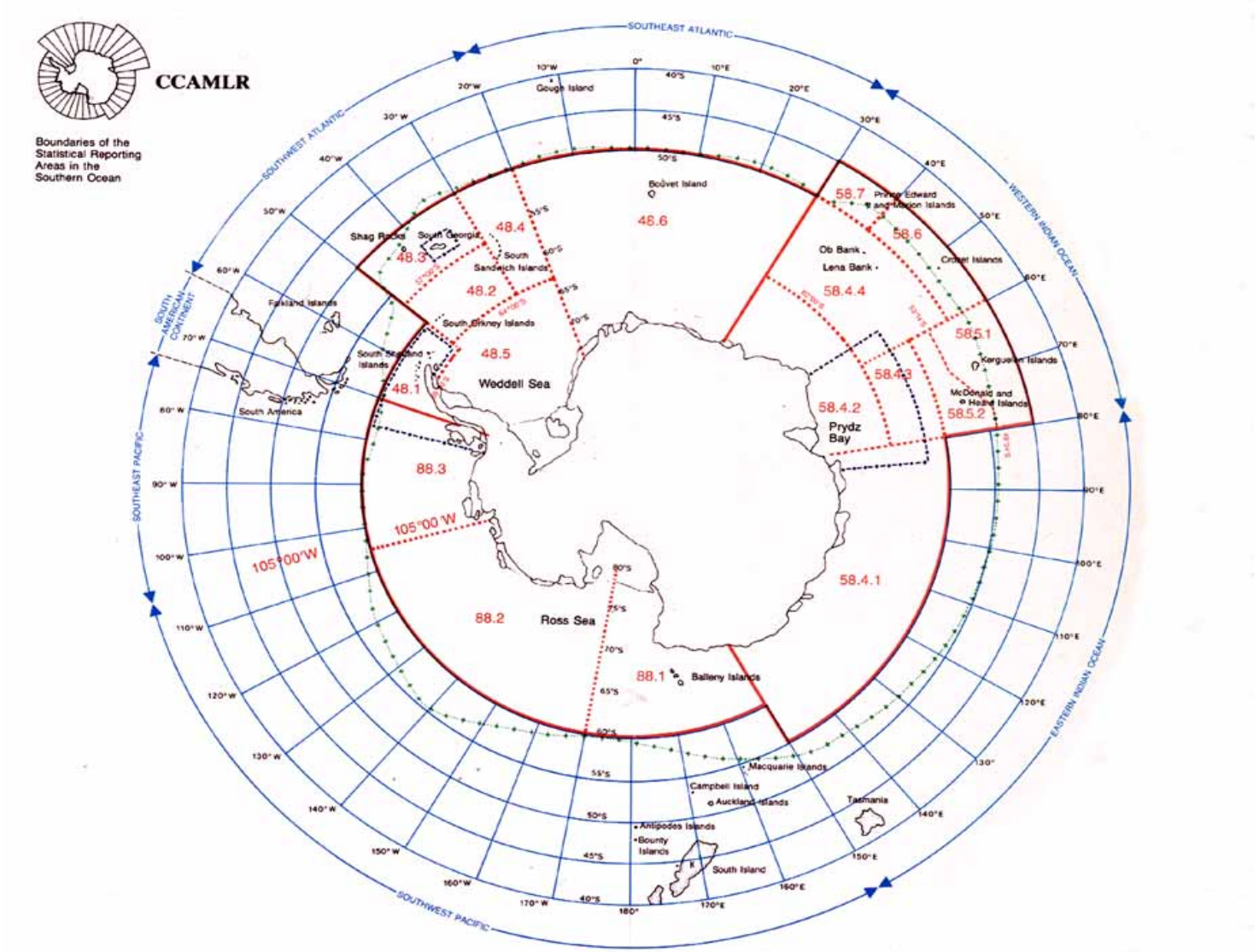


Approaches to ecosystem-based management in the Southern Ocean

Stephen Nicol
Australian Antarctic Division

Convention on the Conservation of Antarctic Marine Living Resources
Article II

1. The objective of this Convention is the conservation of Antarctic marine living resources.

2. For the purposes of this Convention, the term "conservation" includes rational use.

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 of Antarctic marine living resources and the restoration of depleted populations and

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

CCAMLR's ecosystem approach

- Adopted because:
  - **Historical over-harvesting of seals and whales**
  - **Region with high conservation values**
  - **Development of the krill fishery**

