and sites

Network monitoring sites

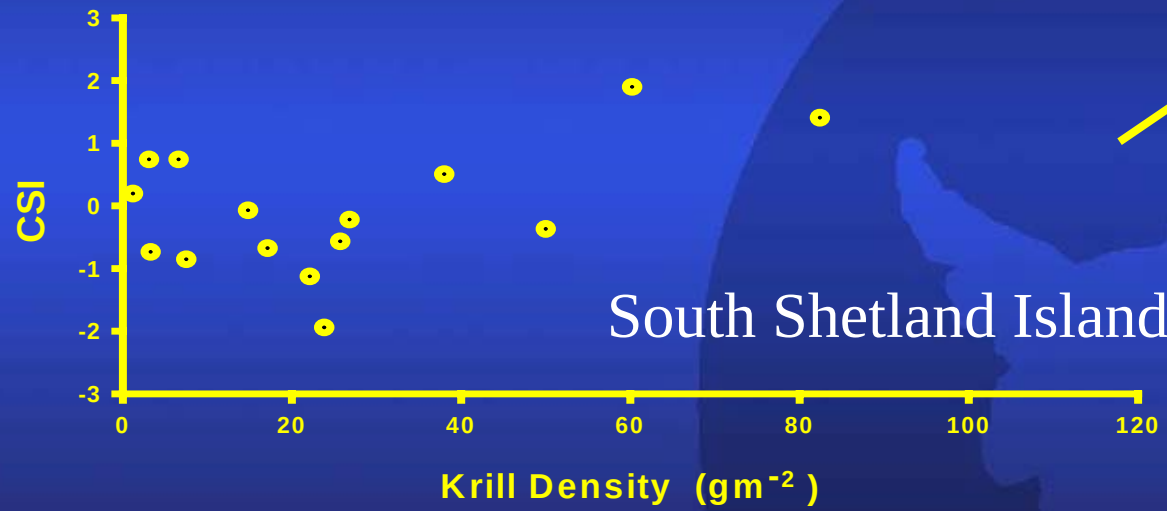


1. South Georgia
2. South Orkney Islands
3. South Shetland Islands

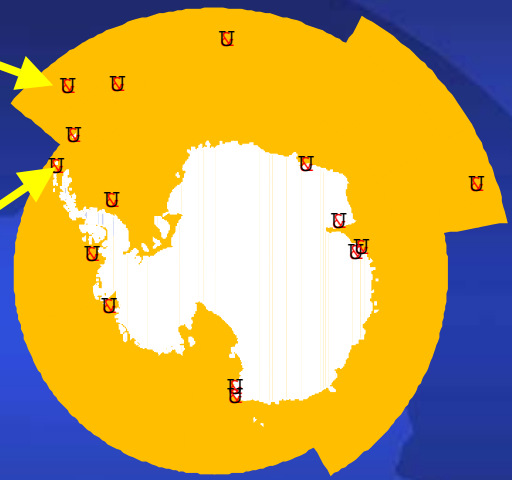
Monitored predatory species



South Georgia



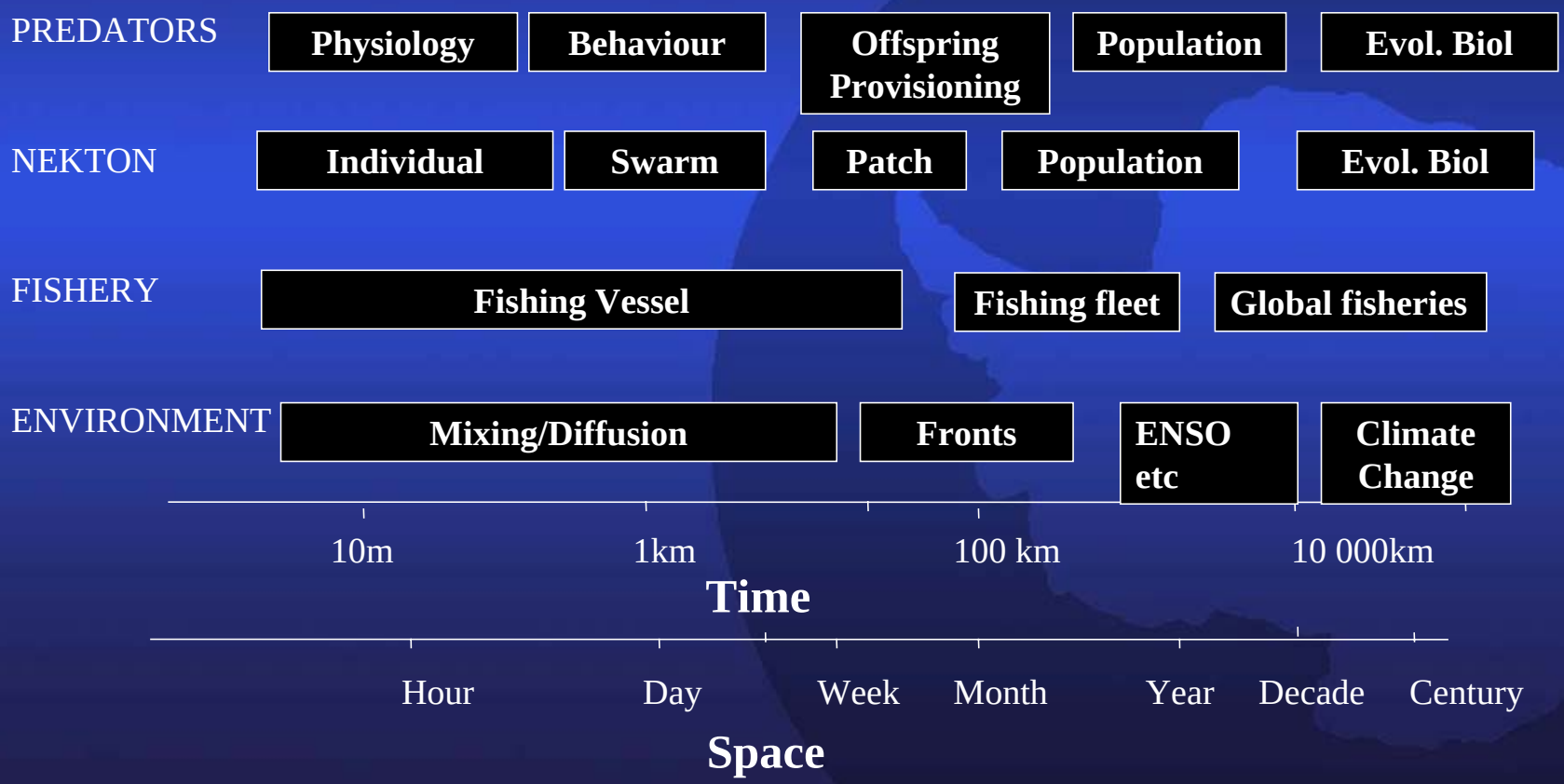
South Shetland Islands



Geographical differences in response of predators to changes in krill

Incorporating CEMP data into Fisheries Management

Scales of interactions



From Monitoring to Management

Detecting change - statistical power

Understanding causes of change - ecological knowledge

Understanding consequences of change - predictive ecosystem models

Conclusions

Predators can be used as ecosystem indicators

Responses to different processes occur at different scales

Identification of scales of operation is crucial for incorporation into management

THANKS

PICES - Bill Sydeman
Colleagues in BAS and CCAMLR

All the people (and the penguins and seals) who have (been) counted, weighed, sorted diet etc etc