

# BROKE-West – the final update

Steve Nicol and Klaus Meiners

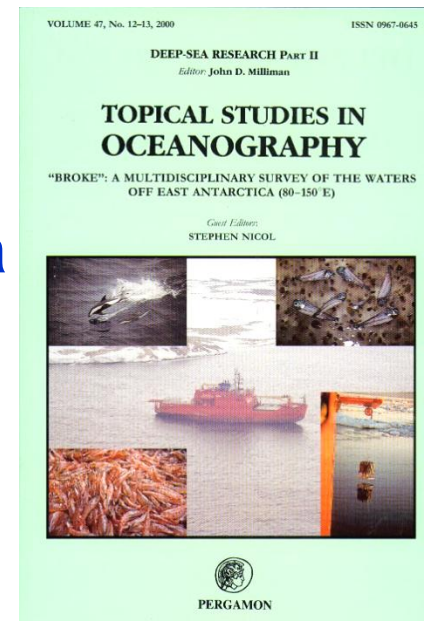
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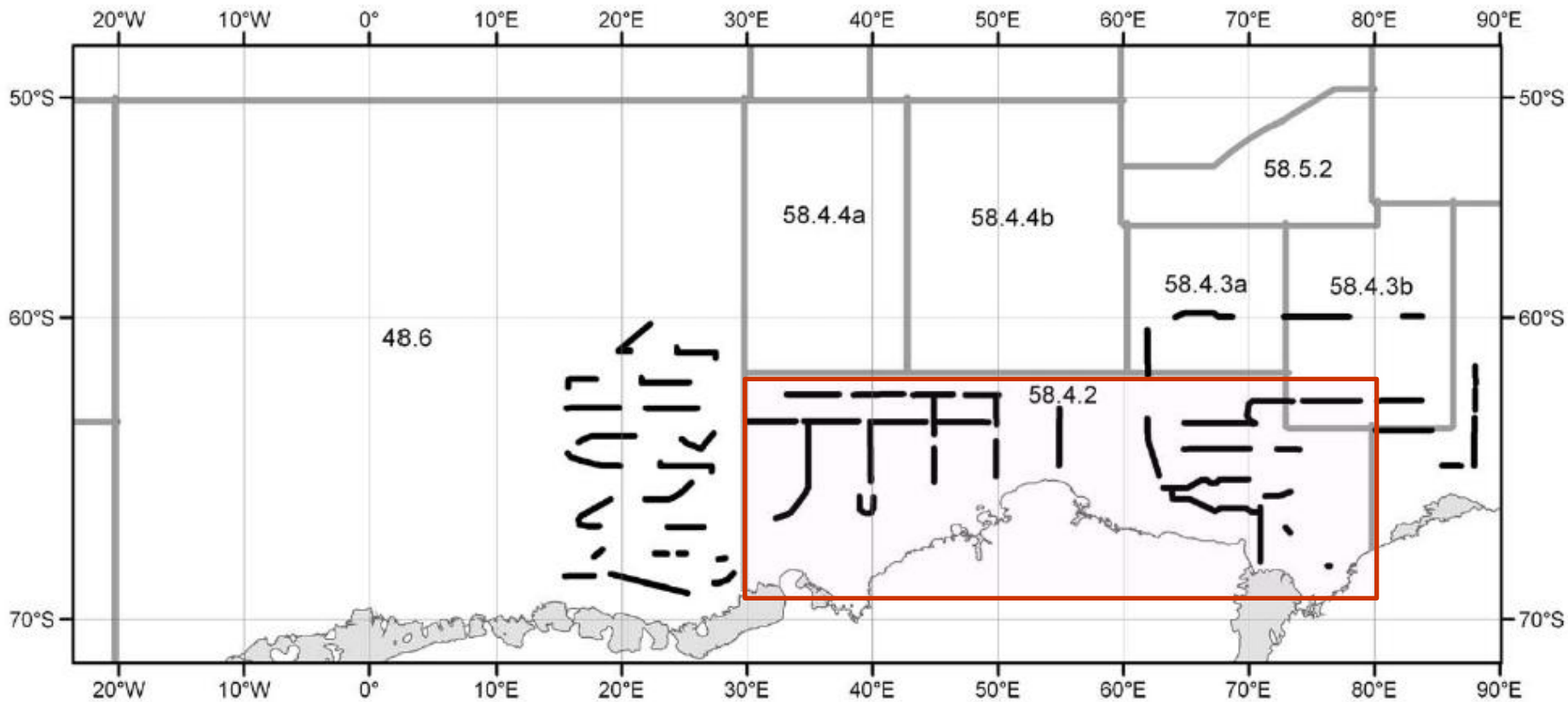


# What was BROKE-WEST

- Baseline Research on Krill, Oceanography and the Environment – West survey of the 30-80° E region (1996 BROKE voyage surveyed 80-150° E)
- An oceanographic survey of the SW Indian Ocean sector.
- A comprehensive suite of ecological measurements: viruses to whales.
- An acoustic biomass survey for krill in CCAMLR Division 58.4.2 to produce the data for a revised catch limit on the krill fishery.