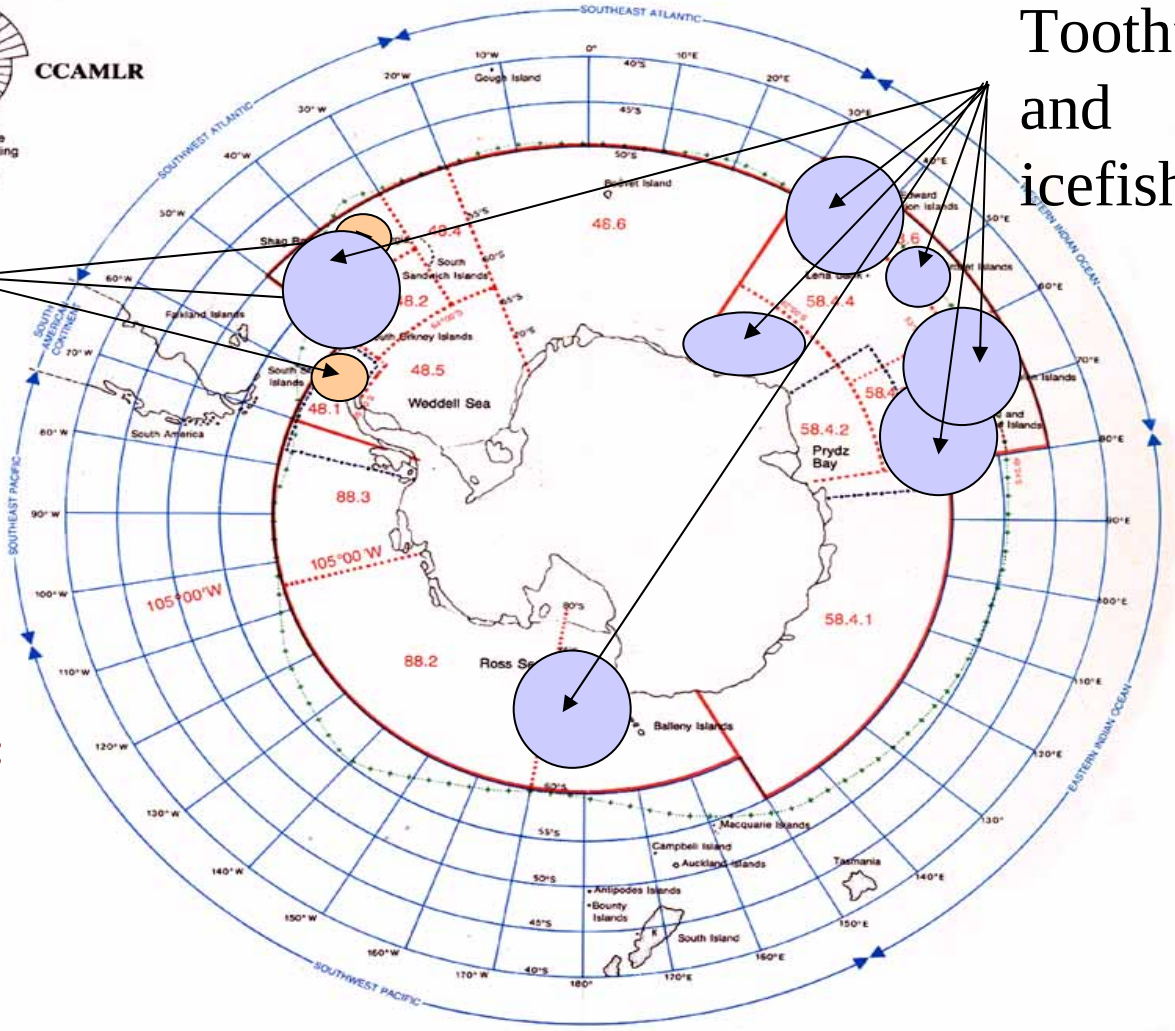


Current fisheries in the Southern Ocean managed by CCAMLR

Legal catch in 2001/2002:
12,817 tonnes

Toothfish and icefish

Krill



Catch in 2001/2002:
118,705 tonnes

Catch in 2001/02:

