

**13th SOUTHERN AFRICAN MARINE SCIENCE SYMPOSIUM
'OUR CHANGING SEAS'**



**Kramer Building, Middle Campus
University of Cape Town
Sunday 29 June- Thursday 3 July 2008**

Background and invitation:

This symposium continues the tri-annual SAMSS series that began in Durban in August 1970, when 54 professional South African scientists presented papers at the 'First National Oceanographic Symposium', held in the then prestigious Lonsdale Hotel. Over the intervening 38 years the conference has grown from strength to strength, and is now arguably the most important and best-attended marine meeting in the region. In 2008 the Western Cape representatives of the South African Network for Coastal and Oceanic Research (SANCOR) are proud to host the 13th SAMSS. We welcome you to Cape Town for this meeting and hope that it will prove both an intellectually stimulating and enjoyable week.

Venue:

All conference sessions and social functions, with the exception of the conference dinner, will take place in the Kramer Building, Middle Campus, University of Cape Town. The dinner will be at the Sea Point Civic Centre.

Getting to the venues:

The Kramer Building is the only academic building on the middle campus of UCT. If approaching from the city, airport, or N2 take the M3 (Rhodes Drive) exit, which is signposted to Muizenberg. Take the second exit to your left (just after the windmill). This is sign-posted 'Rosebank, UCT'. As you come down the exit ramp, cross straight across the traffic lights, following the sign to 'Middle Campus'. Parking is on your right and the Kramer Building on your left. See map on page vii. From Main Road turn up Woolsack Drive (next to the Baxter Theatre) and then left into Middle Campus, just before the road passes under the freeway.

The Sea Point Civic Centre is situated on the junction of Main Rd and Three Anchor Bay Rd in Sea Point (past the Green Point Common just before you enter Sea Point shopping area).

Registration:

Registration will take place in the Kramer Building on Sunday 29 June 2008 from 1600- 1800, with late registration from 0800 on Monday 30 June. The registration desk will be situated in the lower foyer of the building.

Scientific programme:

Commencing from 0900 on Monday 30 June, ending lunchtime Thursday 3 July (lunch will be provided after the closing session). Each daily schedule includes 30-minute morning and afternoon refreshment breaks and a 90-minute midday break, designed to allow for lunch, poster viewing and networking. All sessions take place in the Kramer Building, UCT.

Please wear your name-tag at all times, as this acts as your ticket for entry, refreshments and lunch. Existing registrations already exceed the capacity of the main lecture hall, so please arrive early if you wish to make sure of a seat for the plenary sessions – we cannot guarantee to accommodate all delegates at these sessions. Once we split into three parallel sessions for the thematic sections there will be enough space for everyone.

Refreshment arrangements:

All meals are Halaal and vegetarian options are provided.

A complimentary conference coffee/tea mug is included in your conference pack and should be used for all refreshment breaks – *no other mugs will be supplied!*

Packed lunches are provided in the foyer area and, weather permitting, there are attractive outside seating areas available. In order to minimize unnecessary wastage please return your used lunch bags to the tables after use. Undamaged bags can be reused and any unopened food will be donated to a worthy cause.

Exhibitors:

A number of publishers, booksellers and equipment manufacturers will have display tables in the foyer at which you can view and purchase products. A limited supply of conference T-shirts, mugs and scarves will also be on sale at the registration table. Delegates who would like to market their own publication through the registration desk may do so, at a small charge of R 10 per item sold.

Social programme:

The following social events are planned:

Sunday 29 June 1700-1900: Icebreaker function in Kramer Building (free snacks and introductory drinks for registered delegates, cash bar thereafter). Drinks tickets are tucked into your name-tag.

Tuesday 1 July 1630-1830: 'Posters, pints and peanuts', Kramer Building (substantial snacks and two complimentary drinks are provided free to registered delegates and a cash bar is available thereafter). Drinks tickets are tucked into your name-tag.

Wednesday 2 July 1900 till late: Symposium dinner and awards ceremony, Sea Point Civic Centre (extra charge). Free bus transport will be provided between UCT and the venue. **Entry by pre-purchased ticket only!** If you have purchased a ticket it is tucked into your name-tag.

Awards:

Awards will be made at the closing function for the best student poster and for the best student oral presentation.

The following awards will be made at the symposium dinner:

The Marine and Coastal Communicator Awards. These awards are made to individuals or groups of individuals in recognition of their outstanding contributions towards communication of information about the marine and coastal environment to the public.

The Derek Krige Medal, awarded in recognition of outstanding achievements in the field of technical support to marine science in South Africa.

The Gilchrist Memorial Medal to be awarded to distinguished marine scientists. The Medal serves as recognition of the recipients' contributions to marine science, to further stimulate excellence in South African marine science, and to focus attention on South Africa's marine and coastal environments.

Registration and payment:

Registration for the meeting is closed. The conference is fully- (in fact substantially over-) subscribed and late registration cannot be considered. Access, especially to the plenary sessions, is strictly for registered delegates only, as seating in the plenary lecture theatre is at capacity.

The National Research Foundation is thanked for awarding a grant to subsidize the registration fees of presenting students.

Registration fees entitle delegates to attend all symposium presentations and include morning and afternoon teas, packed lunches, social functions (excluding the dinner, for which there is an extra charge), coffee mug, conference bag and abstract book. There is an extra charge for commemorative T-shirts and scarves.

Accommodation:

Residence accommodation is provided (if booked in advance) in the new Graca Machel residence, which is situated on campus close to the conference venue. If approaching from the city, N2 or airport take the same (Rosebank/UCT) exit that leads to the conference venue, but turn left as you come down the off ramp and proceed down Woolsack Drive under the footbridge. After about 200 m take the off ramp to the left. The residence is the building on your left (turn left and left again to reach the entrance).

Accommodation is on a bed and breakfast basis and the cost is R 198 per person per night for a single room, including bedding, towels, a heater and a hot breakfast. Double rooms, with two single beds, are also available.

All rooms use a 'reslock' system, which is basically a padlock that locks from the outside. Each room door, however, can still be locked from the inside when guests are inside their rooms. The padlock and keys will be provided to guests on arrival. No deposit is required for the keys and padlocks, but if the key is lost, a replacement fee of R 100 will be charged. A maintenance person is available at the residence to assist with general problems, such as replacing locks or bulbs. Guests are requested to inform the receptionist or the residence facilities officer about general problems with the accommodation. A general maintenance check is done on each room prior to guests arriving to minimise queries. The residence does not have a laundry facility for guests, but there is a public one available on Main Road. Each room is equipped with 1 Duvet inner and cover, 1 blanket, 1 fitted sheet, 1 pillow and pillow-case, a hand towel and 1 bath towel. If necessary, guests may bring extra bedding.

It is a short walk from the residence to the symposium venue. If you walk up the hill towards the mountain there is a footbridge across the road at Kopano residence. Alternatively cross Woolsack Drive by the road bridge, just downhill of the residence, and work up through this attractive wooded section of the university to the Kramer Building.

Transport:

A conference shuttle will be available to transport delegates between Cape Town International Airport and the conference venue and residence. The shuttle will depart from the domestic terminal at approximately hourly intervals **ONLY** between 13h00 and 17h00 on Sunday 29 June. Look out for someone holding a SAMSS 2008 sign in the terminal.

Shuttles back to the airport will operate **ONLY** between 13h00 and 17h00 on Thursday 3 July and by prior arrangement on the morning of Friday 4 July.

Delegates arriving or leaving at other times must make their own arrangements. This is easily done via one of the several commercial shuttle services operating at the airport. See the website for suggestions.

Transport between the residence and the conference dinner venue will be provided. All other local travel must be organised individually. The venue is well serviced by the suburban train service running between Cape Town city centre and Muizenberg/Simonstown. The closest stations are Rosebank and Rondebosch and both are only a few minutes walk from the venues.

Presentation and abstract submission:

Oral presentations (other than invited plenaries) are 15 minutes in **total** duration (12 minutes talk, plus 3 minutes for questions and changeover). The time schedule will be strictly enforced by the chairpersons. Data projectors are provided in each venue, but delegates who require other facilities (overhead or 35mm projector) must contact the organisers in advance.

Powerpoint presentations must be submitted to the secretariat **prior to the meeting**. Talks may be submitted by email to samss2008@gmail.com , by **26th June**. **Please note this address for sending large files.**

If you are based in Cape Town you may also take your presentation on a flash drive, CD or DVD to either Gilly Smith (UCT Zoology) or Carmen Visser (MCM). Late submissions will be accepted at the icebreaker, but we will not accept talks brought to lecture theatres during the session breaks.

Posters:

The poster display area is in the main foyer, one level up from the lecture theatres. Poster display boards will be erected there before the icebreaker session and will be labelled by theme. Posters should be hung by lunchtime on Monday 30th. There will be opportunities to view posters during the lunch breaks and also a special

poster session on Tuesday afternoon. Poster presenters should be in attendance at their posters during the dedicated poster sessions as indicated on the programme.

The maximum dimension of posters is 100 cm high by 80 wide. Poster headings should include the name, address and email of the author(s), with the presenting author underlined and should be printed in a font large enough read to be read from a distance of 2 m. Suitable tape to attach the posters to the poster boards will be provided at the registration desk.

General information:

Dress: The weather in Cape Town can be cold and wet at this time of year so warm clothing and rain gear should be part of your equipment. Casual wear is acceptable for the symposium sessions, but more formal smart wear is expected for the dinner (jacket and tie for men).

Eating out: There are a variety of restaurants and take-away establishments in Main Road Rondebosch, a few 100 m along main road to the south of the venue, plus a wider range of facilities in adjacent suburbs.

Contact details:

For additional information please contact us on samss@uct.ac.za or samss2008@gmail.com

Useful numbers at the conference :

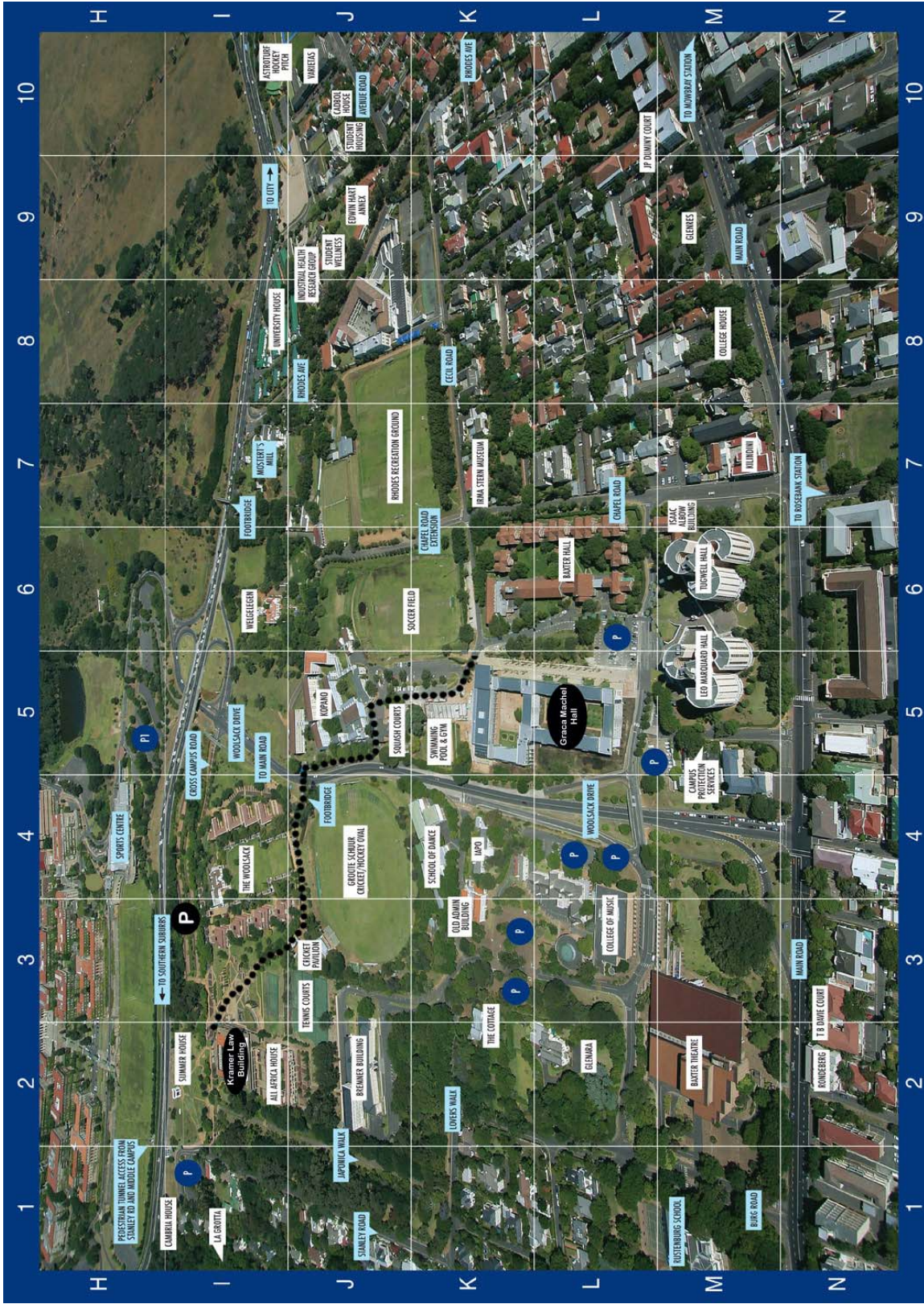
Campus Security – main office 021 650 2222/3 (only the extension number need be dialled inside UCT)

- Kramer building x 3022

- Traffic office x 3314

General queries during the conference : 072 074 2626

Please note this number will ONLY be operational from Saturday 28th June to Saturday 5th July



Map of Middle and Lower Campus showing Kramer Building (conference venue), Graca Machel Residence, parking areas and route between residence and venue.