# FIBEX survey in 1981



**Fig. 1.** The FIBEX survey of Division 58.4.2 showing the ship's tracks from the four vessels (Agulhas, Kaiyo Maru, Nella Dan and Marion Dufresne) and the adjacent CCAMLR Statistical areas (re-drawn from Trathan et al., 1992 by Angela Bender, Australian Antarctic Data Centre).

# BROKE-West survey 2006

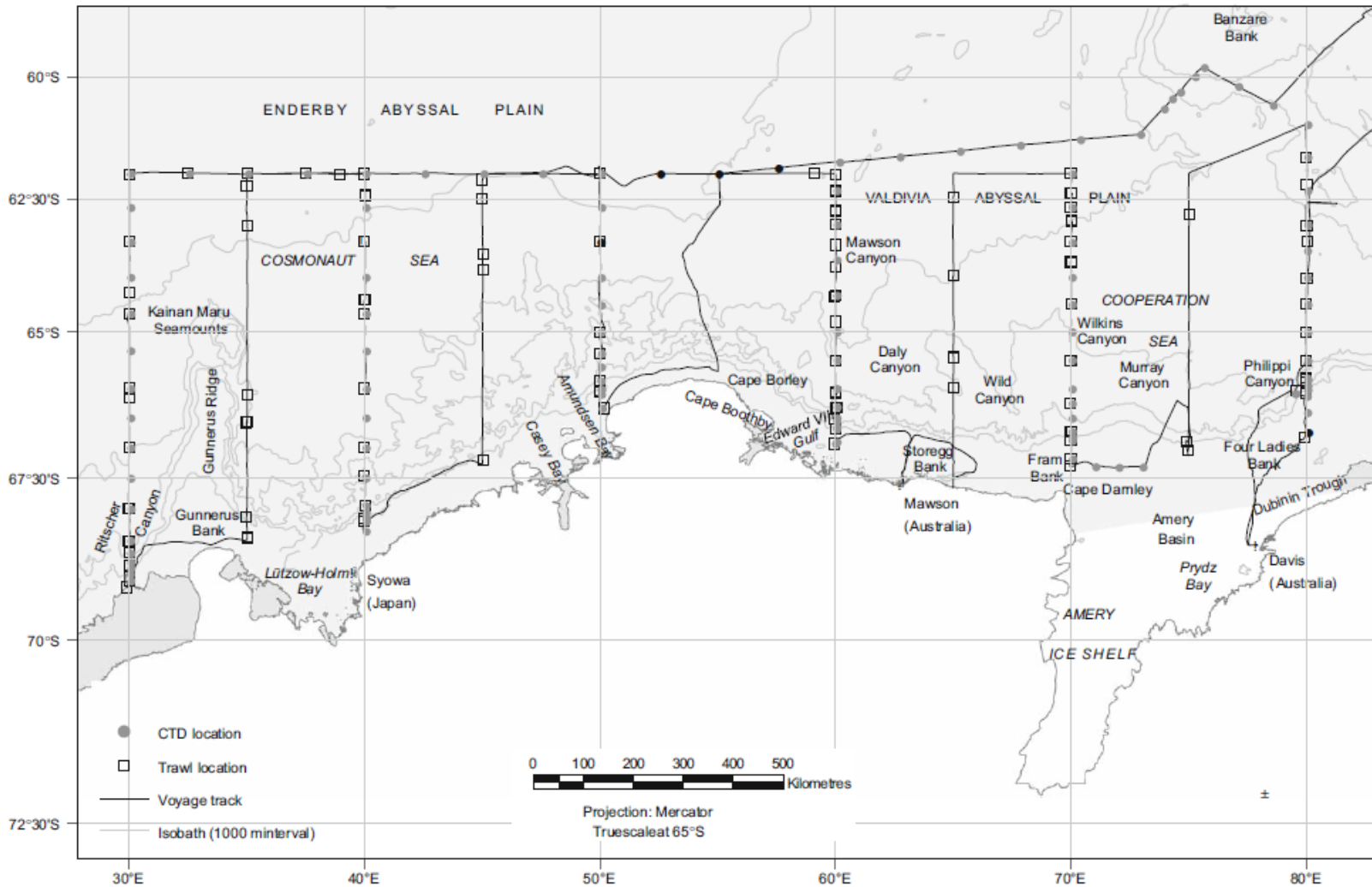