3,506 tonnes

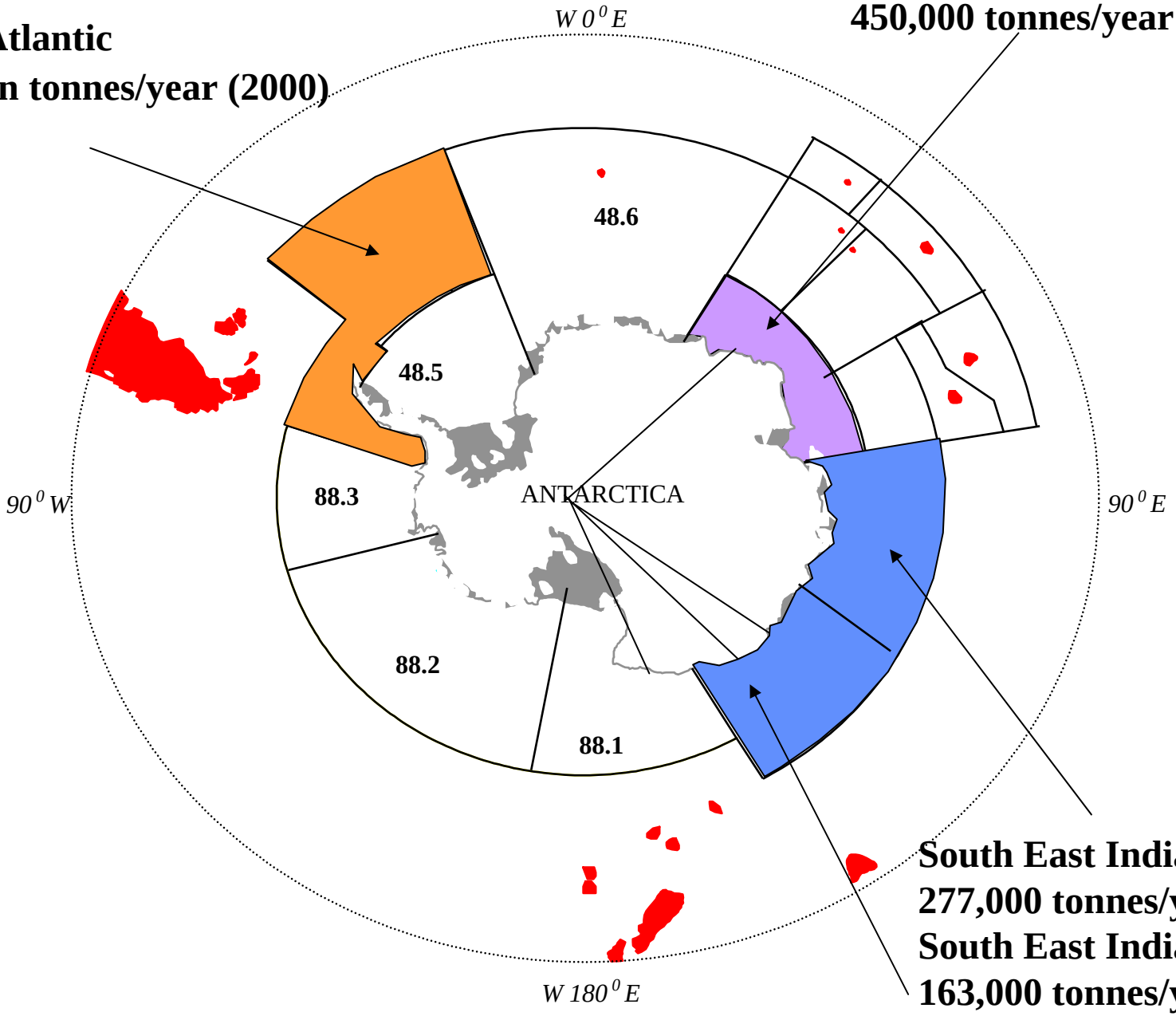
How is the ecosystem approach implemented?

- **Harvested species**
  - **Precautionary harvest levels on fish, krill, crabs, squid**
- **Dependent/related species**
  - **Bycatch, Generalised Yield Model – predator discount and decision rules, marine debris, Ecosystem Monitoring Program (CEMP)**
- **Restoration of depleted populations**
  - **Fishing closures, CEMP, bycatch limits**
- **Prevention of irreversible change**
  - **Yield projection models**

Precautionary management

- CCAMLR's early history was reactive
- In 1991 CCAMLR moved to a more pre-emptive management regime
- Established first catch limits on the krill fishery (1.5 million tonnes when fishery was only 275,000 tonnes)
- Current catch limits total 5 million tonnes compared to the fishery at ~120,000 tonnes

Towards global krill catch limits



South Atlantic
4 million tonnes/year (2000)

South West Indian
450,000 tonnes/year (1992)

South East Indian (W)
277,000 tonnes/year (2000)
South East Indian (W)
163,000 tonnes/year (2000)

Calculation of precautionary yield

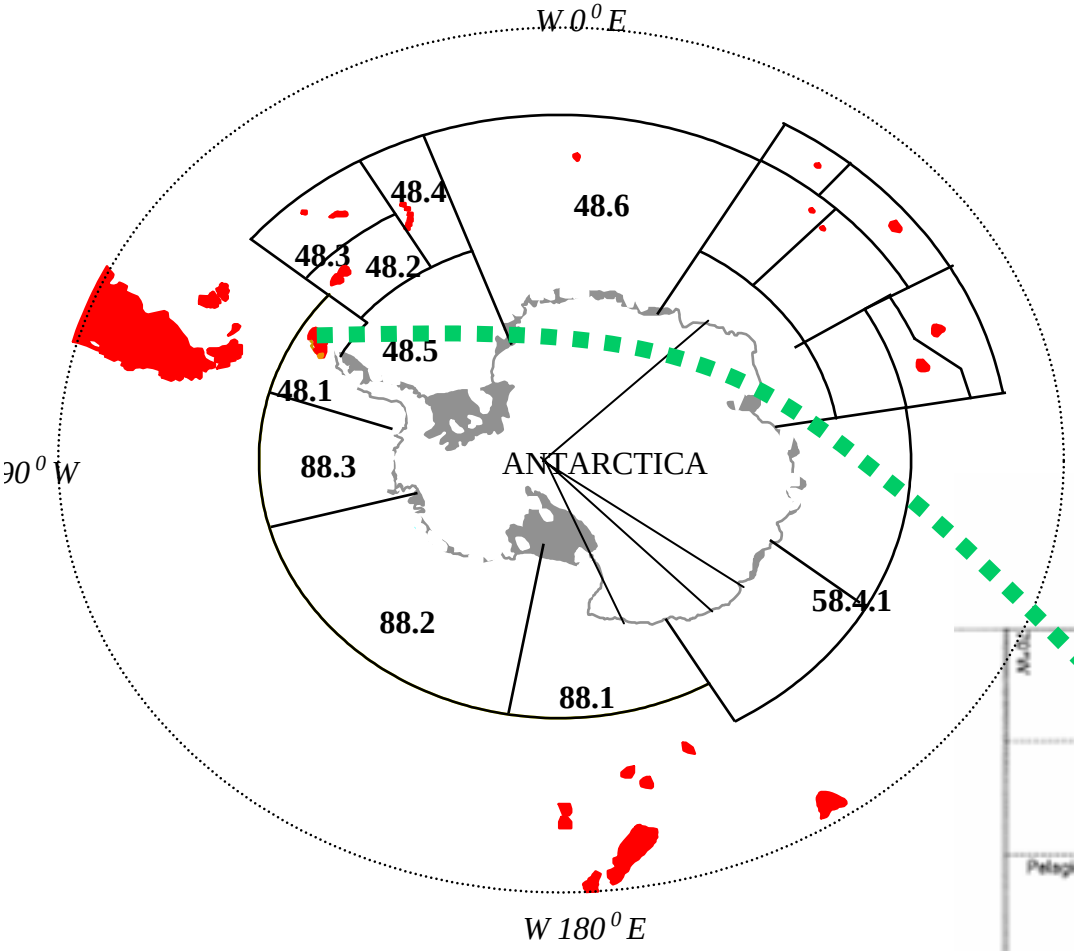
- **A simulation model is used to calculate a distribution of population sizes both in the absence of fishing and at various levels of fishing mortality.**
- **These distributions are used to determine λ - an estimate of the unexploited biomass that can be caught each year.**