Abbreviated programme

Monday 30 June 2008			
08:00	REGISTRATION (Kramer)		
08:30	WELCOME AND HOUSEKEEPING (LT1)		
09:00	PL1	G. Philander (LT1)	
		Sharks (LT1)	Temp. open/closed estuaries (LT2)
09:30			Aquaculture biotechnology (LT3)
		C. Da Silva	N. Carrasco
		G. Cliff	G. Tweddle
09:45		J. Escobar-Porras	N. Thwala
10:00			V. Coyne
			B. Arendze-Bailey
			B. Blake
10:15	REFRESHMENTS		
10:45	MPA Symposium (LT1)		
		E. Allan	S. Botha
		J. Adams	C. Ealand
11:00		N. James	D. Harding
		B. Ellender	R. Horwitz
11:15		A. Ter rde	R. Huddy
		J. Turpie	M. Janse van Rensburg
11:30		U. Scharler	L. Kandjengo
11:45			
12:00			
12:15			
12:30	LUNCH AND POSTERS (Mon. posters)		
14:00	PL2	A. Whitfield (LT1)	
14:15	PL3	C. Attwood (LT1)	
		Marine Protected Areas (LT1)	Estuaries (LT2)
		Coastal impacts (LT3)	
14:30		N. Ntunzi	B. Clark
		A. G tz	J. Sherwood
14:45		P. Watt-Pringle	N. Gordon
		M. Botha	G. Snow
15:00			S. Taljaard
			L. Fairhurst
			A. Cartwright
			L. Guastella
15:15			
15:30	REFRESHMENTS		
16:00			Aquaculture (LT3)
		S. Bollmohr	A. Green
16:15		T. Bornman	G. Maneveldt
		S. Lamberth	C. Jones
16:30		L. van Niekerk	D. Shuuluka
			T. Dlaza
16:45			E. van der Merwe
17:00		General CERM Meeting, 17:00 - 18:30 (LT2)	
17:15			

Tuesday 1 July 2008			
08:30	PL4	R. Pollard (LT1)	
		Food web variability (LT1)	Southern Ocean (LT2)
		Fish parasites (LT3)	
09:00		C. Moloney	J. Durgadoo
		L. Blamey	N. Hart
09:15		D. Yemane	W. Froneman
		L. Shannon	R. Daly
09:30		H. Arancibia	J. Sterley
09:45			N. Smit
			K. Hadfield
			M. Coetzee
			C. Reed
			D. Vaughan
10:00			
10:15	REFRESHMENTS		
10:45	Fisheries stock assessment and management (LT1)		Studies off the west coast (LT3)
		K. Bernard	N. Burls
		N. Richoux	F. Shillington
11:00		A. Bernard	J. Veitch
		. Plaginyi	R. Barlow
11:15		G. Hofmeyr	G. Pitcher
		M. Wheeler	S. Sono
11:30		M. de Villiers	F. Cazassus
11:45			
12:00			
12:15			
12:30	LUNCH AND POSTERS (Tue. Posters)		
13:30	LUNCH AND POSTERS (Tue. Posters)		
14:00	PL5	J. Field (LT1)	
		Biotelemetry (LT2)	
14:15		R. Rademeyer	A. Kock
		M. Meyer	M. Cyrus
14:30		P. Britz	N. Swart
		S. Somhlaba	S. Thomalla
14:45		P. Cowley	B. Hubbart
			D. Colenbrander
15:00			
15:15			
15:30	REFRESHMENTS		
16:00	PL6	Networking and funding opportunities and information (LT1)	
		J. Field	
16:15	PL7	R. le Roux	
		D. Vousden	
16:30	PL8	J. Hermes	
		J. Hermes	
16:45	PL9	J. Hermes	
		J. Hermes	
17:00 to 19:00		Posters, Pints and Peanuts, 17:00-19:00 (Kramer courtyard)	

Abbreviated programme

Wednesday 2 July 2008			
08:30	PL10	J. Lutjeharms	
08:45	PL11	A. Jarre	
09:00	Ecosystem-based fisheries management (LT1)	Ecology of the sardine run (LT2)	Monitoring systems and networks (LT3)
	M. Angula	C. van der Lingen	G. Brundrit
	M. Honig	J. Coetzee	R. Egypt
	T. Fairweather	Q. Mketsu	M. Grundlingh
	S. Petersen	S. O'Donoghue	B. Maritz
	W. Potts	S. Fennessy	C. Lawrence
REFRESHMENTS			
Benthic diversity and impacts (LT1)		Marine education and communication (LT3)	
10:45	L. Atkinson	S. Dudley	J. Mann
11:00	L. Lange	M. Roberts	J. Porter
11:15	S. Mafwila	L. Hutchings	Coastal and estuarine research (LT3)
	M. Hendricks	Studies off the south and east coasts (LT2)	L. Woolley
11:30	Intertidal and nearshore ecology (LT1)	B. Backeberg	R. Lawrie
	V. Cole	R. Blamey	C. Chrystal
12:00	C. von der Meden	N. Chang	L. Vivier
12:15	B. Mostert	I. Halo	D. Cyrus
LUNCH AND POSTERS (Wed. posters)			
LEAP School performance (LT1)			
14:00	T. Robinson	L. Jacobs	K. Hutchings
14:15	N. Hussey	A. Mafimbo	N. Miranda
14:30	F. Porri	R. Roman	P. Matsapola
14:45	M. Rothman	M. Rouault	C. Wainman
15:00	V. Wepener	C. Bosman	L. Hancke
15:15	A. Biccard	T. Morris	H. Waldron
REFRESHMENTS			
16:00	R. Eager	S. Porter	R. Martins
16:15	S. Kohler	T. Samaai	J. Githaiga
16:30	A. Mead	S. Deyzel	N. Downey
16:45	M. Pfaff	M. Dicken	L. Singh
17:00	PL12	C. McQuaid	
17:15	PL13	J. Huggett	
17:30	Student meeting and election of SANCOR student representative (LT1)		

Thursday 3 July 2008			
09:00	PL14	H. Kleinschmidt	
09:15	PL15	M. Lucas	
09:30	Marine vertebrate biology and ecology (LT1)	Systematics and molecular techniques (LT2)	Coastal management (LT3)
		B. Macey	K. Bezuidenhout
	M. Dopolo	C. Matthee	T. Jordaan
10:00	M. Gibbons	P. de Coito	
REFRESHMENTS			
10:45	P. Patrick	S. Dos Santos	A. Rajkaran
11:00	A. Bernatzeder	L. Mmonwa	F. Kuriah
11:15	R. Bennett	C. Oosthuizen	A. Mather
11:30	N. Twatwa	C. Simon	A. Forbes
11:45	R. Nel	S. von der Heyden	G. Cilliers
12:00	PL16	S. P. n	
12:15	PL17	P. Best	
Student awards and symposium closure (LT1)			
LUNCH			
13:30	Post-SAMSS: Estuary RDM and monitoring workshop, 13:30-16:00 (LT2)		Post-SAMSS: Marine Linefish Research Group, 13:30-15:00 (LT3)
14:00			Post-SAMSS: Biotelemetry Research Group, 15:00-16:30 (LT3)
14:15			Post-SAMSS: Biotelemetry Research Group, 15:00-16:30 (LT3)
14:30			Post-SAMSS: Biotelemetry Research Group, 15:00-16:30 (LT3)
14:45			Post-SAMSS: Biotelemetry Research Group, 15:00-16:30 (LT3)
15:00			Post-SAMSS: Biotelemetry Research Group, 15:00-16:30 (LT3)
15:15	Post-SAMSS: Estuary RDM and monitoring workshop, 13:30-16:00 (LT2)		Post-SAMSS: Biotelemetry Research Group, 15:00-16:30 (LT3)
15:30			Post-SAMSS: Biotelemetry Research Group, 15:00-16:30 (LT3)
16:00			Post-SAMSS: Biotelemetry Research Group, 15:00-16:30 (LT3)
16:15			Post-SAMSS: Biotelemetry Research Group, 15:00-16:30 (LT3)
16:30			Post-SAMSS: Biotelemetry Research Group, 15:00-16:30 (LT3)
16:45			Post-SAMSS: Biotelemetry Research Group, 15:00-16:30 (LT3)
17:00			
17:15			
17:30			

MONDAY **LT1**: Sessions A1, A2, A3, A4 and Plenary talks PL1, PL2, PL3

PLENARY TALK PL1

09:00 **George Philander**. Why is the ocean so cold?

SESSION A1

SHARKS

- 09:30 **C. Da Silva**. The status and prognosis of the smoothhound shark (*Mustelus mustelus*) fishery in the southeastern and southwestern Cape coasts, South Africa.
- 09:45 **Jeremy Cliff, Michael Anderson-Reade, Graeme Charter**. Marked fluctuations in numbers of whale sharks in northern KwaZulu-Natal, South Africa.
- 10:00 **Jessica Escobar-Porras, Warwick Sauer, Paul Cowley**. Are catsharks as homely as tabby cats?

10:15 REFRESHMENTS

SESSION A2

MPA SYMPOSIUM

- 10:45 **Charles Griffiths**. Marine biodiversity and biogeography of South Africa.
- 11:00 **T. Livingstone, J.M. Harris, D. Schoeman, A.T. Lombard**. An offshore classification for biodiversity conservation planning on the east coast of southern Africa.
- 11:15 **Hedley S. Grantham, Amanda T. Lombard, Edward T. Game, Alistair J. Hobday, Anthony J. Richardson, Lynnath E. Beckley, Robert L. Pressey, Carl D. van der Lingen, Samantha L. Petersen, Jenny A. Huggett, Janet C. Coetzee, Dagmar Merkle, Jane E. Alpine, Hugh P. Possingham**. Conservation planning in spatially and temporally dynamic marine environments.
- 11:30 **E. Lagabrielle, G. David, A. Thomassin**. Conservation planning and social science: crossed-visions in the Indian Ocean.
- 11:45 **Michael H. Schleyer, Louis Celliers, Alke Kruger**. Results of reef surveys and associated research relevant to management of the IsiMangaliso Wetland Park.
- 12:00 **Sven E. Kerwath, Eva B. Thorstad, Tor F. Næsje, Colin G. Attwood, Chris Wilke, Finn Økland, Paul D. Cowley**. Can a marine protected area protect mobile fish? A South African case study.
- 12:15 Discussion session

12:30 LUNCH AND POSTERS (Authors of Mon posters: please attend your poster from 13:15-13:45)

PLENARY TALKS PL2 and PL3

- 14:00 **Alan K. Whitfield, Janine B. Adams, Guy C. Bate, Karen Bezuidenhout, Tom G. Bornman, Paul D. Cowley, William Froneman, Phumelelo T. Gama, Nicola C. James, Bernard Mackenzie, Tarin Riddin, Gavin C. Snow, Nadine A. Strydom, Susan S. Taljaard, Anja I. Terörde, Andre K. Theron, Jane K. Turpie, Lara van Niekerk, Paul D. Vorwerk, Tris H. Wooldridge**. A multidisciplinary study of a small, intermittently open South African estuary, with particular emphasis on the influence of mouth state on the ecology of the system.
- 14:15 **Colin G. Attwood, Kerry J. Sink**. The role of marine protected areas in South Africa: contrasting coastal and offshore environments.

SESSION A3

MARINE PROTECTED AREAS

- 14:30 **Nolubabalo H. Ntunzi, Malcolm J. Smale.** Intertidal fishes of areas adjacent to the East London marine reserves.
- 14:45 **Albrecht Götz, Paul D. Cowley.** Temporal variability of protected inshore fishery populations in the Tsitsikamma National Park marine protected area, South Africa.
- 15:00 **Peter Watt-Pringle, Paul D. Cowley, Colin G. Attwood.** Post-settlement movement behaviour of blacktail (*Diplodus sargus capensis*), zebra (*Diplodus cervinus hottentotus*) and white musselcracker (*Sparodon durbanensis*) along the South African coast.
- 15:15 **Marie Botha, Mike Meyer, Ronel Nel, Herman Oosthuizen, Jeff Gaisford, Deon Kotze.** Inter-nesting behaviour of leatherback turtles in iSimangaliso Wetland Park and the usefulness of this MPA to provide protection.

15:30 REFRESHMENTS

SESSION A4

MARINE PROTECTED AREAS (continued)

- 16:00 **R. Chalmers, A. Götz, W.H.H. Sauer.** Strategic planning for the Greater Addo MPA – understanding the key issues.
- 16:15 **A. Evans, R. Nel, M. Smale.** An investigation into the functioning of Sardinia Bay MPA, Port Elizabeth.
- 16:30 **M.D.V. Nakin, C.D. McQuaid, A. J. Booth.** Effects of marine reserves on growth of commonly exploited and rarely exploited limpets on the southeast coast of South Africa.
- 16:45 **C. Floros, M.H. Schleyer, D. Schoeman.** Differing fish communities on sanctuary and open reefs reveal impacts of recreational fishing and diving on the Maputaland coral reefs of South Africa.
- 17:00 **R.J. Anderson, J.J. Bolton, H. Stegenga, D. Wilby.** Using biogeographic patterns of seaweed species and communities to test the efficacy of marine protected areas: an example from the Agulhas Marine Province, South Africa.
- 17:15 **A. Oosthuizen.** MPAs, science and SANParks

MONDAY LT2: Sessions B1, B2, B3, B4

09:00 **PLENARY PL1 - go to LT1**

SESSION B1

TEMPORARILY OPEN/ CLOSED ESTUARIES

- 09:30 **Nicola K. Carrasco, Renzo Perissinotto, Deena Pillay.** Zooplankton of the St. Lucia Estuary during the current drought cycle: a comparison between open- and closed-mouth conditions.
- 09:45 **G.P. Tweddle, P.W. Froneman.** Variability in the recruitment of zooplankton and nekton into a temporarily open/closed Eastern Cape estuary, during 3 different hydrological mouth phases.
- 10:00 **N.N. Thwala, T.H. Wooldridge.** The combined effects of salinity and temperature on postembryonic growth, survival and fecundity of the amphipod, *Melita zeylanica* Stebbing (Gammaridae).