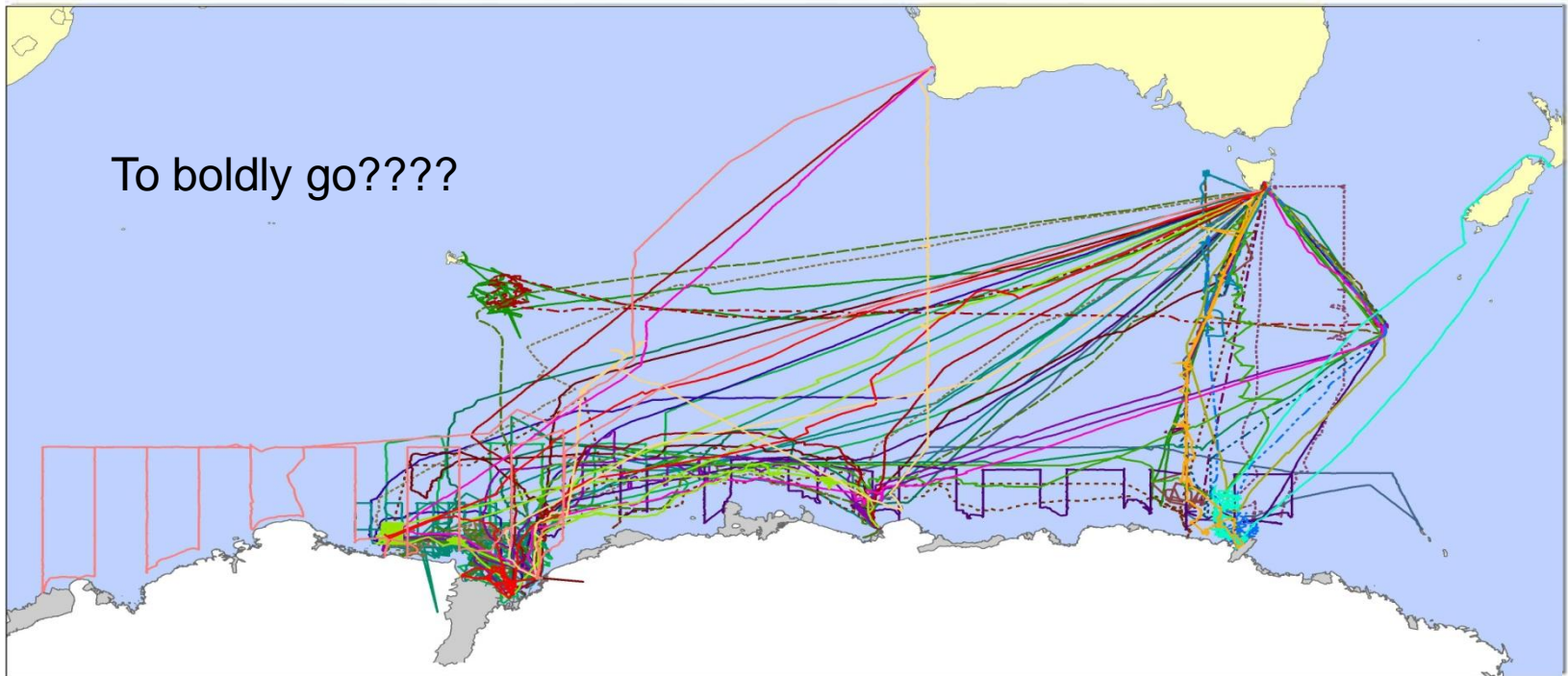
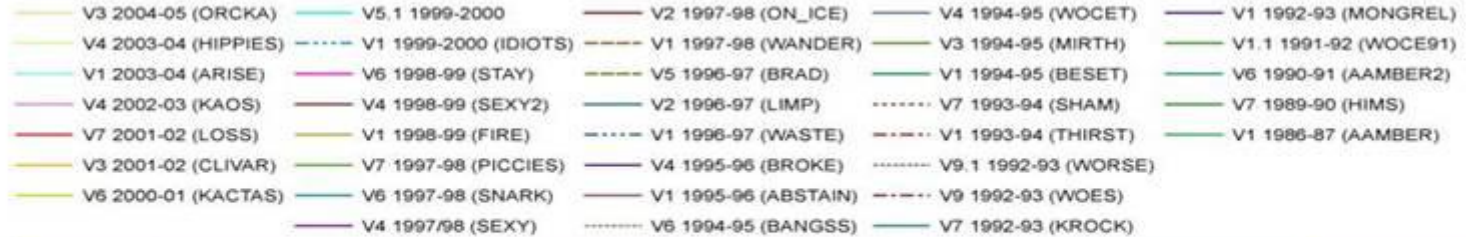


Fig. 2. The BROKE-West survey of CCAMLR Division 58.4.2 – boundaries are at 30°E and 80°E and 62°S. The survey progressed from west to east to match the direction taken in the 1996 BROKE survey of CCAMLR Division 58.4.1. The locations of trawl and CTD sites are indicated.