Decision rules

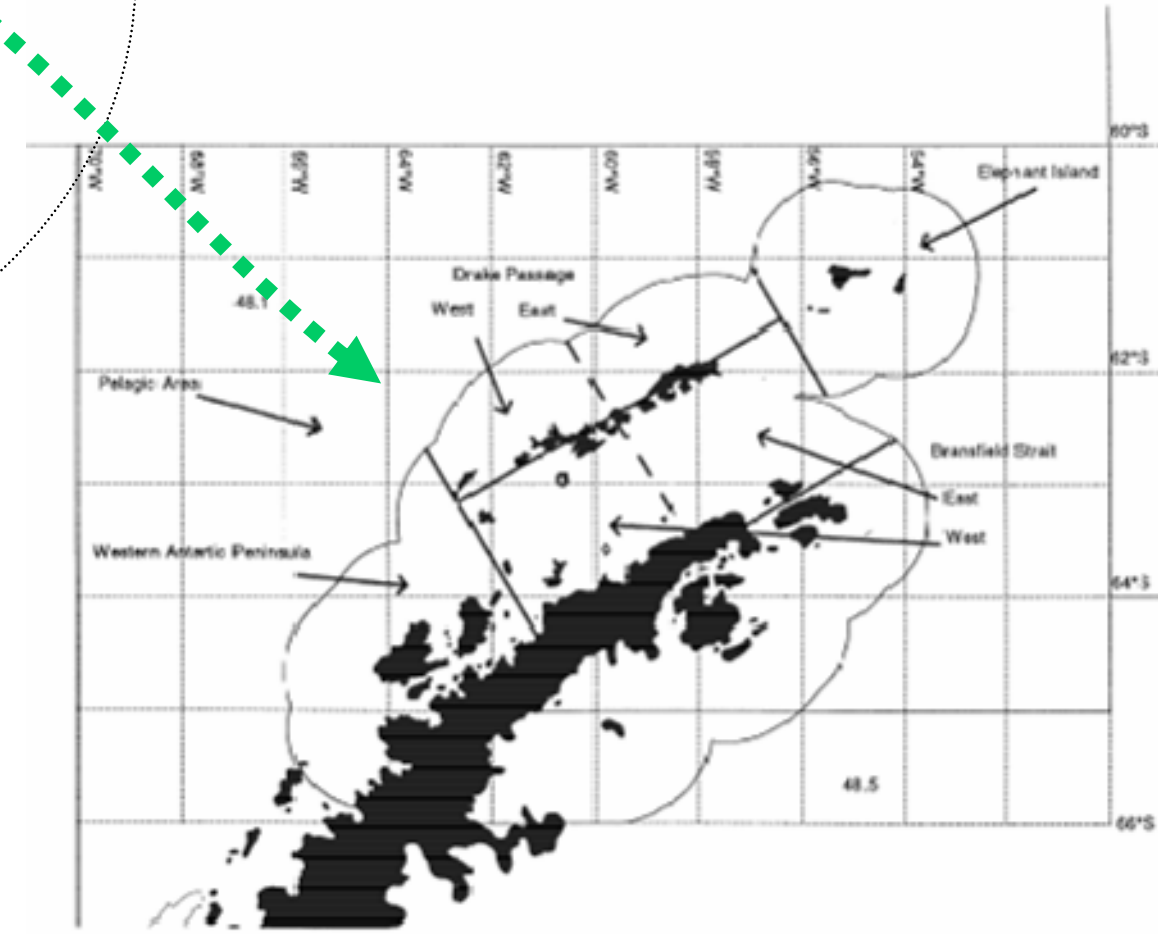
- **CCAMLR has developed a three-part decision rule for determining the value of λ:**
  1. **choose λ_1 so that the probability of the spawning biomass dropping below 20% of its pre-exploitation median level over a 20-year harvesting period is 10%; and**
  2. **choose λ_2 so that the median krill escapement in the spawning biomass over a 20 year period is 75% of the pre-exploitation median level.**
  3. **select the lower of λ_1 and λ_2 as the level of λ for the calculation of the krill yield.**

Precaution and the GYM

- Attempts to take into account uncertainty
- Uses a conservative set of decision rules
- Takes into account natural mortality (needs of predators)
- Is being applied to smaller areas.