10:15 REFRESHMENTS

SESSION B2**TEMPORARILY OPEN/ CLOSED ESTUARIES (continued)**

- 10:45 **E.L. Allan, P.W. Froneman.** Top-down, bottom-up control of bacterial production in a temporarily open/closed estuary.
- 11:00 **Janine B. Adams, Taryn Riddin.** Influence of mouth status and water level on the macrophytes in a small temporarily open/closed estuary.
- 11:15 **Nicola C. James, Paul D. Cowley, Alan K. Whitfield.** Abundance, recruitment and residency of two sparid fishes in an intermittently open estuary in South Africa.
- 11:30 **Bruce R. Ellender, Olaf L.F Weyl, Paul D. Cowley.** Temporal and spatial distribution of *Oreochromis mossambicus* in the intermittently open East Kleinemonde Estuary, South Africa.
- 11:45 **Anja Terörde, Jane Turpie.** The influence of mouth dynamics on the avifauna of four intermittently open estuaries in the Eastern Cape, South Africa.
- 12:00 **Jane K. Turpie, Barry M. Clark.** Ecological-economic modelling for estuarine management: a case study of the East Kleinemonde estuary.
- 12:15 **Ursula M. Scharler.** Ecosystem responses of temporary open/closed estuaries.

12:30 LUNCH AND POSTERS (Authors of Mon posters: please attend your poster from 13:15-13:45)

14:00 **PLENARY PL2 - go to LT1**

14:15 **PLENARY PL3 - go to LT1**

SESSION B3**ESTUARIES**

- 14:30 **Barry Clark.** From flow to fishes: a new understanding of links between physic-chemical parameters and biota in the Berg estuary.
- 14:45 **John Sherwood, Adam Pope, Lance Lloyd, Chris Gippel, Marcus Cooling, Jeremy Hindell, Brett Anderson.** A “down under” approach to determining environmental flow needs of estuaries.
- 15:00 **N. Gordon, J.B. Adams, F. Garcia-Rodriguez.** Paleolimnology of Soetendalsvlei situated within the Agulhas Plain, South Africa: Preliminary findings.
- 15:15 **G.C. Snow, J.B. Adams.** A review of the use of microalgae in estuarine freshwater reserve determinations.

15:30 REFRESHMENTS

SESSION B4**ESTUARIES (continued)**

- 16:00 **Silke Bollmohr, Paul J. van den Brink, Ralf Schulz.** The use of Principle Response Curve to explain meiofaunal community response to two runoff events different in pesticide input in a temporarily open estuary, South Africa.
- 16:15 **T.G. Bornman, J.B. Adams.** The importance of river flow in small temporarily open/closed estuaries along the southern Cape coast, South Africa.
- 16:30 **S.J. Lamberth, L. Van Niekerk, K. Hutchings.** Comparison of, and the effects of altered freshwater inflow on, fish assemblages of two contrasting South African estuaries: the cool temperate Olifants and the warm temperate Breede.
- 16:45 **L. van Niekerk, Susan Taljaard, Piet Huizinga.** Assessing variability in the hydrodynamic processes of South Africa’s estuaries.
- 17:00 GENERAL CERM MEETING (17:00 to 18:30)

MONDAY **LT3**: Sessions C1, C2, C3, C4

09:00 **PLENARY PL1 - go to LT1**

SESSION C1

AQUACULTURE BIOTECHNOLOGY

- 09:30 **Vernon Coyne, Tanya Lebi.** Identification of differentially expressed genes in the commercially important agarophyte, *Gracilaria gracilis*, following nitrogen deprivation.
- 09:45 **Bronwyn L. Arendze-Bailey, Vernon E. Coyne.** Identification of differentially expressed immune response genes in the South African abalone, *Haliotis midae*, following the administration of a probiotic supplemented artificial diet.
- 10:00 **Bronwen Blake, Vernon Coyne.** Cloning and molecular characterisation of four alginate lyase genes from the abalone enteric bacterium *Vibrio midae* SY9.

10:15 REFRESHMENTS

SESSION C2

AQUACULTURE BIOTECHNOLOGY (continued)

- 10:45 **Suzanne M. Botha, Ann E. Meyers, Vernon E. Coyne.** Transient expression of two reporter genes, lacZ and EGFP, in the red algae *Gracilariopsis longissima* and *Gracilaria gracilis*.
- 11:00 **Christopher S. Ealand, Vernon E. Coyne.** Identification of differentially expressed genes in the commercially important agarophyte, *Gracilaria gracilis*, following exposure to disease response elicitors.
- 11:15 **David G. Harding, Vernon E. Coyne.** Identification of genes expressed in response to bacterial infection of the commercially-important South African abalone *Haliotis midae*.
- 11:30 **Rael Horwitz, Vernon Coyne.** Characterisation of an intracellular bacterium infecting the digestive gland of the South African abalone, *Haliotis midae*.
- 11:45 **Robert J. Huddy, Vernon E. Coyne.** Molecular characterisation of the extracellular proteases of *Vibrio midae* SY9.
- 12:00 **Marike Janse van Rensburg, Vernon E. Coyne.** The role of electron transport in the defence response of the South African abalone, *Haliotis midae*.
- 12:15 **Lineekela Kandjengo, John J. Bolton, Terry A. J. Hedderson.** Is it really *Ulva lactuca* or what species are we growing in aquaculture in the South African Abalone industry?

12:30 LUNCH AND POSTERS (Authors of Mon posters: please attend your poster from 13:15-13:45)

14:00 **PLENARY PL2 - go to LT1**

14:15 **PLENARY PL3 - go to LT1**

SESSION C3

COASTAL IMPACTS

- 14:30 **S. Taljaard, L. van Niekerk, A.K. Theron, P.D. Morant, Y. Peterson, F. Albertus-Stanley.** South Africa's National Programme of Action to protect the coastal marine environment from land-based activities.
- 14:45 **Lucinda Fairhurst, Geoff Dekker, Gregg Oelofse, Geoff Brundrit.** Sea level rise impacts for Cape Town 1. Inundation scenarios.
- 15:00 **Anton Cartwright, Gregg Oelofse, Lucinda Fairhurst.** Sea level rise impacts for Cape Town 2. Risk assessment and adaptation measures.
- 15:15 **Lisa A. Guastella, Alan M. Smith, Andrew A. Mather, Simon C. Bundy.** Post March 2007 marine storm erosion of KZN beaches.

15:30 REFRESHMENTS

SESSION C4**AQUACULTURE**

- 16:00 **Alistair J. Green, Clifford L.W. Jones, Peter J. Britz.** An investigation into the protein and energy requirements of the South African abalone *Haliotis midae* cultured at optimal and elevated water temperatures.
- 16:15 **T.L. Francis, G.W. Maneveldt, J. Venter.** Comparing the growth of market-size abalone fed kelp versus the new low protein, commercially available Abfeed®-K26.
- 16:30 **Rowan D. Yearsley, Clifford L.W. Jones, Peter J. Britz.** What effect does settled sludge have on dissolved ammonia concentrations in raceways used to grow abalone *Haliotis midae* fed a formulated diet?
- 16:45 **Diina Shuuluka, John J. Bolton, Robert J. Anderson, Michael S. Stekoll.** Ecophysiological studies of a new aquaculture crop, *Ulva capensis* (Chlorophyta).
- 17:00 **Thembinkosi S. Dlaza, John J. Bolton, Robert J. Anderson.** Towards *Porphyra* aquaculture: propagule release and growth of the conchocelis phase of three South African species in culture.
- 17:15 **E. van der Merwe, G.W. Maneveldt, J. Venter.** The effects of hand vs machine grading on the growth and survivorship of grow-out abalone.

TUESDAY **LT1**: Sessions A5, A6, A7 and Plenary talks PL4 to PL9

PLENARY TALK PL4

08:30 **Raymond Pollard**. Does iron fertilization in the Southern Ocean enhance export? Crozet, a natural example.

SESSION A5

FOOD WEB VARIABILITY

- 09:00 **Coleen L. Moloney, Carl D. van der Lingen, Astrid Jarre, Lynne J. Shannon**. Changing food webs of the southern Benguela upwelling ecosystem.
- 09:15 **Laura K. Blamey, George M. Branch**. Changes in kelp forest communities caused by rock lobster invasion?
- 09:30 **Dawit Yemane, Yunne –J. Shin, John G. Field**. Assessing spatial patterns in the size structure and sources of fish mortality for the fish communities in the southern Benguela ecosystem based on an IBM model: a comparison across three periods.
- 09:45 **L.J. Shannon, M. Coll, S. Neira**. Understanding the behaviour of ecological indicators using food web models fitted to time series of abundance and catch data.
- 10:00 **Hugo Arancibia, Sergio Neira, Lynne Shannon**. Interaction strength and keystones in upwelling food webs: comparing the southern Benguela and the southern Humboldt.

10:15 REFRESHMENTS

SESSION A6

FISHERIES STOCK ASSESSMENT AND MANAGEMENT

- 10:45 **Bruce Q. Mann, Greg Nanni, Pierre Pradervand**. An aerial survey to estimate total shore angling effort along the KwaZulu-Natal coast, South Africa.
- 11:00 **Tor F. Næsje, Colin Attwood, Sven Kerwath, Paul D. Cowley, Felicia Keulder, Clement Arendse**. Patterns and volumes of commercial and recreational harvest of white stumpnose in Saldanha Bay: a preliminary assessment of the fishery.
- 11:15 **Bruce Donovan, Thomas Hecht, Olaf Weyl**. Towards greater accuracy in the estimation of time-based nominal effort for a boat-based linefishery.
- 11:30 **D. Smith, B.Q. Mann, R.P. van der Elst**. Biology and stock assessment of the coastal fish *Lichia amia* (Teleost: Carangidae) off the South African coast.
- 11:45 **C.H. Kirchner, C.H. Bartholomae**. Identifying and estimating the variability of Namibian hake *Merluccius capensis* recruitment.
- 12:00 **Margit R. Wilhelm, Jean-Paul Roux, M. Deon Durholtz**. Indirect age validation of Cape hake *Merluccius capensis* in the northern Benguela using otoliths collected from Namibian seal scat samples.
- 12:15 **Faye R.V. Brinkman, Margit R. Wilhelm, J. Pedro Andrade**. Analysis of annuli on otoliths and growth rates of the Namibian hake (*Merluccius capensis*).

12:30 LUNCH AND POSTERS (Authors of Tue posters: please attend your poster from 13:15-13:45)

PLENARY TALK PL5

14:00 **John Field, Coleen Moloney, Louis du Buisson, Astrid Jarre, Tore Stroemme, Marek Lipinski, Paulus Kainge**. Exploring the BOFFFF hypothesis using a model of South African deepwater hake (*Merluccius paradoxus*).

SESSION A7

FISHERIES STOCK ASSESSMENT AND MANAGEMENT (continued)

- 14:15 **Rebecca A. Rademeyer, Charles T.T. Edwards, Éva E. Plagányi, Doug S. Butterworth.** Ecosystem considerations for the management of the South African hake resource: Modelling approaches.
- 14:30 **Genevieve Maharaj, Robert J.Q. Tarr, Angus J. Mackenzie.** The trials and tribulations of the abalone.
- 14:45 **Peter Britz, Serge Raemaekers.** Profile of the illegal abalone fishery in South Africa: Is a sustainable, legal fishery achievable?
- 15:00 **S. Somhlaba, D.S. Butterworth, É.E. Plaganyi.** What is the potential for the constraints associated with ECOPATH to improve estimates of biomass and productivity in the southern Benguela?
- 15:15 **Doug S. Butterworth.** On controversial issues in South African renewable marine resource management.

15:30 REFRESHMENTS

PLENARY TALKS PL6 to PL9. Networking and funding opportunities and information

- 16:00 **John Field, Sheldon Dudley.** SAMCA: Progress towards a new dispensation in South African Marine Science.
- 16:15 **Renee le Roux.** Optimizing on international co-operation for marine and coastal research in South Africa: FP7 as an instrument.
- 16:30 **David Vousden.** African countries join hands in management programme.
- 16:45 **Juliet C. Hermes, Kim Bernard, Angus Paterson, Johan Pauw.** An introduction to the South African Environmental Observation Network's two marine nodes – Elwandle and Egagasini.

POSTER SESSION

17:00-19:00 Posters, Pints and Peanuts (Kramer courtyard)

TUESDAY LT2: Sessions B5, B6, B7

08:30 **PLENARY PL4 - go to LT1**

SESSION B5

SOUTHERN OCEAN

- 09:00 **J.V. Durgadoo, J.R.E. Lutjeharms, I.J. Ansorge, A. Biastoch.** Obstructions to the Antarctic Circumpolar Current: case study of the circulation at the Conrad Rise.
- 09:15 **Neil C.G. Hart, Chris J.C. Reason.** The influence of SST's and ocean modes of variability on mid-latitude cyclones over South Africa.
- 09:30 **P.W. Froneman, E.L. Allan.** The influence of Prince Edward Islands (Southern Ocean) in mediating trophic interactions among the plankton: evidence from trophic cascading experiments.
- 09:45 **R. Daly, P.W. Froneman.** Trophodynamics of selected mesozooplankton in the region of the Subtropical Convergence in the Indian sector of the Southern Ocean.
- 10:00 **J.A. Sterley, P.W. Froneman.** Carnivorous macrozooplankton community structure in the region of the Subtropical Convergence in the Indian sector of the Southern Ocean during late austral summer (April) 2007.