# Australian Antarctic marine research effort, 1987-2005

## Australian Antarctic Division Marine Science Voyages (1986 - 2005)



# Timeline before survey

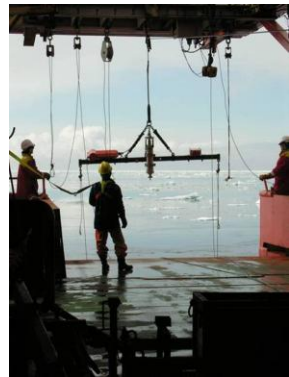
- CCAMLR suggests the need for a survey (2000)
- EOI submitted, scientific planning begins (2001)
- Included in the CRC bid (2002)
- June 2004 AAS proposal submission
- July 2004 submission of survey plans to CCAMLR WG-EMM for approval
- May 2005 Proposal approved through AAD-ARAC process
- June 2005 Voyage Management team appointed, funding approved, team assembled
- July 2005 Revised survey plan submitted to CCAMLR WG-EMM for approval
- October 2005 Trials voyage
- November 2005 BROKE-West database finalised
- January 2006 Voyage sails from Fremantle

# Logistics

- Cargo onto ship before V2
- People and equipment to Fremantle
- 38 cabins, 61 scientists
- 8 laboratory containers
- Total required ship time 52.3 days
- 46 science days allocated.
- Transit from Fremantle to first CTD, 2305 miles @ 10 knots = 9.6 days

# Voyage Statistics

- Scientists from 12 nations
- 6 Scientists who took part in original BROKE
- 71 days of sailing pleasure
- 118 full depth CTDs
- 125 trawls
- Total distance sailed: 23,000 km, 14,000 nm actually on the survey (The circumference of Australia is 25,760 km)
- 1.5 million km<sup>2</sup> surveyed (> than the land area of Tasmania, Victoria and S. Australia combined)



# Timeline after the survey pt 1

- April 2006 Voyage returns.
- May 2006 first BROKE-West workshop to plan write up of data.
- May 2006 Journal approached for BROKE-West special issue
- July 2006 krill biomass and associated data submitted to CCAMLR WG-EMM
- September 2006 second BROKE-West workshop
- November 2006 CCAMLR considers BROKE-West data and suggests some revisions
- August 2007 WG-EMM considers revised biomass estimate
- November 2007 CCAMLR uses biomass estimate to set precautionary catch limits

**CONSERVATION MEASURE 51-03 (2008)**  
**Precautionary catch limitation on *Euphausia superba***  
**in Statistical Division 58.4.2**

Species	krill
Area	58.4.2
Season	all
Gear	trawl

- Access 1. The fishery for *Euphausia superba* in Statistical Division 58.4.2 shall be conducted by vessels using fishing methods listed in Conservation Measure 21-03, Annex A only.
- Catch limit 2. The total catch of *Euphausia superba* in Statistical Division 58.4.2 shall be limited to 2.645 million tonnes in any fishing season.
- 3. The total catch limit shall be further subdivided into two subdivisions within Statistical Division 58.4.2 as follows: west of 55°E, 1.448 million tonnes; and east of 55°E, 1.080 million tonnes.
- Trigger level<sup>1</sup> 4. Until the Commission has defined an allocation of this total catch limit between smaller management units, as the Scientific Committee may advise, the total catch in Division 58.4.2 shall be limited to 260 000 tonnes west of 55°E and 192 000 tonnes east of 55°E in any fishing season.
- 5. This measure shall be kept under review by the Commission, taking into account the advice of the Scientific Committee.
- Season 6. A fishing season begins on 1 December and finishes on 30 November of the following year.
- Mitigation 7. The operation of this fishery shall be carried out in accordance with Conservation Measure 25-03 so as to minimise the incidental mortality of seabirds in the course of fishing.
- 8. The use of marine mammal exclusion devices on trawls is mandatory.
- Observers 9. Each vessel participating in the fishery shall have at least one scientific observer in accordance with the CCAMLR Scheme of International Scientific Observation or a domestic scientific observer fulfilling the requests in the scheme, and where possible one additional scientific observer, on board throughout all fishing activities within the fishing period<sup>2</sup>.
- Data 10. For the purposes of implementing this conservation measure, the data requirements set out in Conservation Measure 23-06 shall apply.

**Environmental protection**

11. Conservation Measure 26-01 applies.

<sup>1</sup> A trigger level is a set level that the catch shall not exceed until a procedure for the division of the overall catch limit into smaller management units, upon which the Scientific Committee has been directed to provide advice, has been established.