From Large-scale statistical areas
To
Small-scale Management Units.



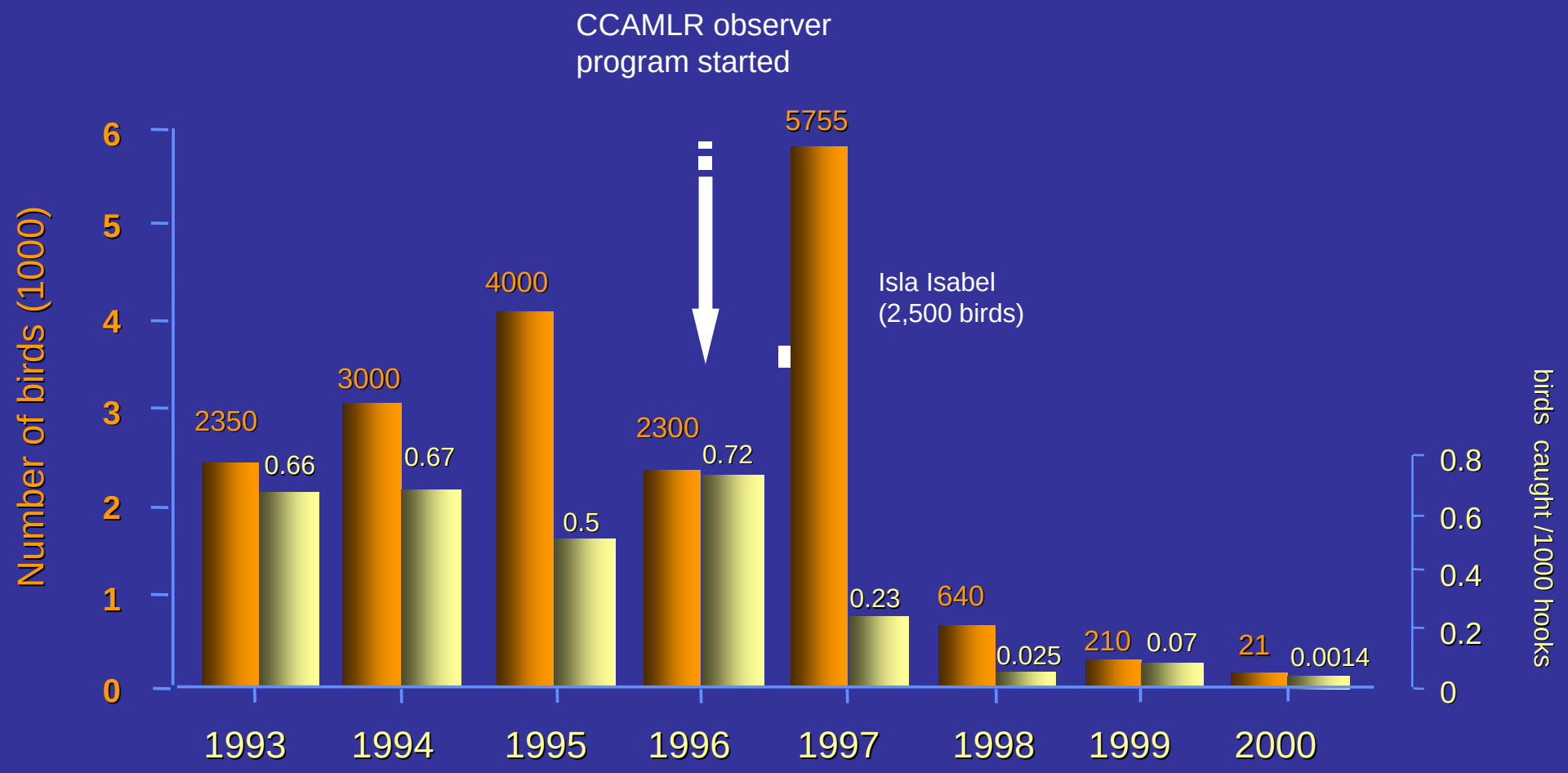
Bycatch

Effects of fishing on non-target components of the ecosystem (fish, birds, benthos)