10:15 REFRESHMENTS

SESSION B6**SOUTHERN OCEAN (continued)**

- 10:45 **Kim S. Bernard, Brian P.V. Hunt, Evgeny A. Pakhomov, Graham W. Hosie, Volker Siegel, Peter Ward.** Potential implications of a decline in Southern Ocean pteropod densities due to ocean acidification.
- 11:00 **Nicole B. Richoux, P. William Froneman.** Krill trophodynamics at the Subtropical Convergence, Indian Ocean.
- 11:15 **Anthony T.F. Bernard, Isabelle J. Ansonge, P. William Froneman, Johann R.E. Lutjeharms, Kim S. Bernard, Neil Swart.** Entrainment of Antarctic euphausiids across the Antarctic Polar Front by a cold eddy.
- 11:30 **Éva Plagányi.** Modelling the impacts on top predators of an expanding Krill fishery.
- 11:45 **G.J. Greg Hofmeyr, Marthán N. Bester, Azwienewi B. Makhado, Pierre A. Pistorius.** Increase in populations of sympatric species of fur seals at Marion Island.
- 12:00 **Mariëtte Wheeler, Marienne S. de Villiers, Res Altwegg.** The effect of research disturbance on the behavioural responses and breeding success of Grey-headed Albatrosses at Marion Island.
- 12:15 **M.S. de Villiers.** Lessons learnt: Two decades of human disturbance research in the Antarctic and sub-Antarctic.

12:30 LUNCH AND POSTERS (Authors of Tue posters: please attend your poster from 13:15-13:45)

14:00 **PLENARY PL5 - go to LT1**

SESSION B7**BIOTELEMETRY**

- 14:15 **Alison Kock, Karl Laroche, Michael Meyer, Leonard Compagno, Deon Kotze, Charles Griffiths, Herman Oosthuizen.** Seasonal trends in habitat utilization of white sharks (*Carcharodon carcharias*) in False Bay, South Africa.
- 14:30 **M.A. Meyer, M. Smale, M. Paterson, R. Johnson, P. Koen, S. Kirkman, W.H. Oosthuizen, P.G.H. Kotze, S. Swanson.** Developing procedures and equipment for large shark telemetry studies.
- 14:45 **M.J. Smale, M.R. Farquhar, M. Meyer, A.J. Booth.** Survival and autumnal north-eastward migration of formerly captive and wild raggedtooth sharks (*Carcharias taurus*).
- 15:00 **Amber-Robyn Childs, Paul D. Cowley, Tor F. Næsje, Bronwyn A. O'Connell, Eva B. Thorstad, Anthony J. Booth, Warren M. Potts, Finn Økland.** Using acoustic telemetry to monitor estuarine movements and habitat use of spotted grunter *Pomadasy commersonii*.
- 15:15 **Paul D. Cowley, Tor F. Næsje, Audrey Darnaude, Amber-Robyn Childs, Sven E. Kerwath, Eva B. Thorstad.** Assessment of estuarine-dependency and multiple-habitat use patterns in dusky kob *Argyrosomus japonicus*, using a multi-faceted approach.

15:30 REFRESHMENTS

16:00 **PLENARY PL6 - go to LT1**

16:15 **PLENARY PL7 - go to LT1**

16:30 **PLENARY PL8 - go to LT1**

16:45 **PLENARY PL9 - go to LT1**

POSTER SESSION

17:00-19:00 Posters, Pints and Peanuts (Kramer courtyard)

TUESDAY **LT3**: Sessions C5, C6, C7

08:30 **PLENARY PL4 - go to LT1**

SESSION C5

FISH PARASITES

- 09:00 **Nico J. Smit**. Blood protozoans of South African marine fishes.
- 09:15 **Kerry A. Hadfield, Nico J. Smit**. The biodiversity of marine fish parasitic isopods of the family Cymothoidea from southern Africa.
- 09:30 **Maryke L. Coetzee, Nico J. Smit, Angela J. Davies**. The feeding behaviour of the fish parasitic larvae of *Gnathia africana* Barnard, 1914 (Isopoda), from Tsitsikamma National Park, South Africa.
- 09:45 **C.C. Reed, L. Basson, L.L Van As**. New species of Myxozoa (Myxosporaea: Bivalvulida) from the south coast of Africa.
- 10:00 **David B. Vaughan, Kevin W. Christison, Anna Mouton**. Haematological examination as a tool to determine the efficacy of oral praziquantel in individually pit-tagged *Seriola lalandii* (Yellowtail Kingfish) infested with *Zeuxapta seriolae* (Monogenea: Heteraxinidae).

10:15 REFRESHMENTS

SESSION C6

STUDIES OFF THE WEST COAST

- 10:45 **Natalie Burls, Chris Reason**. The role of ocean processes within coupled ocean-atmosphere variability in the tropical Atlantic.
- 11:00 **F.A. Shillington, E.D. Barton, M. Ostrowski**. Comparative aspects of the North and South Atlantic upwelling regimes.
- 11:15 **J.A. Veitch, P. Penven, F.A. Shillington**. Equilibrium dynamics of the northern and southern Benguela systems.
- 11:30 **R. Barlow, T. Lamont, B. Mitchell-Innes, D. Louw, M. Kyewalyanga, H. Sessions**. Primary production in the Benguela ecosystem.
- 11:45 **Grant C. Pitcher, Andre du Randt, F.G. Figueiras, B.M. Hickey, M.T. Moita**. Mechanisms of phytoplankton bloom formation in embayments of eastern boundary upwelling systems.
- 12:00 **S. Sono, C.L. Moloney, C.D. van der Lingen**. Comparing estimates of zooplankton abundance from CUFES samples with those from a vertical bongo net.
- 12:15 **Fabienne M. Cazassus, Sakhile Tsotsobe, Coleen L. Moloney, Hans M. Verheye**. 1984: Benguela Niño or turning point?

12:30 LUNCH AND POSTERS (Authors of Tue posters: please attend your poster from 13:15-13:45)

14:00 **PLENARY PL5 - go to LT1**

SESSION C7

STUDIES OFF THE WEST COAST (continued)

- 14:15 **Mark D. Cyrus, John J. Bolton, Robert J. Anderson, Edmund C. February**. Use of stable isotope signatures in the macroalga *Ecklonia maxima* and the filter-feeder *Mytilus galloprovincialis* to determine the extent of sewage dispersal from the Green Point Outfall, South Africa.
- 14:30 **Neil C. Swart, Lihini I. Aluwihare, Peter J.S. Franks, Howard N. Waldron**. Lateral carbon export from the southern Benguela upwelling system.

14:45 **Sandy Thomalla, Robert Turnewitsch, Mike Lucas, Alex Poulton.** Particulate organic carbon export from the North and South Atlantic gyres: the $^{234}\text{Th}/^{238}\text{U}$ disequilibrium approach.

15:00 **Bernadette Hubbard, Grant C. Pitcher, Alan Cembella, John J. Bolton.** Quantifying PSP toxins on the west coast of South Africa.

15:15 **D. Colenbrander, L. Celliers, C. Oelofse.** Defining coastal zones: Implications for coastal sustainability.

15:30 REFRESHMENTS

16:00 **PLENARY PL6 - go to LT1**

16:15 **PLENARY PL7 - go to LT1**

16:30 **PLENARY PL8 - go to LT1**

16:45 **PLENARY PL9 - go to LT1**

POSTER SESSION

17:00-19:00 Posters, Pints and Peanuts (Kramer courtyard)

WEDNESDAY **LT1**: Sessions A8, A9, A10, A11 and Plenary talks PL10 to PL13

PLENARY TALKS PL10 and PL11

- 08:30 **Johann R. E. Lutjeharms**. A century of research on the Agulhas Current system.
- 08:45 **Astrid Jarre, Barbara Paterson, Margaret N. Angula *et al.*** Multi-criteria decision support: a toolbox for integration, communication and collaboration in marine social-ecological systems under global change?

SESSION A8

ECOSYSTEM-BASED FISHERIES MANAGEMENT

- 09:00 **Margaret Ndapewa Angula, Merle Sowman, Astrid Jarre**. Towards an adaptive management framework for the Namibian line fishery.
- 09:15 **Samantha L. Petersen, Maria B. Honig, Peter G. Ryan, Les G. Underhill**. An ecosystem approach to reducing seabird bycatch in the South African demersal longline fishery.
- 09:30 **Tracey P. Fairweather**. Indicators of sustainable fishing for the South African hakes (*Merluccius capensis* and *M. paradoxus*) - management applications/implications.
- 09:45 **Samantha L. Petersen, Peter G. Ryan, Les G. Underhill**. Albatross overlap with fisheries in the Benguela upwelling system: implications for conservation and management.
- 10:00 **W.M. Potts, W.H.H. Sauer, A.-R. Childs, A.D.C. Duarte**. Using baseline biological and ecological information to design a traffic light precautionary management framework for leerfish *Lichia amia* (Linnaeus 1758) in southern Angola.

10:15 REFRESHMENTS

SESSION A9

BENTHIC DIVERSITY AND IMPACTS

- 10:45 **Lara J. Atkinson, John G. Field**. Impacts of the demersal hake trawl fishery on benthic biodiversity in southern Africa.
- 11:00 **L. Lange, C.L. Griffiths**. Benthic invertebrate biodiversity and biogeography offshore of South Africa.
- 11:15 **S.K. Mafwila, J.G. Field**. Exploring the effects of bottom trawling in the Benguela system: an experimental approach.
- 11:30 **M.G.J. Hendricks, M.J. Gibbons, P.J.D. Lamshead**. The nematodes of Saldanha Bay – is Squiggler Park a high or low octane community?

INTERTIDAL AND NEARSHORE ECOLOGY

- 11:45 **Victoria J. Cole**. Mussels as ecosystem engineers: does density influence the strength of engineering?
- 12:00 **C.E.O. von der Meden, F. Porri, J. Erlandsson, C.D. McQuaid**. The effect of coastline topography on mussel distribution across life-history stages: larval settlement and beyond.
- 12:15 **B.P. Mostert, C.D. McQuaid, A. Elliott**. The effect of small scale water movement on the growth rate of the brown mussel, *Perna perna*.

12:30 LUNCH AND POSTERS (Authors of Wed posters: please attend your poster from 13:00-13:30)

13:30 LEAP School performance (LT1)

SESSION A10

INTERTIDAL AND NEARSHORE ECOLOGY (continued)

- 14:00 **George M. Branch, Francois Odendaal, Tamara B. Robinson**. Long-term monitoring of the arrival, expansion and effects of an alien mussel *Mytilus galloprovincialis* relative to wave action.
- 14:15 **N.E. Hussey, I.D. McCarthy, G. Cliff, S.F.J. Dudley, A.T. Fisk**. Stomach contents and stable isotopes: trophic ecology of a carcharhinid and a sphyrid off south east Africa.
- 14:30 **F. Porri, T. Jordaan, C.D. McQuaid**. Does larviphagy affect the connectivity of mussel populations?
- 14:45 **M.D. Rothman, R.J. Anderson, C.J.T. Boothroyd, F.A. Kemp, J.J. Bolton**. Testing a rapid method of kelp biomass estimation.
- 15:00 **V. Wepener, K.A. Mills, K. Schüring, S. Schweintek**. The use of resident and transplanted brown mussels (*Perna perna*) to assess metal exposure and effects along the subtropical east-coast of South Africa.
- 15:15 **Aiden Biccard, George M. Branch, Maya C. Pfaff**. Fast food: the transport of particulate organic matter over an upwelling event on the west coast of southern Africa.

15:30 REFRESHMENTS

SESSION A11

INTERTIDAL AND NEARSHORE ECOLOGY (continued)

- 16:00 **R.C. Eager, G.W. Maneveldt, A. Bassier**. The effects of long-term exclusion of *Cymbula oculus* (Born) on the distribution of intertidal organisms on the rocky shore at Kalk Bay.
- 16:15 **S. Kohler, S. Jaquemet, C.D. McQuaid**. Present and past foraging ecology of the African Black Oystercatcher on the rocky shores of the Eastern Cape, South Africa.
- 16:30 **A. Mead, K. Tunley, C.L. Griffiths, M. Rouault**. Times of change: a spatio – temporal assessment of rocky shore communities in False Bay, South Africa.
- 16:45 **Maya C. Pfaff, Vera Hoffmann, Wisaal Osman, Jennifer Fisher, John L. Largier, George M. Branch**. Land ahoy! Different onshore transport mechanisms of intertidal mussel and barnacle larvae off the west coast of South Africa.

PLENARY TALKS PL12 and PL13

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| <p>17:00 C.D. McQuaid, G.I. Zardi, K.R. Nicastro, M.J. Roberts, L. Hancke. Selection and dispersal, twin drivers for genetic structure in intertidal mussels.</p> <p>17:15 Jenny A. Huggett, Hans M. Verheye, Larry Hutchings. Patterns in the plankton: copepod abundance, biomass and distribution in the Southern Benguela-Agulhas Bank ecosystem over the last 20 years.</p> |
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<p>17:30 Student meeting and election of SANCOR student representative</p>

WEDNESDAY LT2: Sessions B8, B9, B10, B11

08:30 **PLENARY PL10 - go to LT1**

08:45 **PLENARY PL11 - go to LT1**

SESSION B8

ECOLOGY OF THE SARDINE RUN

- 09:00 **Carl D. van der Lingen, Marc Hendricks, M. Deon Durholtz, Cynthia N. Mtengwane**. Overview of the sardine run and biological characteristics of sardine engaged in the KwaZulu-Natal sardine run.
- 09:15 **J.C. Coetzee, D. Merkle, L. Hutchings, C.D. van der Lingen, M. van den Berg, M. Roberts**. How many sardines in a sardine run and other interesting observations.