<sup>2</sup> Bearing in mind the limited ecological information from research and fisheries observers in Statistical Division 58.4.2 compared to Statistical Area 48, the Commission recognised the need to collect scientific data from the fishery. This paragraph applies only to the krill fishery in Statistical Division 58.4.2 and shall be revised depending on the advice of the Scientific Committee on a systematic scheme for scientific observation in the krill fishery or reviewed within three years, whichever comes earlier.

# DEEP-SEA RESEARCH PART II

## Topical Studies in Oceanography

“BROKE-West” a Biological/Oceanographic Survey  
Off the Coast of East Antarctica (30–80°E)  
Carried Out in January–March 2006

Volume 57, Issues 9–10, 2010

### CONTENTS

#### Editorial

- S. Nicol, K. Meiners and B. Raymond 693 BROKE-West, a large ecosystem survey of the South West Indian Ocean sector of the Southern Ocean, 30°E–80°E (CCAMLR Division 58.4.2)

#### Special Issue Articles

- J.N. Schwarz, B. Raymond, G.D. Williams, B. Pasquer, S.J. Marsland and R.J. Gorton 701 Biophysical coupling in remotely-sensed wind stress, sea surface temperature, sea ice and chlorophyll concentrations in the South Indian Ocean
- A.J.S. Meijers, A. Klocker, N.L. Bindoff, G.D. Williams and S.J. Marsland 723 The circulation and water masses of the Antarctic shelf and continental slope between 30 and 80°E
- G.D. Williams, S. Nicol, S. Aoki, A.J.S. Meijers, N.L. Bindoff, Y. Iijima, S.J. Marsland and A. Klocker 738 Surface oceanography of BROKE-West, along the Antarctic margin of the south-west Indian Ocean (30–80°E)
- S.W. Wright, R.L. van den Enden, I. Pearce, A.T. Davidson, F.J. Scott and K.J. Westwood 758 Phytoplankton community structure and stocks in the Southern Ocean (30–80°E) determined by CHEMTAX analysis of HPLC pigment signatures
- B. Pasquer, M. Mongin, N. Johnston and S. Wright 779 Distribution of particulate organic matter (POM) in the Southern Ocean during BROKE-West (30°E - 80°E)
- K.J. Westwood, F. Brian Griffiths, K.M. Meiners and G.D. Williams 794 Primary productivity off the Antarctic coast from 30°–80°E; BROKE-West survey, 2006
- P.G. Thomson, A.T. Davidson, R. van den Enden, I. Pearce, L. Seuront, J.S. Paterson and G.D. Williams 815 Distribution and abundance of marine microbes in the Southern Ocean between 30 and 80°E

(Continued on inside back cover)

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# DEEP-SEA RESEARCH PART II

Editor:

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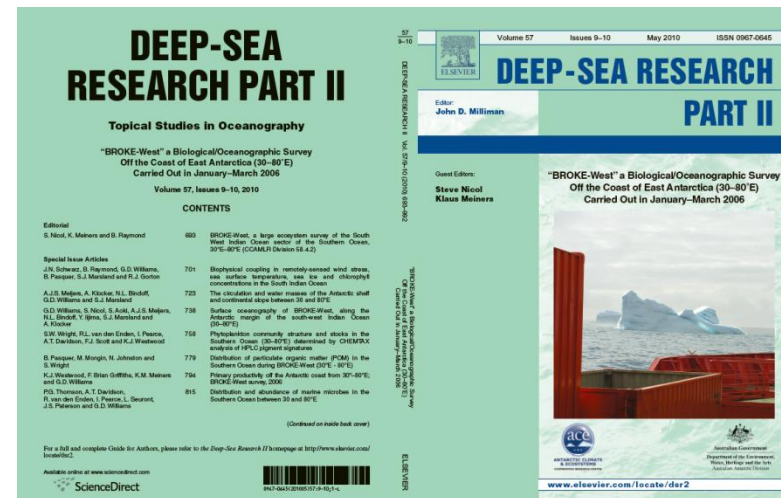


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# BROKE-West DSR Volume

- Published in May 2010
- 20 papers
- 63 authors
- AAD scientists authors on 18 papers
- 13 CRC papers
- Cf. the BROKE Volume was 13 papers