CCAMLR's measures to reduce seabird bycatch

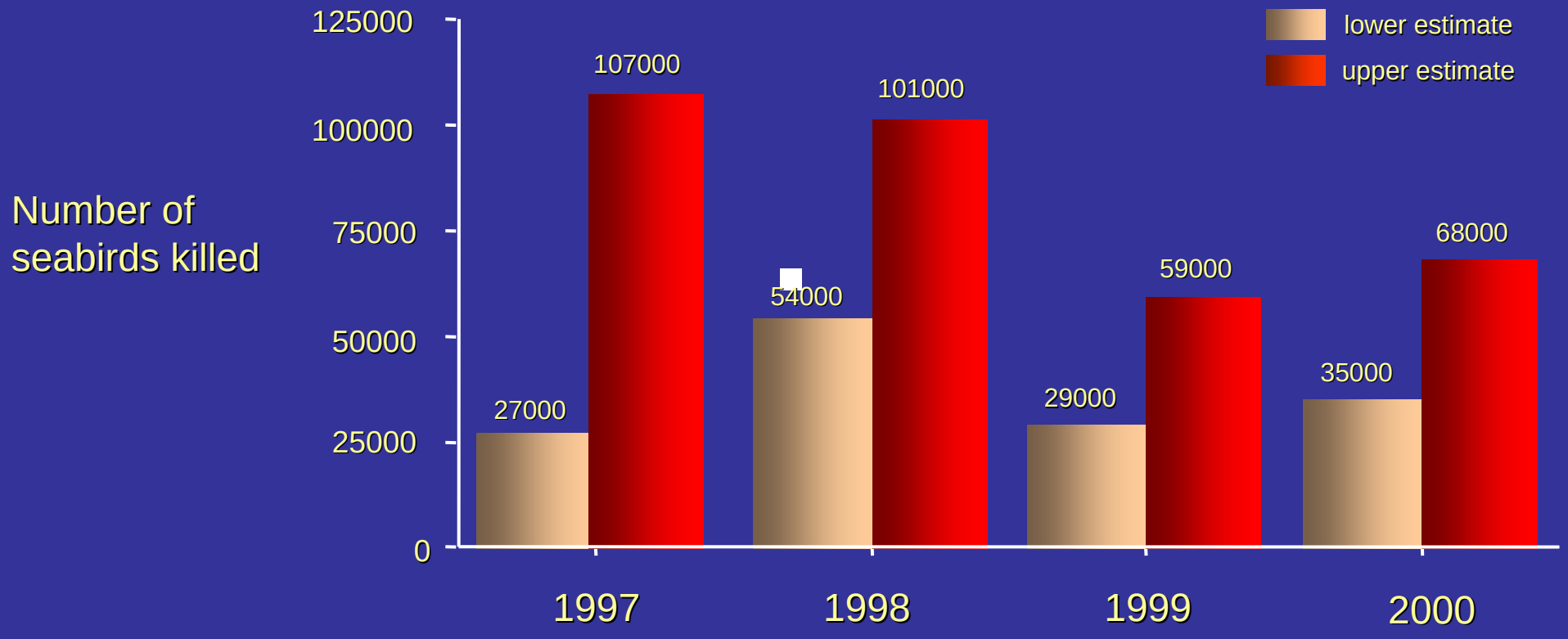
- Prohibition of driftnet fishing
- Educational booklet for fishers "Fish the sea not the sky"
- Fishing season changes
- Streamer lines
- Offal discharge
- Line weighting
- Observer Scheme

Example of seabird catch statistics (CCAMLR sub-area 48.3)



In general, seabird strike rates have fallen since the CCAMLR observer program started in 1996

Potential seabird mortality from I.U.U. fishing in CCAMLR waters



Potentially, vast number of seabirds have been killed by vessels fishing illegaly in CCAMLR waters