- 09:30 **Q.K. Mketsu, C.D. van der Lingen, C.L. Moloney.** Comparative dietary analysis of small pelagic fish species from presumed mixed shoals off South Africa's east coast during the sardine run.
- 09:45 **Sean O'Donoghue, Victor Peddemors, Laurent Drapeau, Phillip Whittington.** A brief synopsis of sardine and predator movements during the annual KwaZulu-Natal sardine run.
- 10:00 **Pierre Pradervand, Sean Fennessy, Paul de Bruyn.** Do fish predators prefer their sardines fresh or frozen? Evidence from trends in shore angling catches on the KwaZulu-Natal coast.
-

10:15 REFRESHMENTS

SESSION B9

ECOLOGY OF THE SARDINE RUN (continued)

- 10:45 **Sheldon F.J. Dudley, Geremy Cliff.** The influence of the annual sardine run on catches of large sharks in the protective gill nets off KwaZulu-Natal, South Africa, and the occurrence of *Sardinops sagax* in shark diet.
- 11:00 **M.J. Roberts, C.D. van der Lingen, J.C. Coetzee, M. van den Berg.** Oceanography of the Transkei shelf and its relevance to the Natal sardine run.
- 11:15 **L. Hutchings, T. Morris, C. van der Lingen, S. Lamberth, A. Connell.** Ecosystem considerations of the KZN sardine run.

STUDIES OFF THE SOUTH AND EAST COASTS

- 11:30 **Bjorn C. Backeberg, Johnny A. Johannessen, Laurent Bertino, Chris J. Reason.** The greater Agulhas Current system: an integrated study of its mesoscale variability.
- 11:45 **Ross C. Blamey, Chris J.C. Reason.** The role of the Agulhas Current in an extreme weather event.
- 12:00 **N. Chang, P. Penven, F.A. Shillington.** ROMS model results of the seasonal structure and circulation on the Agulhas Bank.
- 12:15 **I. Halo, I.J. Anson, J.R.E. Lutjeharms, P. Florenchie.** The influence of ocean ridges on the circulation in the Mozambique Channel and south of Madagascar.
-

12:30 LUNCH AND POSTERS (Authors of Wed posters: please attend your poster from 13:00-13:30)

13:30 LEAP School performance (go to LT1)

SESSION B10

STUDIES OFF THE SOUTH AND EAST COASTS (continued)

- 14:00 **Lee-Ann Jacobs, Mike Roberts.** The mechanics of a dipole eddy in the western Mozambique Channel and its influence on primary production.
- 14:15 **Ali J. Mafimbo, John G. Mungai, C.J.C. Reason, F.A. Shillington.** Analysis and modelling of the upwelling region of the Somali coast.
- 14:30 **Raymond Roman, Johann R.E. Lutjeharms.** Red Sea Water in the greater Agulhas Current system.
- 14:45 **Mathieu Rouault, Pierrick Penven, Benjamin Pohl.** Warming in the Agulhas current system since the 80's.
- 15:00 **Charl Bosman, Alan Smith, Ron Uken.** A sigmoidal shoreface-connected ridge field: Aliwal Shelf, KZN, South Africa.
- 15:15 **T. Morris, M.J. Roberts, M.H. Schleyer, M.A. van den Berg.** Comparative temperature studies on coral reef communities in Sodwana Bay, South Africa.
-

15:30 REFRESHMENTS

SESSION B11**SOUTH AND EAST COAST STUDIES (continued)**

- 16:00 **S. Porter, K. Sink, G. Branch.** Abiotic correlates of shallow subtidal reef community structure in KwaZulu-Natal.
- 16:15 **Toufiek Samaai, Kerry Sink.** The use of sponge bathymetric distribution patterns in defining depth zones in the GSWLP.
- 16:30 **Shaun H.P. Deyzel, Tris H. Wooldridge.** Distribution, abundance and production rates of *Acartia natalensis* (Calanoida: Copepoda) eggs in soft sediments: implications to ecological interpretations.
- 16:45 **M.L. Dicken, S.G. Hosking.** Economic valuation of tiger shark diving within the Aliwal Shoal Marine Protected Area.
- 17:00 **PLENARY PL12 - go to LT1**
- 17:15 **PLENARY PL13 - go to LT1**

17:30 Student meeting and election of SANCOR student representative - go to LT1
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WEDNESDAY **LT3**: Sessions C8, C9, C10, C11

- 08:30 **PLENARY PL10 - go to LT1**
- 08:45 **PLENARY PL11 - go to LT1**

SESSION C8**MONITORING SYSTEMS AND NETWORKS**

- 09:00 **Geoff Brundrit, Mika Odido, Lucy Scott, Stewart Bernard, Justin Ahanhanzo.** New marine observing systems around Africa.
- 09:15 **Russel Egypt, Carl Wainman, Julian Smit.** The potential of GIS as a maritime operational platform for modelled meteorological data.
- 09:30 **Marten Grundlingh, Ursula von St Ange.** Extensive, open, free database for marine biogeographic data in Africa: AFROBIS.
- 09:45 **S. Gildenhuis, H. Waldron, W. Kwak, C.K. Wainman, B. Maritz, P.E. Matsapola, J.G.W. Scholtz, R. Egypt.** Simon's Bay Seawatch – A ten year overview.
- 10:00 **C. Lawrence, K. Sink.** SANBI'S marine programme: meeting the challenge for the next national spatial biodiversity assessment.

10:15 REFRESHMENTS

SESSION C9**MARINE EDUCATION AND COMMUNICATION**

- 10:45 **Judy Mann.** Linking ecosystems to society: what is the role of aquariums in conservation?
- 11:00 **Jone Porter.** South African life sciences learners can benefit from current scientific research.

COASTAL AND ESTUARINE RESEARCH

- 11:15 **L.D. Woolley, C.L.W. Jones, P.J. Britz.** A practical diet for the South African marine finfish industry: towards better water quality and feed conversion.
- 11:30 **Robynne A. Lawrie, Derek D. Stretch, Renzo Perissinotto, Ricky H. Taylor.** The water balance and management of St Lucia.
- 11:45 **Clinton P. Chrystal, Derek D. Stretch, Renzo Perissinotto, Ricky H. Taylor.** Inlet hydrodynamics and sediment transport at the St Lucia Estuary.

- 12:00 **L. Vivier, D.P. Cyrus.** The St Lucia - Mfolozi System link: importance of the Mfolozi estuary for juvenile marine fish when the St Lucia system is closed.
- 12:15 **Digby Cyrus, Leon Vivier.** Lake St Lucia at the cross roads: the impact of reduced rainfall on the fish fauna.
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12:30 LUNCH AND POSTERS (Authors of Wed posters: please attend your poster from 13:00-13:30)

13:30 LEAP School performance (go to LT1)

SESSION C10**COASTAL AND ESTUARINE RESEARCH (continued)**

- 14:00 **K. Hutchings, B.M. Clark, L.J. Atkinson.** Monitoring of the linefishery in the Berg River Estuary (Western Cape, South Africa), with evidence of recovery subsequent to closure of commercial gill netting.
- 14:15 **Nelson A.F. Miranda, Renzo Perissinotto, Chris C. Appleton.** Salinity and temperature tolerance of the alien invasive prosobranch gastropod *Tarebia granifera* (Lamarck, 1816) in the St. Lucia Estuary.
- 14:30 **P.E. Matsapola, C.K. Wainman.** Results of an ADCP and RCM current speed comparison in moderate wave conditions in shallow water.
- 14:45 **Carl K. Wainman, Brian Sherriff, Mike E. Gardener.** A shallow-water retractable autonomous buoy - concept, developments and progress.
- 15:00 **L. Hancke, M.J. Roberts.** Lagrangian observations of the Tsitsikamma Coastal Current, South Africa.
- 15:15 **H.N. Waldron, C.K. Wainman, M.E. Waldron, C. Whittle, G.B. Brundrit.** A prominent colour front in False Bay, South Africa: cross-frontal structure, composition and origin.
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15:30 REFRESHMENTS

SESSION C11**COASTAL AND ESTUARINE RESEARCH (continued)**

- 16:00 **Rodrigo S. Martins, Michael J. Roberts, Érica A.G. Vidal, Coleen L. Moloney.** Effects of temperature on utilization of yolk by chokka squid (*Loligo reynaudii*) paralarvae.
- 16:15 **J.M.W. Githaiga, M.J. Roberts, M. Lucas.** What are nepheloids and nepheloid layers, where do you find them and who cares?
- 16:30 **Nicola J. Downey, Michael J. Roberts.** Determining the influence of upwelling on chokka squid spawning behaviour.
- 16:45 **Larvika Singh, William Froneman, Malcolm Smale.** Predator-prey interaction on squid spawning sites by top predators.
- 17:00 **PLENARY PL12 - go to LT1**
- 17:15 **PLENARY PL13 - go to LT1**

17:30 Student meeting and election of SANCOR student representative - go to LT1
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THURSDAY **LT1**: Sessions A12, A13 and Plenary talks PL14 to PL17

PLENARY TALKS PL14 and PL15

- 09:00 **H. Kleinschmidt, W.H.H. Sauer, S. Moola.** South African fisheries: the long term road to ruin?
- 09:15 **Mike Lucas, Richard Lampitt, John Shepherd.** Fertilising the oceans to mitigate anthropogenic CO₂ accumulation: options, problems and feasibility?

SESSION A12

MARINE VERTEBRATE BIOLOGY AND ECOLOGY

- 09:30
- 09:45 **Mbulelo T. Dopolo, Carl D. van der Lingen.** Reproductive strategy of Cape horse mackerel *Trachurus trachurus capensis* inferred from ichthyoplankton data collected in the southern Benguela upwelling system, 2000 – 2005.
- 10:00 **Mark J. Gibbons, Bronwyn Currie, Anne Christine Utne-Palm, Anne Gro Vea Salvanes, Jens Otto Krakstad, Jean Paul Roux, Stein Kaartvedt, Göran Nilsson, Victoria Braithwaite, Jonathon A.W. Stecyk, Thor A. Klevjer.** Eat your gobies! A review of the biology of *Sufflogobius bibarbatus* off Namibia.

10:15 REFRESHMENTS

SESSION A13

MARINE VERTEBRATE BIOLOGY AND ECOLOGY (continued)

- 10:45 **P. Patrick, N.A. Strydom.** Larval fish dynamics in a shallow nearshore habitat and the implications of currents and swimming abilities on dispersal.
- 11:00 **Andrea K. Bernatzeder, Paul D. Cowley, Tom Hecht.** Salinity induced physiological responses in dusky kob *Argyrosomus japonicus* (Pisces: Sciaenidae).
- 11:15 **Rhett H. Bennett, Warwick H.H. Sauer, Paul D. Cowley, Albrecht Götz, Ryan M. Palmer.** Optimisation of a sampling protocol for long-term monitoring of temperate reef fishes.
- 11:30 **N. Twatwa, S. Somhlaba, J.C. Coetzee.** Comparing the spatial and temporal distribution of pelagic fish species with environmental parameters.
- 11:45 **Ronel Nel.** Is there a change in the threats and status of sea turtles in countries of the western Indian Ocean since the inception of conservation in region?

PLENARY TALKS PL16 and PL17

- 12:00 **Stephanie Plön, Christopher Marshall, David Raubenheimer, David Greenwood, Stuart Parsons.** Skunks of the sea? The composition and function of pygmy sperm whale “ink”.
- 12:15 **Bruce Mate, Peter B. Best.** Whither Wendy? Where do right whales go when they leave the South African coast?

12:30 Student awards and symposium closure (LT1)

13:00 LUNCH

13:30 Post-symposium meetings (LT2 and LT3)

THURSDAY **LT2**: Sessions B12, B13

09:00 **PLENARY PL14** - go to LT1

09:14 **PLENARY PL15** - go to LT1

SESSION B12**SYSTEMATICS AND MOLECULAR TECHNIQUES**

09:30 **Brett M. Macey, Ikenna O. Achilihu, Karen G. Burnett, Louis E. Burnett.** Impacts of water quality on the inactivation and elimination of bacterial pathogens in oysters.

09:45 **C.A. Matthee, A. Cockcroft, S. von der Heyden, K.A. Tolley, K. Gopal, J.C. Groeneveld.** Genetic signatures suggest alternative gene-flow patterns for southern African lobsters.

10:00 **Paula M. de Coito, George M. Branch, Rauri C.K. Bowie.** *Siphonaria compressa*: a genetic investigation into South Africa's most endangered marine invertebrate.

10:15 REFRESHMENTS

SESSION B13**SYSTEMATICS AND MOLECULAR TECHNIQUES (continued)**

10:45 **S.M.R. Dos Santos, A.W. Klopper, W. Potts, P. Bloomer.** Phylogeography of elf, *Pomatopus saltatrix* (Linnaeus 1756), along the southern African coast.

11:00 **Lucas K. Mmonwa, Christopher D. McQuaid, Nigel P. Barker.** Phylogeographic patterns of *Gelidium pristoides* (Gelidiaceae: Rhodophyta) and *Hypnea spicifera* (Hypneaceae: Rhodophyta) along the South African coastline.

11:15 **Carel J. Oosthuizen, Bruce Q. Mann, Paulette Bloomer.** Swimming strong after stock collapse?