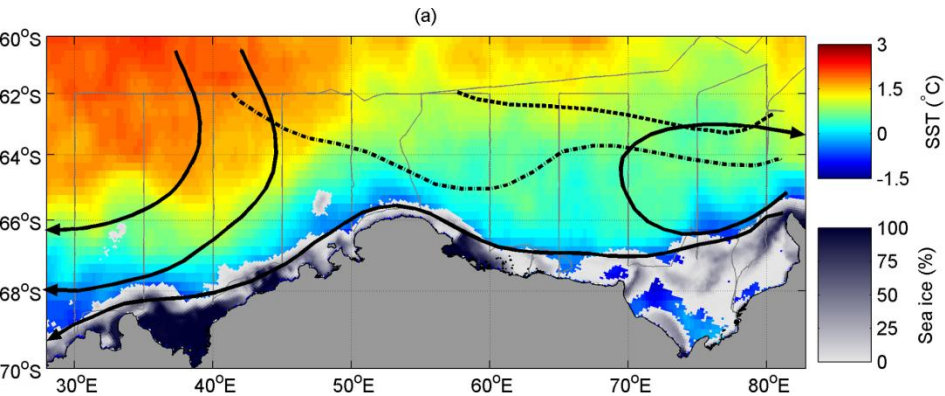


# Investment

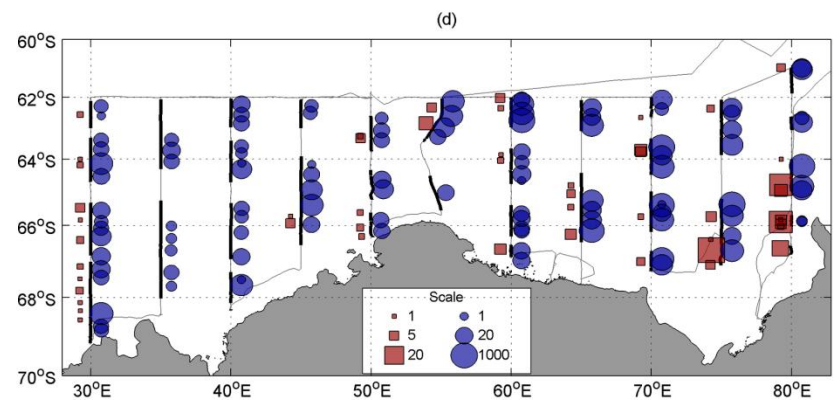
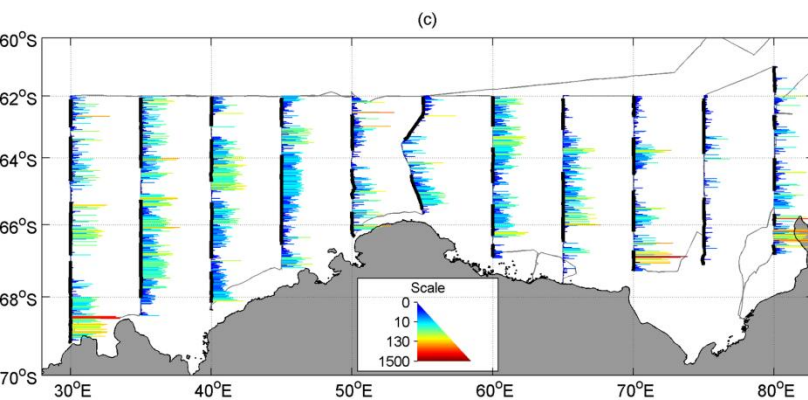
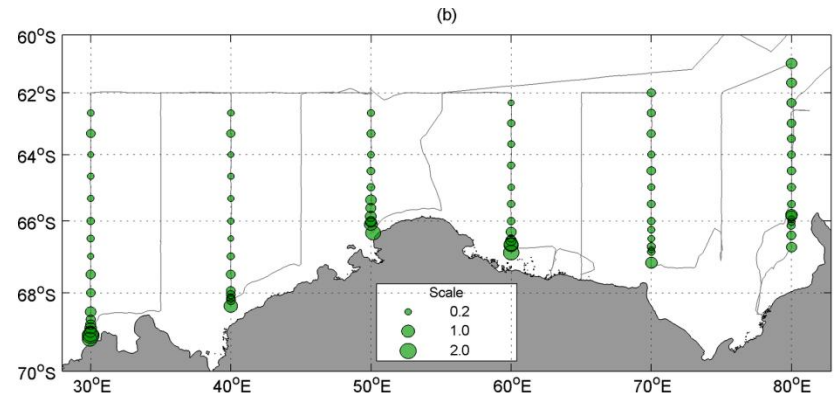
- Took 10 weeks at sea
- 16 weeks in CCAMLR meetings from initial proposal to acceptance of precautionary catch limit
- Average time to from docking to manuscript submission: 2 years
- Time from docking to publication: 4 years and one month
- Time from initiation of project to final publication: 10 years