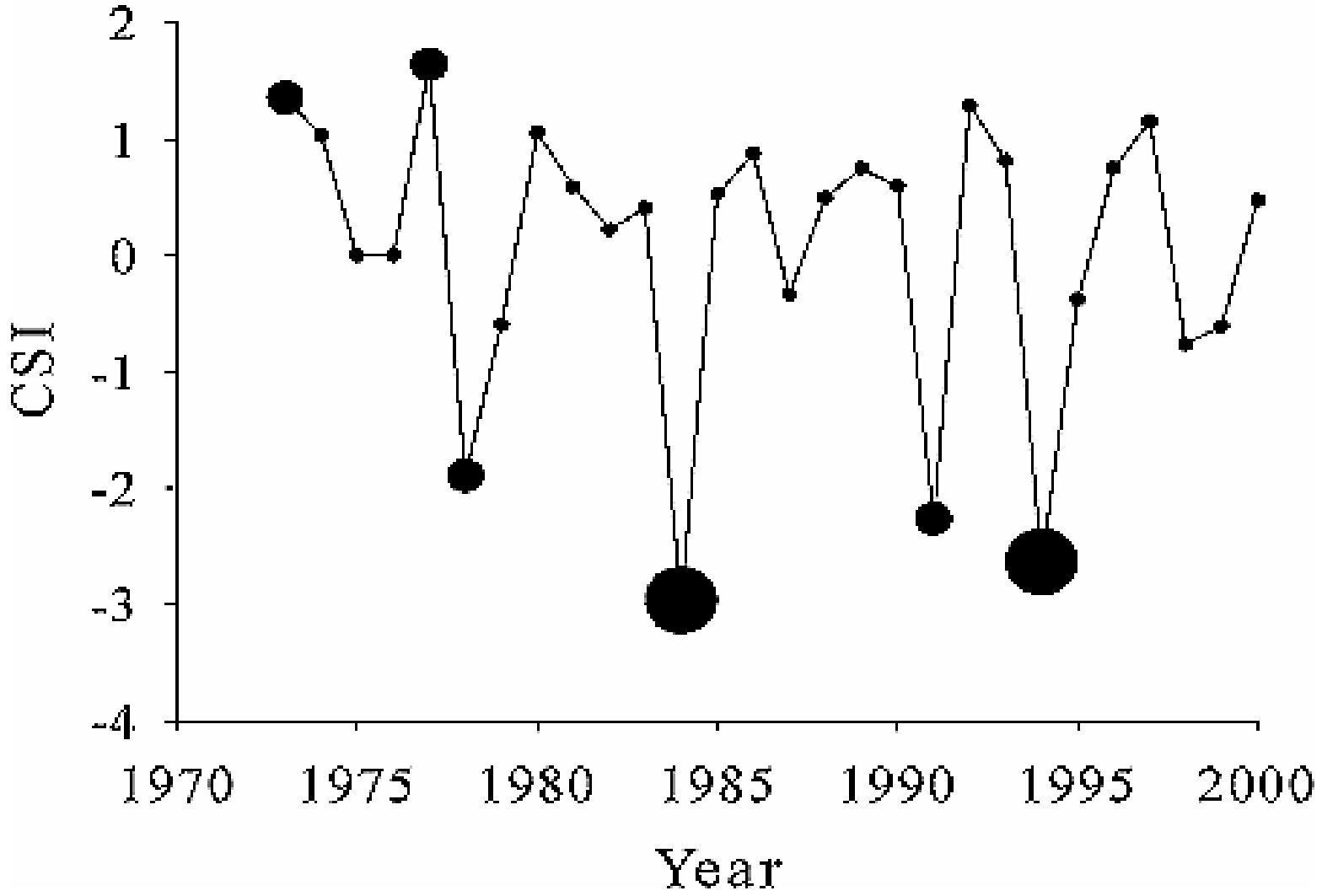
Ecosystem Monitoring

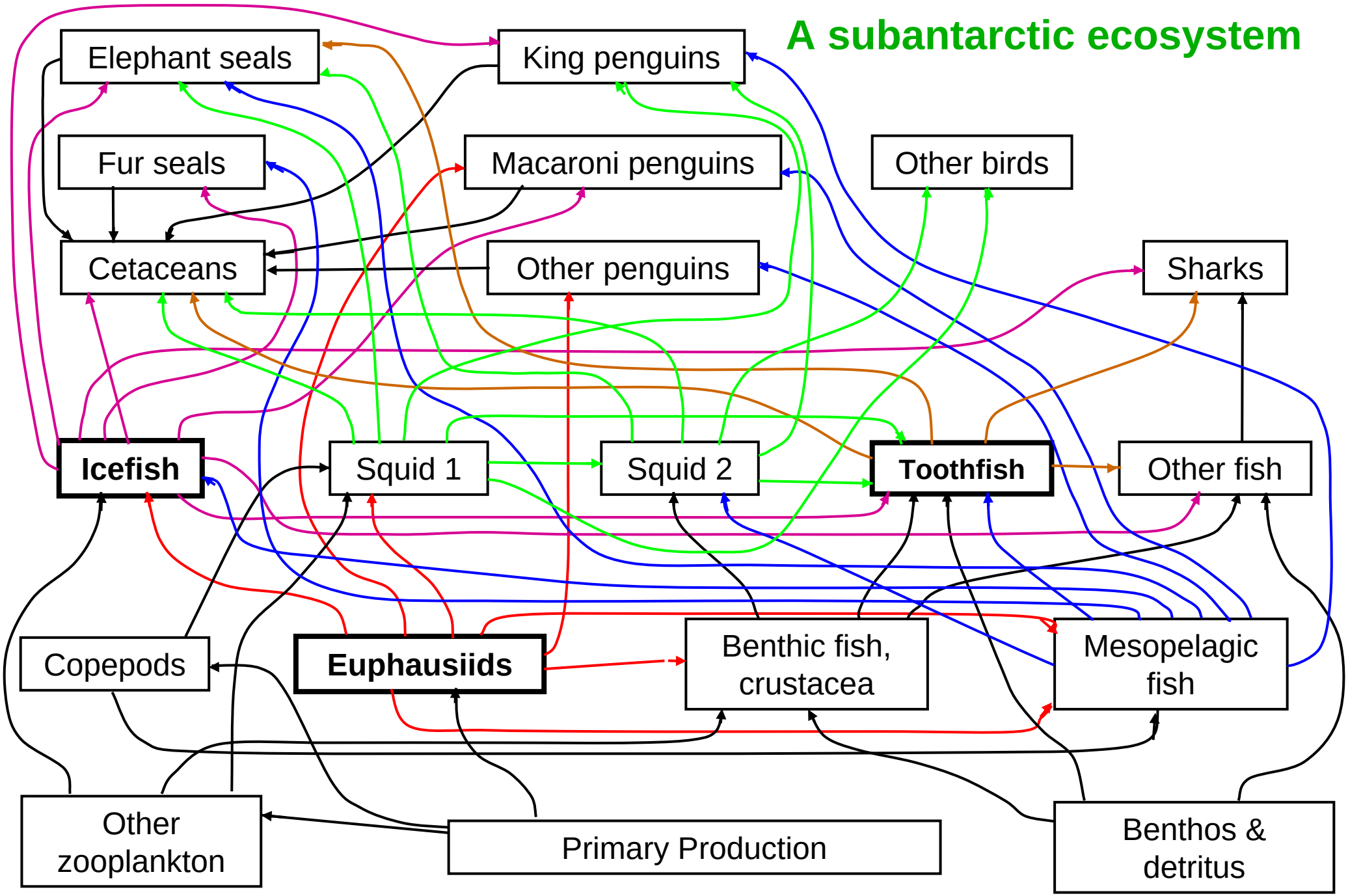
- **to detect the effects of fishing in sufficient time for fishing to be altered before irreversible damage is incurred**
- **to detect long-term trends in the environment that require re-assessment of fishing controls**
- **to distinguish between the effects of fishing and those of the environment**
- **To assess the effectiveness of management measures**