11:30 **Carol Simon, Daniel J. Thornhill, Kenneth M. Halanych.** Apparent western North American origin of *Boccardia proboscidea* pests on the cultured abalone, *Haliotis midae*, in South Africa.

11:45 **S. von der Heyden, G. Bernardi, R.C.K. Bowie.** A comparative phylogeography of three southern African clinid fishes.

12:00 **PLENARY PL16** - go to LT1

12:15 **PLENARY PL17** - go to LT1

12:30 Student awards and symposium closure - go to LT1

13:00 LUNCH

13:30 Post-symposium meetings: Estuary RDM and monitoring workshop (13:30-16:00)

THURSDAY **LT3**: Sessions C12, C13

09:00 **PLENARY PL14** - go to LT1

09:14 **PLENARY PL15** - go to LT1

SESSION C12

COASTAL MANAGEMENT

09:30 **Ronel Nel, Karien Bezuidenhout**. Ecological effects of off-road vehicle driving (for boat launching) on macroinfauna of sandy beaches of northern KwaZulu-Natal

09:45 **Tembisa Jordaan, Christopher McQuaid, Francesca Porri**. Biodiversity of fauna associated with mussel beds in relation to bed structure.

10:00

10:15 REFRESHMENTS

SESSION C13

COASTAL MANAGEMENT (continued)

10:45 **Anusha Rajkaran, Janine B. Adams**. Managing mangrove resources using matrix modelling.

11:00 **F.K. Kuriah, E.A. Pakhomov**. Effects of land use and urban development: Using $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ stable isotopes to reveal river food webs structure.

11:15 **N.T. Demetriades, A.T. Forbes, C.G.M Archibald, A. Mather**. Durban Bay fish kill – system and management responses.

11:30 **A.T. Forbes, N.T. Demetriades**. The fate of South African estuaries – the KZN experience.

11:45 **Gerhard Cilliers, Neels Kleynhans, Barbara Weston**. Towards a national estuarine monitoring programme in South Africa. The DWAF perspective.

12:00 **PLENARY PL16** - go to LT1

12:15 **PLENARY PL17** - go to LT1

12:30 Student awards and symposium closure - go to LT1

13:00 LUNCH

13:30 Post-symposium meetings: Marine Linefish Research Group (13:30-15:00)

Biotelemetry Research Group (15:00-16:30)

Oral B 2

Influence of mouth status and water level on the macrophytes in a small temporarily open/closed estuary

Janine B. Adams, Taryn Riddin
Nelson Mandela Metropolitan University, Port Elizabeth, South Africa

The monthly responses of macrophytes in the East Kleinemonde Estuary were examined in relation to changes in physical factors between March 2006 and March 2007. This is a small temporarily open/closed system where the mouth breaches in response to high water levels (>2 m amsl) or following high river inflow. On breaching there is a rapid drop in water level that causes the submerged macrophytes to be exposed and they die as a result of desiccation. Salt marsh plants then establish in the vacant habitat. Correlation analysis showed that water level, duration of inundation and temperature influenced macrophyte cover abundance. Inundation for three months caused die back of intertidal salt marsh. Under open and tidal conditions, cover of intertidal salt marsh increased at a maximum monthly expansion rate of 25%. Because of its position at a relatively high elevation compared to other vegetation, supratidal salt marsh was only affected by water levels of >1.8 m amsl and only after being inundated for one to two months. Submerged macrophytes developed in inundated areas when stable water levels were present for longer than two months at a monthly maximum expansion rate of 23%. Macrophytes responded quickly to water level fluctuations. This indicates that monthly monitoring is needed to provide an understanding of macrophyte response. This is the first study that reports on rates of macrophyte habitat development in temporarily open/closed estuaries. These data can be used in mouth management plans and freshwater requirement studies to predict the growth and establishment of a diversity of macrophyte habitats.

Poster Mon 19

A theoretical assessment of ecosystems valuation initiatives in coastal areas

F Ahmed, N Poona
University of KwaZulu-Natal, Durban, South Africa

Coastal zones around the world are being bombarded with development pressures. The largest local pressure is certainly the urbanisation pressure; notwithstanding its operation against the backdrop of global climate

change. Coastal management decisions, which are often concerned with how much natural ecosystem to conserve versus allocate to human development activities, is largely taking effect in a vacuum (of both local and global consequences). The wanton erosion of the resilience of many coastal ecosystems has a twofold effect – on the one hand, it has diminished its ability to protect us from disturbance; and on the other, it has eroded the resilience of many social systems to natural catastrophes has been reduced as demand for land for urbanisation has forced people to settle and organize economic activities in vulnerable areas. Ecosystem valuation has become a significant area of research aimed at generating a better and more comprehensive understanding of baseline information for the policy formulation and decision-making process. This paper critically reviews the literature on economic valuation of ecosystem services across the range of terrestrial coastal ecosystems. It draws as its starting point that while most studies cover ecosystems, terrestrial coastal ecosystems as distinct, and as important conduits between the terrestrial and marine interface have received little attention, or have been addressed separately. It argues that the concept of ecosystems services provides a robust and complementary rationale for conservation, as compared to the traditional arguments of conservation based on intrinsic value. Furthermore, it advocates multidimensional valuation studies that capture the ‘before and after’ states of ecosystem changes as important compliments to more informed decision making in land suitability for development versus conservation

Oral B 2

Top-down, bottom-up control of bacterial production in a temporarily open/closed estuary

E.L. Allan, P.W. Froneman
Rhodes University, Grahamstown, South Africa

Top-down and bottom-up control of bacterial production in the small temporarily open/closed East Kleinemonde Estuary was assessed over the period May 2006 to April 2007. Spatial and temporal patterns in bacterial abundance, biomass and production were investigated to determine the importance of abiotic and biotic factors in controlling bacterial production. With a few exceptions, there were no evident spatial patterns for bacterial abundance, biomass and production. There was, however, a distinct temporal pattern with lowest values consistently recorded during the winter months. The frequency of visibly infected bacterial cells demonstrated no temporal or spatial patterns indicating that viral infection and lysis was a constant source of bacte-

rial mortality throughout the year. The estimated percentage of bacterial production removed by viral lysis ranged between 7.8 and 88.9% of the total suggesting that viral lysis may at times represent a very important source of bacterial mortality. There was a strong correlation between nanoflagellate and bacterial abundances suggesting a strong predator-prey relationship. Indeed results of the trophic cascading experiments indicated that nanoflagellates were the most important consumers of bacteria. In the presence of larger grazers, however, the impact of the nanoflagellates on the bacteria was reduced. The presence of the larger heterotrophs therefore, mediates the interactions between the primary bacterivores, the nanoflagellates and the bacteria within the estuary.

Poster Mon 23

The Knysna Basin Project – A new field research facility

Brian Allanson

Rhodes University, Grahamstown, South Africa

The Knysna Basin Project (KBP) was established in 1995 with the objective to continue and develop the earlier work of Professor John Day on the Knysna estuarine embayment. This is a unique system; and during the 1990s was the subject of meaningful research, largely published in 2000 in the *Transaction of the Royal Society of South Africa* vol 55: 97 – 240. The Project provided a base for graduate studies at MSc and PhD level and offered honours field study sites for Rhodes University and the University of the Western Cape. Internships have been successful and are welcomed; two are expected from the USA in 2008. By the end of 2003, the first field station on the banks of the estuary was lost in the name of progress on Thesen Island and it has taken until now (2008) to find a suitable housing. Through the generous grant-in-aid from, Barloworld it has been possible to refurbish a new laboratory with upto-date equipment used in systems orientated estuarine ecological research. The laboratory is for the use of the university and institutional research community and we look forward to your becoming involved in projects that will increase our understanding of this unique system. Phase 2 of the Project's program invites studies on, *inter alia*, the changing character of the tidal water column under the stress of increasing urbanization; subsequent changes in the status of eelgrass and saltmarsh systems and of the macroinvertebrate fauna of these marshes.

Oral A 4

Using Biogeographic patterns of seaweed species and communities to test the efficacy of marine protected areas: An example from the Agulhas Marine Province, South Africa.

R. J. Anderson¹, J. J. Bolton² H. Stegenga³, D. Wilby²

¹ *Marine and Coastal Management, Cape Town, South Africa*

² *University of Cape Town, Cape Town, South Africa*

³ *Rijksherbarium Leiden, Leiden, Netherlands*

While systems of Marine Protected Areas may have several aims (e.g. resource protection and rebuilding, habitat conservation) it is increasingly recognized that they should conserve biogeographically representative communities of as many taxa as possible. In shallow, rocky marine environments seaweeds are often among the best-studied groups of organisms and are good biogeographic indicators because they are sessile and their geographical distribution is overwhelmingly controlled by temperature. Few studies examine the effectiveness of an MPA system. We analyse 3 separate datasets for seaweeds along a complete marine province covering 1400 km of coastline in order to investigate the biogeographic effectiveness of the siting of 8 MPAs on this coast. Firstly, Biogeographical (presence/absence) distribution data for the ca. 500 taxa recorded from the south coast of South Africa (Cape Agulhas to northern Transkei), were compiled from literature and collections. Cluster analyses separate an eastern group from a western group: the eastern group is subdivided into two sub-groups. All major subdivisions include at least one MPA, indicating that they are well-sited (at least with respect to seaweeds). Secondly, collections were made in these 8 MPA's during 3-4 day trips, yielding between 121 and 182 taxa in each MPA. In total, 74.5% of previously-recorded Agulhas Marine Province species were collected during these brief visits to the 8 MPAs spread along the coast, indicating very good overall MPA coverage. Our data suggest that a centrally-placed MPA is most critical, and that more extra species are added by MPA's to the east, because more warmer-water species are included. Thirdly, we analysed seaweed community data for the shallow sub-tidal zone. These samples contained relatively few species and show a somewhat different biogeographical pattern from presence/absence data, with an increase in overall biomass and biomass of articulated coralline species, moving eastwards into warmer water. Although seaweeds themselves seldom require conservation, seaweed species and communities may be good indicators of overall benthic diversity in the shallow

zone of MPAs that include significant areas of rocky shore, and are therefore very useful in investigations on the optimal biogeographic placement of MPAs.

Oral A 8
Towards An Adaptive Management Framework For The Namibian Line Fishery

Margaret Ndapewa Angula, Merle Sowman, Astrid Jarre
University of Cape Town, Cape Town, South Africa

Namibia experienced a regime of uncontrolled fishing and inadequate fisheries management during 1960s, 1970s and 1980s, which led to overexploitation of its living marine resources. After having gained independence in 1990, Namibia has been commended on developing and legislating modern policies for fisheries management. However, environmental variability and ecosystem-scale changes in the northern Benguela ecosystem have hampered the recovery of overexploited resources. The Namibian line fishery is no exception in this general picture. This fishery comprises artisanal, recreational, ski-boat fishermen and commercial line-boat sectors. Its economic and social importance is thought to be undervalued. The need for all stakeholders to participate in the planning and management processes is generally acknowledged. However, views and perceptions of Namibian line fishery stakeholders are not well integrated within the management of this fishery. This case study seeks to obtain a holistic understanding of the line fish sector in Namibia, to gain an improved understanding of stakeholders' perceptions regarding the management of line fish resources in Namibia and to develop a decision support tool that would enhance current management within the broader context of an Ecosystem Approach to Fisheries Management (EAF). We present results of a stakeholder analysis and a survey undertaken to establish the role, values, needs, perceptions and capacity of Namibian line fishery stakeholders in managing the fishery and adapt to impacts of uncertainty, and capture the results in value trees. The existing legislation for the line fishery management in Namibia is moderately sufficient to manage line fish resources in a sustainable manner. However, our preliminary results reveal inconsistencies in decision making, planning and implementation of management strategy among four sectors of the Namibian line fishery. We evaluate these results in relation to the complexity of human and natural systems in the context of environmental variability and change, and an unstable economic system.

Oral A 5
Interaction strength and keystone in upwelling food webs: comparing the southern Benguela and the southern Humboldt

Hugo Arancibia¹, Sergio Neira², Lynne Shannon³
¹ *Universidad de Concepción, Concepción, Chile*
² *University of Cape Town, Cape Town, South Africa*
³ *Marine and Coastal Management, Cape Town, South Africa*

Keystone species (species that have strong trophic interactions) play important roles in food web structure and dynamics. Identifying these species is a key point for conservation and management issues. Up to date, identification of keystone and strong interacting species in upwelling ecosystems has been circumscribed to a restricted number of experimental and modeling studies. Therefore, the "keystone" and the interaction strength in upwelling food webs are still poorly known. In this paper, we use results of published ECOPATH models describing the southern Benguela (off South Africa) and southern Humboldt (off Central Chile) to calculate the Keistonestess (K, Libralato et al., 2004) and interaction strength (IS, Shannon and Cury, 2004). The aim is to highlight similarities and differences in terms of the trophic role of the main target and non-target groups in these two highly productive food webs. K and IS are calculated using temporal simulations and network indicators obtained with Ecopath and Ecosim software. The observed values of IS of similar fish species in the southern Benguela and southern Humboldt suggest that hakes species have the highest IS value in both systems. Anchovy, common sardine and horse mackerel have lower IS in the southern Humboldt than in the southern Benguela. Although K distributes similarly in both food webs, differences in K at the level of similar functional groups are observed. For example the top three groups in the southern Humboldt are euphausiids, sea lion and microzooplankton whereas in the southern Benguela are mesozooplankton, macrozooplankton and chondrichthyans. Target species such as small pelagics, horse mackerel and hakes have intermediate values of K. We end the paper by comparing K and IS in the southern Humboldt and the southern Benguela with those found in other marine food webs and discussing these results in the scope of the ecosystem approach to fisheries.