# Scientific Outputs

## Oceanography



## Chlorophyll



Krill

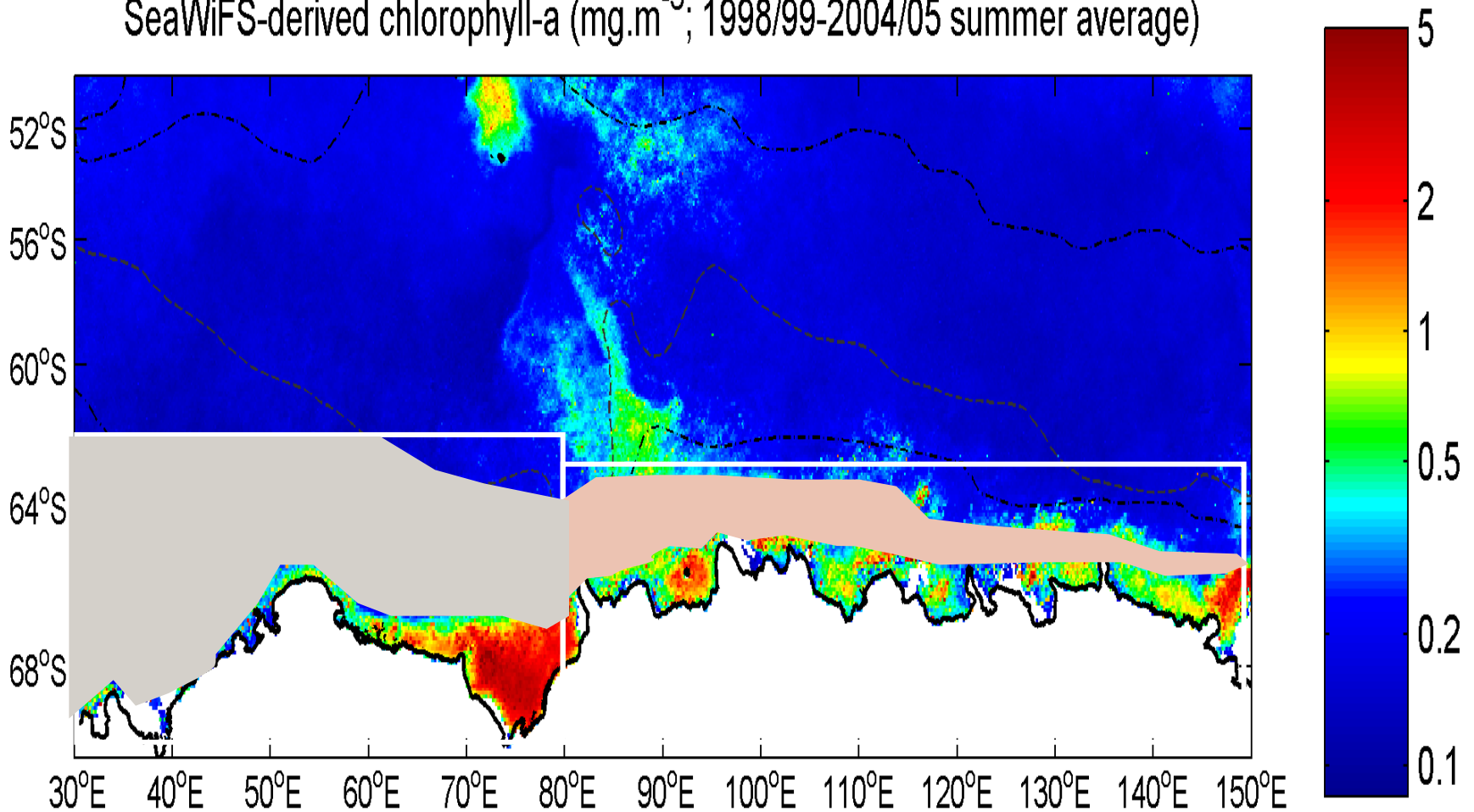
Whales and seabirds

# Some conclusions

- Area is oceanographically more complex than the SE Indian Ocean sector – influenced by up to 4 gyres.
- Primary productivity is highest in the deeper coastal mixed layer.
- Krill-based ecosystem extends further to North than further East
- Krill density is intermediate between S. Atlantic and S.E. Indian Ocean.
- Distribution of krill predators also more widespread.

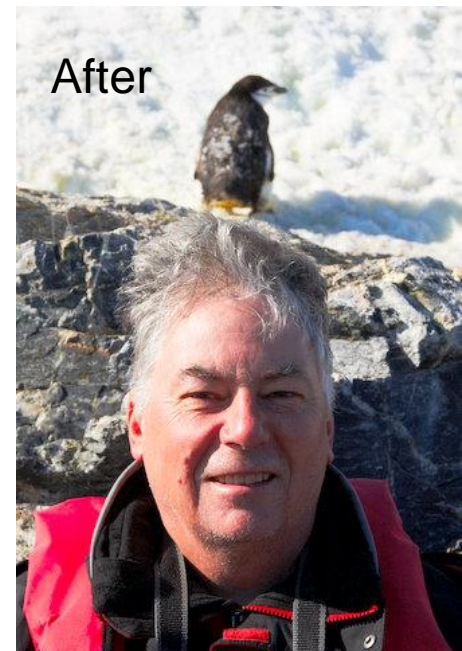
# Examining the East Antarctic ecosystems using the data from BROKE and BROKE-West