CCAMLR Ecosystem Monitoring Program (CEMP)

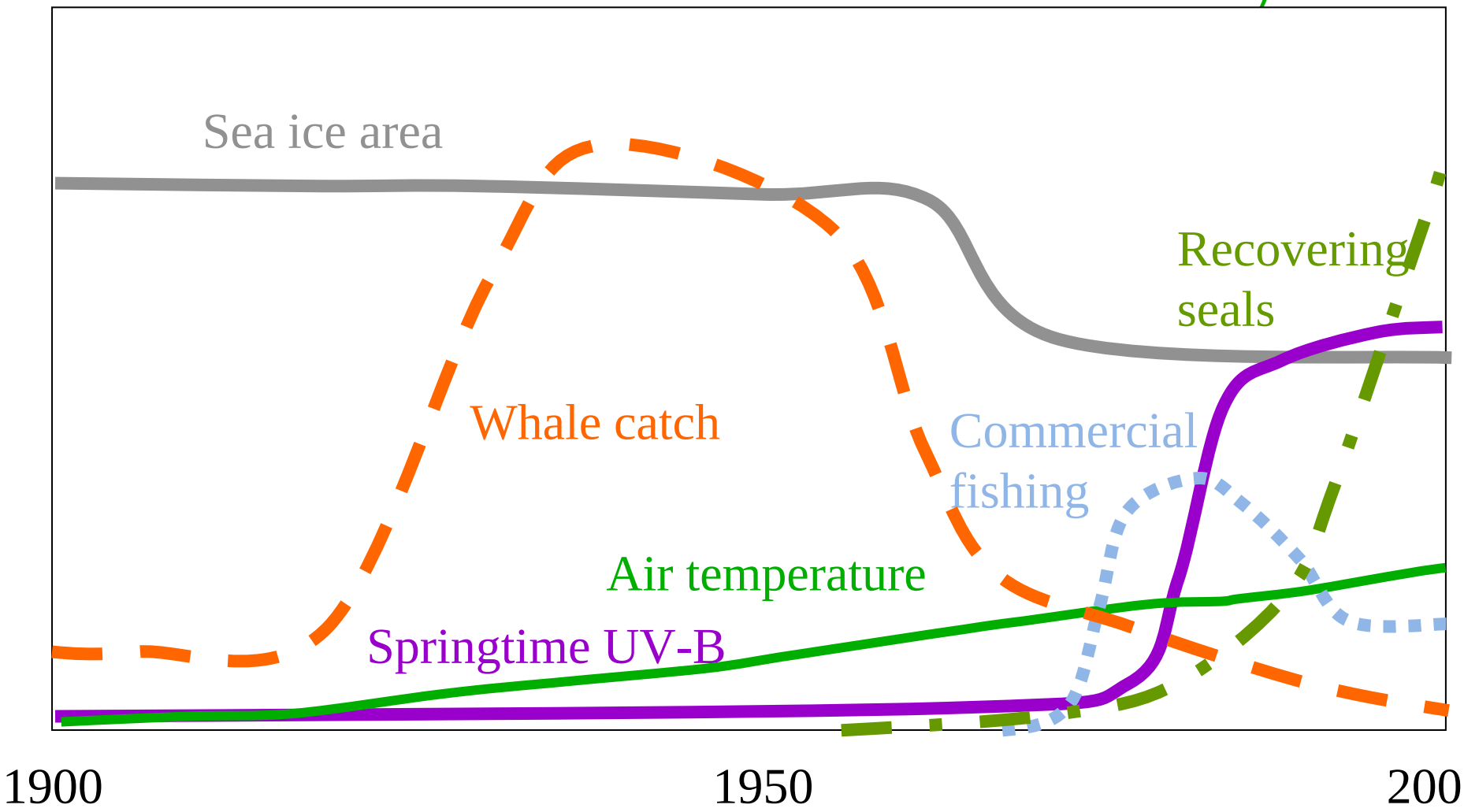
- Indicator species
- Standardised parameters
- Long-term monitoring sites

Status of the Ecosystem




A subantarctic ecosystem
Elephant seals
King penguins
Fur seals
Macaroni penguins
Other birds
Cetaceans
Other penguins
Sharks
Icefish
Squid 1
Squid 2
Toothfish
Other fish
Copepods
Euphausiids
Benthic fish, crustacea
Mesopelagic fish
Other zooplankton
Primary Production
Benthos & detritus

Cumulative effects: Physical and biological changes in the Antarctic in the 20th Century



Future sustainability in the Southern Ocean

- An accepted management and enforcement regime
- World's best practice science, management and technology
- The ecosystem approach incorporating precaution
- Predictive ability – scientific, economic and political
- Adaptation to change
- The will to make it work