Poster Mon 6

Effect of algal concentration on gonad maturation in the scallop *Pecten sulcicostatus*

Dale C.Z. Arendse¹, Sissel Andersen², Mashudu Nemutandani¹, Grant C. Pitcher¹

¹ Marine and Coastal Management, Cape Town, South Africa

² Institute of Marine Research – Austevoll, Storebø, Norway

The local scallop *Pecten sulcicostatus* is presently being investigated as a potential species for mariculture in South Africa. As there is no commercial fishery for scallops in South Africa little is known about the ecology and biology of the local species. This study was conducted to investigate broodstock conditioning of *P. sulcicostatus* and was started in February 2007 as a part of a Norwegian-South African cooperation funded by NORAD. *P. sulcicostatus*, was collected from False Bay in February 2008 when the gonads of the population were expected to start building up after the yearly minimum in December. The reproductive cycle in the False Bay population has been described in earlier work. Experiments were conducted to investigate the effect of algal concentration on the maturation process in the gonads. Three replicate tanks, each containing 13 scallops, of three algal concentrations was run at 14 °C in a flow-to-waste system adding the algal feed continuously. The diet consisted of three algal species and 70 % of the cells was diatoms. Rearing system and conditions were based on experiences made in Norwegian hatcheries with the European species great scallop, *Pecten maximus*. Gonad status was assessed in the population at the collection date and at the end of the experiment, and in individuals from all tanks at the end of the experiment. Gonad status was described by calculating the gonado-somatic index (GSI), and by a qualitative (oocyte stages) and quantitative (oocyte diameter) study of histological slides. Preliminary results indicate that the maturation process was affected by algal concentration.

Oral C 1

Identification of differentially expressed immune response genes in the South African abalone, *Haliotis midae*, following the administration of a probiotic supplemented artificial diet

Bronwyn L. Arendze-Bailey, Vernon E. Coyne
University of Cape Town, Cape Town, South Africa

Abalone aquaculture has become a lucrative industry

worldwide, where the market price for abalone meat can demand up to \$ 1000 / kg. The abalone species *Haliotis midae* is an indigenous species to South Africa and it is the main species utilised by the local abalone aquaculture industry. Due to the intensive feeding frequency and high stocking densities associated with abalone aquaculture, the farmed abalone are often stressed and thus susceptible to opportunistic pathogen outbreaks and slow growth rates. The use of probiotics has become a favourable solution to these problems. Macey and Coyne (2005, 2006) have shown that the use of probiotics increases the growth rate and stimulates the immune system of aquacultured *H. midae*. In the current investigation, microarray technology was utilized to identify *H. midae* expressed immune response genes following the administration of a probiotic supplemented artificial diet. Out of 73 cDNA clones sequenced, 44 were assigned putative identification and function. The remainder of the sequenced cDNA clones were identified as unknown hypothetical proteins. This investigation has established a platform for further research involving the investigation of the biological function and regulation of these identified genes. The information gathered by the current study has considerable value to the worldwide understanding of the abalone immune response system. Ultimately, knowledge gained through the current investigation has the potential to be utilized by the abalone aquaculture industry in the selection of abalone with faster growth rates and robust immune response systems, thus improving the overall production efficiency of the industry.

Poster Tue 9

The influence of foraging mode on heart rate and estimated energy expenditure in Cape and Australian fur seals

John P.Y. Arnould¹, Dan P. Costa², Steve P. Kirkman³, W. Herman Oosthuizen³

¹ Deakin University, Victoria, Australia

² University of California, Santa Cruz, CA, USA

³ Marine and Coastal Management, Cape Town, South Africa

Knowledge of the energy expenditure by marine predators is central for modelling their prey biomass consumption. Recorded heart rate (HR) has previously been shown to correlate well with metabolic rate in seals. However, most studies have been limited to captive animals and little is known of the influence of foraging strategy on HR and energy expenditure. In the present study, HR and diving behaviour were recorded

throughout foraging trips and subsequent periods ashore in free-ranging female Cape and Australian fur seals (*Arctocephalus pusillus*), two subspecies with divergent foraging strategies. Cape fur seals ($n = 5$) made predominantly ($93 \pm 4\%$) V-shaped epipelagic dives (54 ± 6 m) while Australian fur seals ($n = 10$) dived predominantly ($75 \pm 6\%$) to the sea-floor (73 ± 5 m). In both species, benthic dives were characterised by severe and sustained bradycardia ($>80\%$ reduction in pre-dive HR) whereas during epipelagic dives HR reductions were less pronounced (30-50%) and more variable. Dive duration was significantly ($P < 0.007$) longer (195 ± 10 s), and average diving HR lower (55 ± 3 beats \cdot min $^{-1}$, $P < 0.04$), in Australian than Cape fur seals (133 ± 12 s and 65 ± 4 beats \cdot min $^{-1}$). However, post-dive HR (106 ± 4 beats \cdot min $^{-1}$) and average at-sea HR (78 ± 3 beats \cdot min $^{-1}$) were not significantly different between the species (both cases $P > 0.1$). In contrast, average on-land HR was significantly greater ($P < 0.002$), and the at-sea: on-land HR ratio lower ($P < 0.02$), in Australian (71 ± 2 beats \cdot min $^{-1}$; 1.08) than Cape fur seals (55 ± 3 beats \cdot min $^{-1}$; 1.48). In addition, there was a significant negative correlation between on-land HR and the proportion of epipelagic diving ($r^2 = 0.53$, $P < 0.003$). These results suggest that extended bradycardia periods at-sea may be compensated for by increased energy expenditure on land.

Oral A 9
Impacts of the demersal hake trawl fishery on benthic biodiversity in southern Africa

Lara J. Atkinson, John G. Field
University of Cape Town, Cape Town, South Africa

The South African commercial trawl fishery originated in the early 1900s and targets hake, (*Merluccius capensis* and *M. paradoxus*) in a near continuous band between 300 and 800 m depth from the west to the south-east coasts of South Africa. The transboundary nature of the hake stocks between South Africa and Namibia has encouraged joint research and management cooperation in the demersal trawl fishery, between the two countries. The hake fishery is the largest and most lucrative of South Africa's fisheries and was awarded the environmentally sustainable Marine Stewardship Council certification in 2004. The impact of trawling on the benthic environment has, however, been identified as a major risk to the sustainability of this fishery. The fishery is currently under review for re-certification of this award, requiring investigation of potential benthic impacts. Elsewhere studies have shown that demersal fishing gear can impact signifi-

cantly on benthic biodiversity, however, such effects have not been examined in southern Africa. The aim of this study is to quantify the impacts of the demersal trawl fishery on abundance, biomass and diversity of benthic macrofauna and epifauna in soft bottom habitats in the southern Benguela region. Benthic macrofauna and epifauna were sampled in areas of light vs. intense fishing activity (note: no trawl grounds in this region are protected from fishing activities, hence the necessity to compare light vs. intensely fished areas) at four sites and analysed for significant differences. Results strongly indicate that the disturbance induced by demersal fishing contributes towards changes in benthic macrofauna and epifauna community compositions. Whilst no significant differences in diversity indices are evident in macrofauna communities, the species present in heavily trawled areas are significantly different from those in lightly trawled areas. The epifauna communities appear to be severely impacted by trawl-induced disturbance. The implications of these results, and future studies of ecosystem functioning, are discussed.

Oral PL 3
The role of marine protected areas in South Africa: contrasting coastal and offshore environments

Colin G. Attwood¹, Kerry J. Sink²
¹ *University of Cape Town, Cape Town, South Africa*
² *South African National Biodiversity Institute, Cape Town, South Africa*

South Africa has 21 marine protected areas (MPAs) and all of these are in coastal waters. One goal of the National Protected Area Expansion Strategy is to address the lack of representation of shelf and deep-sea environments in protected areas. Existing MPAs have (i) protected vulnerable habitats and species, (ii) provided a refuge for heavily exploited fish stocks, (iii) been instrumental in fisheries research, and (iv) provided opportunities for eco-tourism and education. Can we expect that offshore (beyond the 30 m isobath) MPAs will serve similar benefits? We contrast the potential role of MPAs in coastal and offshore environments and ask where, when and how a spatial management approach might be put to good use. Commercial fishing and mining are the two industries that pose significant threats to deep-water habitats. Recoveries in benthic communities in MPAs are documented worldwide, but excluding quota-based fisheries from MPAs will lead to effort displacements, increasing impacts elsewhere. MPAs benefit fisheries which are recruitment over-fished, but offshore fisheries are generally

better-managed than coastal fisheries. Spatial fishery closures may have merit where certain life-stages of targeted populations aggregate. Greater conservation concern relates to bycatch species, which may not be able to sustain rates of harvest set on the productivity of deep-water target species. Deep-water fish resources are frequently wide-ranging, and pelagic habitats themselves are mobile, which argues against all but very large fishery closures. The impact of spatial closures on fishery assessment procedures are secondary but important concerns. MPAs may be used to provide experimental testing of fishery effects, but the required sampling frequency, replication and experimental duration will strongly limit possibilities. Offshore MPAs may not fulfil the variety of objectives or gather the support that we see in coastal MPAs, but are likely to be the single most useful strategy in an ecosystem-approach to fisheries.

Poster Tue 30

Protection from harmful solar radiation by pigmentation in Antarctic krill, *Euphausia superba*

Lutz Auerwald¹, Ullrich Freier², Andreas Lopata³, Bettina Meyer²

¹ Marine and Coastal Management, Cape Town, South Africa

² Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany

³ University of Cape Town, South Africa; & RMIT University, Melbourne, Australia

Antarctic krill, *Euphausia superba*, is very susceptible to harmful solar radiation (especially UVB) due to its unique genetic setup. This disadvantage is countered by an efficient DNA-repair mechanism as well as light-avoidance behaviour. At least in summer and during occasional daytime surface-swarming, krill is exposed to solar radiation. Here, we have investigated physiological and morphological colour changes in Antarctic krill, *Euphausia superba*, during summer and winter cruises to the Lazarev Sea in response to UV- and Photosynthetically active radiation (PAR). Both, the long-term (seasonal) morphological colour change and the short-term physiological colour change are facilitated by only one type of monochromatic red chromatophores (i.e. erythrophones) of 20 – 450 µm in diameter. Superficial erythrophones cover large dorsal and lateral areas, especially above vital organs (brain, sinus glands), and additional “profound” erythrophones cover internal organs (heart, gut, nerve cords). Short-term change in light regime causes rapid physiological colour change in the erythrophones. Pigment disperses

into chromorhizae upon exposure of krill to PAR and UVA and, to a lesser extent, to UVB radiation. Darkness leads to aggregation of pigment in the centre of erythrophones. In addition, stress causes pigment dispersion. Although *E. superba* performs a more or less diel vertical migration, there is no circadian rhythm in the dispersal state of the erythrophones. Physiological colour change in adult krill is 2-3 times more rapid in summer than in winter. Seasonal changes in light regime also results in a profound morphological colour change: in summer animals, abdominal astaxanthin concentration is approximately 450% and erythrophone count 250-480% higher than in winter krill. We conclude from our results, that pigmentation of *E. superba* serves the protection from harmful solar radiation and is arranged to react to diurnal and seasonal changes in light condition.

Oral B 9

The greater Agulhas Current system: An integrated study of its mesoscale variability

Bjorn C. Backeberg^{1,2}, Johnny A. Johannessen^{3,4}, Laurent Bertino^{2,3}, Chris J. Reason¹

¹ University of Cape Town, Cape Town, South Africa

² Mohn-Sverdrup Center for Global Ocean Studies & Operational Oceanography,

Bergen, Norway

³ Nansen Environmental and Remote Sensing Center, Bergen, Norway

⁴ University of Bergen, Bergen, Norway

For the purpose of developing an operational oceanography system for the greater Agulhas Current regime, a high resolution Hybrid Coordinate Ocean Model (HYCOM) has been set in a nested configuration. The intense and complex current regime poses a challenge in modelling. However, access to satellite and in-situ data with strong and persistent signals of the dynamics and mesoscale variability ensure that adequate model validation is feasible. The study concludes that HYCOM reproduces the general larger scale circulation of the greater Agulhas Current reasonably accurately in addition to the regionally specific characteristics and mesoscale variability. Furthermore, strong anti-cyclonic eddies occurring in the Mozambique Channel at a frequency of 5–6 per year, are found to drift southward and merge with the northern Agulhas Current. Evidence of these eddies can also be tracked further southwestwards into the southern Agulhas Current and sometimes all the way towards the Agulhas retroflexion region. Operational forecasting of the greater Agulhas Current, and in particular the retroflexion,

must therefore adequately account for the presence and influence of the Mozambique Channel eddies, in order to forecast their evolution on time scales from days to weeks.

Poster Mon 17

Long-term variation in the demersal fish communities of selected Eastern Cape Estuaries

Sean E. Bailey, Angus W. Paterson
South African Environmental Observation Network, Grahamstown, South Africa

Estuarine research in South Africa has generally been “graduation driven” in that short datasets (<3 years) are mostly collected to answer highly defined questions normally for degree purposes. The SAEON Elwandle node aims to implement a long-term study examining the demersal fish communities of three estuaries with differing freshwater input (Kariega Estuary – marine dominated, Great Fish Estuary – freshwater dominated and Sundays Estuary – intermediate freshwater input). The long-term nature of the study should allow for temporal variation on both the annual and seasonal scales to be investigated and the role that freshwater plays within these systems to be further established. As the selected systems have vastly different turbidity levels, gear avoidance may be an issue in clear water systems such as the Kariega. A pilot study has been initiated where comparative otter trawling for demersal fish was undertaken during the day and night at 15 sites in the Kariega Estuary over a period of three consecutive days in Spring 2007. A total of 1961 fishes representing 28 species from 15 families were recorded. Catches were dominated by *Glossogobius callidus*, *Rhabdosargus holubi*, *Solea turbynei*, *Caffrogobius gilchristi* and *Heteromycteris capensis*. *Glossogobius callidus*, *S. turbynei* and *C. gilchristi* were recorded in significantly higher numbers at night than during the day ($p < 0.05$). In contrast only one species, *R. holubi*, was caught in significantly higher numbers during the day ($p < 0.05$). The total number of species and individuals sampled was also significantly higher at night ($p < 0.05$). Initial results indicate that sampling would be more suitable at night but further investigation in the turbid Great Fish Estuary is required.