SeaWiFS-derived chlorophyll-a ( $\text{mg}\cdot\text{m}^{-3}$ ; 1998/99-2004/05 summer average)

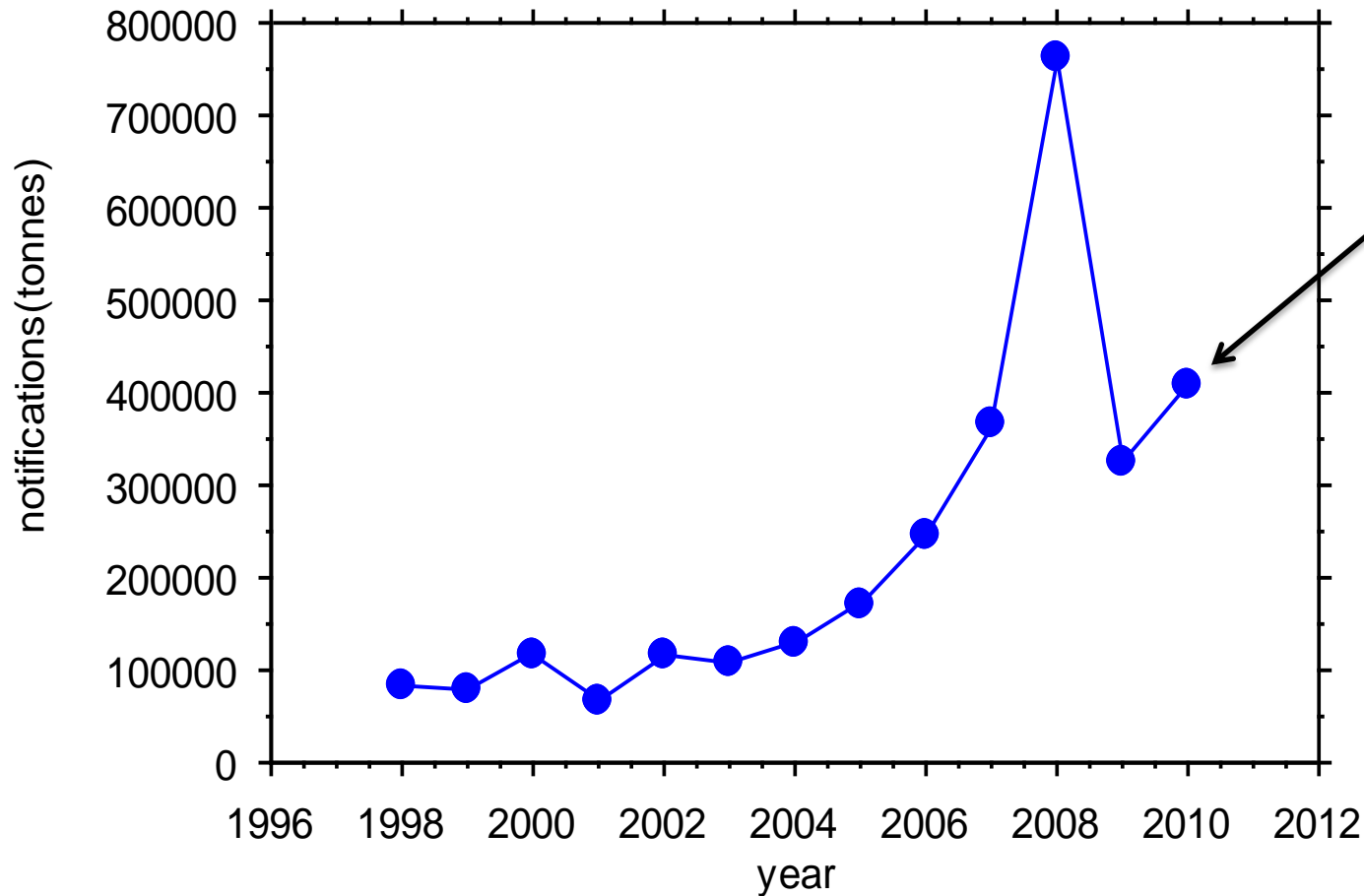


# More work

- DSR II volume only the first cut – many more detailed analyses still to be done.
- Combining the BROKE and BROKE-West databases
- Recalculating krill biomass and precautionary catch limits from both surveys
- Was it worth it?



# Interest in the krill fishery



15 vessels  
From 7  
Nations  
One of which  
is interested in  
fishing off East  
Antarctica



Thanks to: all 62 of the scientific party, 25 crew, 63 authors and 70+ reviewers who made it all possible.  
A special thanks to Klaus – the ideal co-editor.