Poster Tue 31

A 50 year record of zooplankton community structure in the N. E. Atlantic provides evidence for oceanographic regime shifts.

Sarah Baker¹, Mike Lucas¹, Richard Lampitt², Cathy

Lucas²

¹ *University of Cape Town, Cape Town, South Africa*

² *National Oceanography Centre, Southampton, UK*

Continuous Plankton Record (CPR) data have been collected from ships of opportunity in the North Atlantic since 1938 and contributes to one of the longest and most geographically extensive biological time series in the world. As a result, several studies have demonstrated long-term changes in zooplankton community structure in response to oceanographic regime shifts of which changes to the NAO index are the most prominent. In this study we evaluate zooplankton community structure along an onshore-offshore transect that passes through the Porcupine Abyssal Plain (PAP) long-term mooring site. The data-set covers the period 1950's to the present, a period that has seen dramatic but episodic changes in the bottom community structure of detritus-feeding invertebrates such as the holothurian, *Amperina*. Such changes in benthic community structure ought to be reflected in changes in surface productivity and zooplankton community structure. The PAP site is an important location, since it is on the boundary of the N. Atlantic sub-Tropical gyre and the temperate ocean basins to the north. As such, zooplankton community structure at this location may provide early biological evidence for the hypothesised expansion of the sub-Tropical gyres due to global warming.

Poster Tue 8

Developing a Commercial Bait Fishery in South Africa: The White Mussel

Ashok Bali, Genevieve Maharaj, Angus Mackenzie, Brett Lewis, Ryan Marinus
Marine and Coastal Management, Cape Town, South Africa

White mussels (*Donax serra*) are widely distributed from northern Namibia to the Eastern Cape of South Africa and are harvested along sandy beaches in the intertidal zone, and mainly during spring low tides. They are harvested by the broader recreational sector along the entire extent of their distribution range as part of a general bait permit, but the commercial sector is restricted to the west coast on the basis of abundance. The high abundance in this region is linked to higher plankton production, compared to the rest of the South African coast. In 2006, a new term of 2-year rights, which is extended by another two years, was allocated in this sector, still restricted to the west coast and for bait purposes only. In the past, each right holder was

limited to a monthly catch of 2000 mussels, however since October 2006, the monthly catch limit was lifted, with the aim of improving the quality of catch and effort data for future use in resource assessments. A minimum legal size of 35mm is applied for both the commercial and recreational sectors. Harvesting of white mussels is retained as a developing fishing sector and limited to seven areas along the west coast. Each of the seven right holders are allocated one of seven commercial fishing areas along the west coast from the area north of the border of Koeberg Power Station at Bokpunt, up to Oliphants River mouth in Lamberts Bay. Preliminary results show substantially varying numbers of mussel abundance across the different areas sampled. This poster describes briefly the history of this fishery, processes involved in the establishment of this fishery, as well as preliminary results and the proposed way forward.

Oral C 6 Primary production in the Benguela ecosystem

R. Barlow¹, T. Lamont¹, B. Mitchell-Innes¹,
D. Louw², M. Kyewalyanga³, H. Sessions¹
¹ *Marine & Coastal Management, Cape Town, South Africa*
² *Ministry of Fisheries, Swakopmund, Namibia*
³ *University of Dar-es-Salaam, Zanzibar, Tanzania*

Investigations of primary production have been conducted at infrequent intervals in the Benguela ecosystem. Studies conducted in 1999, 2002, 2006 and 2007 under the auspices of the regional BENEFIT programme revealed that primary production is highly variable in the Benguela, with some seasonal variability. Standard ¹⁴C on-deck, 24-hour bottle incubation experiments were conducted in June-July 1999 (winter) and February-March 2002 (summer) between 13°S and 33°S, covering southern Angola, Namibia and the west coast of South Africa. In June-July 1999, primary production was <1 gC m⁻² d⁻¹, except for four stations where production ranged from 1.50-2.2 gC m⁻² d⁻¹, and no significant latitudinal differences were observed. Production was greater in February-March 2002, with values generally between 1 and 2 gC m⁻² d⁻¹, but production was <1 gC m⁻² d⁻¹ at five stations and 4.5-8.8 gC m⁻² d⁻¹ at four stations. Productivity was lower in southern Angolan waters and much more variable off Namibia and South Africa. More modern bio-optical studies of phytoplankton photosynthesis were conducted in the southern Benguela (29°S-34.5°S) in October 2006 and May 2007, utilizing ¹⁴C photosynthesis-irradiance (P-E) experiments, fast repetition rate fluoro-

metry, phytoplankton absorption and pigments analyzed by HPLC. Primary production was estimated from P-E parameters using the exponential model of Platt et al. (1980). Primary production was generally higher during October 2006 (spring), varying from 0.85 to 8.6 g C m⁻² d⁻¹, and lower during May 2007 (autumn), varying from 0.7 to 3.3 g C m⁻² d⁻¹. Diagnostic pigment indices revealed that communities were mostly dominated by diatoms in October 2006 and mixed populations of small flagellates and diatoms prevailed in May 2007. The variability in primary production could be explained by variations in the photosynthetic parameters of the light reactions of photosynthesis as measured by fast repetition rate fluorometry. An example was at a station in May 2007 where primary production was significantly greater than at two adjacent stations even though the phytoplankton biomass was considerably lower. At this station the values of Fv/Fm and *p* were both >0.4, indicating a high quantum yield of photochemistry (Fv/Fm) and energy transfer between PSII photosynthetic units (*p*) in the population, leading to elevated primary production.

Oral A 13 Optimisation of a sampling protocol for long-term monitoring of temperate reef fishes

Rhett H. Bennett¹, Warwick H. H. Sauer¹, Paul D. Cowley², Albrecht Götz³, Ryan M. Palmer³
¹ *Rhodes University, Grahamstown, South Africa*
² *South African Institute for Aquatic Biodiversity, Grahamstown, South Africa*
³ *South African Environmental Observation Network, Grahamstown, South Africa*

In South Africa, increases in fishing effort and inefficient regulations have resulted in steady declines and collapse of most reef-associated linefish stocks. Continued overfishing combined with climate change will have severe effects on these stocks. Marine Protected Areas (MPAs) have been identified as a suitable complement to traditional linefish management measures. Monitoring of fish communities on a long-term basis is therefore essential for assessing the status of fish stocks and evaluating the effectiveness of such management measures. Furthermore, the South African Government has recognised the value and need for long-term monitoring (LTM). The South African Environmental Observation Network (SAEON) will witness the establishment of a network of inshore LTM sites, which will require a standardised protocol for monitoring, to allow comparisons across sites. Therefore, the development of a standardised protocol, intended for long-term

monitoring of inshore reef fish communities and assessment of management measures, is essential. This study aimed to incorporate suitable methods and develop and evaluate such a protocol. The protocol developed is suitable for rapid and long-term assessments of reef fish communities, and will allow for comparisons of results from different studies or areas, particularly across a network of LTM sites, and provide the opportunity for a broad-scale assessment of the effects of different environmental variables on reef fish stocks. Use of the standardised protocol on a long-term basis can provide mortality estimates for indicator species at each site, allowing for comparisons between areas and assessments of the effectiveness of new and well-established management measures. The protocol has been implemented in the Tsitsikamma National Park MPA, but has application in other inshore marine biogeographical regions in South Africa and other parts of the world. Shift in the focus of much marine research, in South Africa and elsewhere, to LTM, highlights the relevance and timeous nature of this study.

Oral B 6

Entrainment of Antarctic euphausiids across the Antarctic Polar Front by a cold eddy

Anthony T.F. Bernard^{1,2}, Isabelle J. Ansoorge³, P. William Froneman¹, Johan R.E. Lutjeharms³, Kim S. Bernard^{1,2}, Neil Swart³

¹ Rhodes University, Grahamstown, South Africa

² South African Environmental Observation Network, Grahamstown, South Africa

³ University of Cape Town, Cape Town, South Africa

Within the Indian Ocean sector of the Southern Ocean, the interaction between the Antarctic Circumpolar Current (ACC) and the Southwest Indian Ridge results in high mesoscale turbulence and eddy shedding. These eddies are thought to dramatically affect the local distribution of marine organisms. To investigate this, the euphausiid community structure and species composition in the region of a cold eddy, within the Antarctic Polar Frontal Zone (APFZ), were investigated during April 2005. The water masses within the core of the eddy were typically Antarctic, indicating that the eddy had originated south of the Antarctic Polar Front. Results from the numerical analysis separated euphausiid samples within the core of the eddy from those occurring on the edge and in the surrounding APFZ water. The core of the eddy was distinguished by the Antarctic euphausiids, *Euphausia frigida*, *Thysanoessa macrura* and *E. superba*, while *E. longirostris*, *Stylocheiron maximum*, *Nematoscelis megalops* and *T.*

gregaria predominated in the APFZ and edge of the eddy. Only *E. vallentini* and *E. triacantha* showed cosmopolitan distributions in the survey area. The results indicate that eddies have the ability to transport distinct communities into different areas, and thus contribute to the spatial heterogeneity of the zooplankton community within the APFZ.

Oral B 6

Potential implications of a decline in Southern Ocean pteropod densities due to ocean acidification

Kim S. Bernard^{1,2}, Brian P.V. Hunt³, Evgeny A. Pakhomov³, Graham W. Hosie⁴, Volker Siegel⁵, Peter Ward⁶

¹ Rhodes University, Grahamstown, South Africa

² South African Environmental Observation Network, Grahamstown, South Africa

³ University of British Columbia, Vancouver, Canada

⁴ Australian Antarctic Division, Tasmania, Australia

⁵ Sea Fisheries Institute, Hamburg, Germany

⁶ British Antarctic Survey, Cambridge, UK

Increasing atmospheric carbon dioxide levels are resulting in an increase in the oceanic acidity, most noticeably in the high latitudes. It has been predicted that within 50 years, the acidity of high latitude oceans will be such that the aragonite shells of living thecosome pteropods will dissolve. The implications for such an event are unknown since little data exist on the relative importance of thecosome pteropods in the pelagic ecosystems of the high latitudes. This paper discusses the ecological role of thecosome pteropods in the Southern Ocean, focusing on their contribution to the carbon cycle. Six species of pteropod occur in the Southern Ocean, south of the Sub-Tropical Convergence, including four thecosomes, *Limacina helicina antarctica*, *L. retroversa australis*, *Clio pyramidata* and *C. piatkowskii* and the two gymnosomes that are specialist predators, feeding only on thecosomes (*Clione limacine antarctica* and *Spongiobranchaea australis*). All four thecosomes are considered to be largely herbivorous and exhibit high ingestion rates. The ingestion rates of *L. r. australis* are in the upper range for sub-Antarctic mesozooplankton (31.2 to 4196.9 ng pigm. ind.⁻¹ d⁻¹), while those of *L. h. Antarctica* and *C. pyramidata* are in the upper range for all Southern Ocean zooplankton, with the latter species at times contributing to > 40% of community grazing impact. Thecosome pteropods are important agents in biogeochemical cycling, their shells contributing > 50% to carbonate flux in the deep ocean south of the Polar Front. In addition to the sinking of their aragonite

shells, thecosome pteropods may contribute significantly to organic carbon flux through the production of fast sinking faecal pellets and abandoned mucous webs. A decline in thecosome pteropods in the Southern Ocean will certainly have implications for the pelagic ecosystem as well as the carbon cycle, the extent of which can only accurately be predicted with further investigations.

Oral A 13

Salinity induced physiological responses in dusky kob *Argyrosomus japonicus* (Pisces: Sciaenidae)

Andrea K. Bernatzeder¹, Paul D. Cowley², Tom Hecht¹

¹ Rhodes University, Grahamstown, South Africa

² South African Institute for Aquatic Biodiversity, Grahamstown, South Africa

Existing knowledge, obtained mostly from the Great Fish Estuary (Eastern Cape), suggests that early juvenile dusky kob *Argyrosomus japonicus* recruit into estuaries and appear to remain in the upper reaches of estuaries at low salinities until they grow to about 150 mm total length. The aim of this study was to shed light on the influence of salinity on the estuarine distribution of juvenile dusky kob. Laboratory reared juveniles were exposed to different salinities to investigate growth, food conversion ratio, plasma osmolality and histological differences. Over a six week trial period juvenile dusky kob exposed to salinities 5, 12 and 35 psu had significantly lower plasma osmolality at 5 psu and 12 psu than 35 psu. Although they were able to maintain stable extracellular osmolality in salinities 5, 12 and 35 psu they also grew significantly less at 5 psu. This coincided with a significantly higher food conversion ratio and a significantly lower condition factor at 5 psu. These findings indicate that although juveniles are able to osmoregulate under a wide range of salinities, they expend more energy on osmoregulation at the lower salinities. Therefore, it is possible that in the Great Fish Estuary the effect of low salinity is negated by the high conductivity, which necessitates further research on the ecology of early life history stages of this species.

Oral A 10

Fast food: the transport of particulate organic matter over an upwelling event on the west coast of southern Africa

Aiden Biccard, George M. Branch, Maya C. Pfaff
University of Cape Town, Cape Town, South Africa

Particulate organic matter, the primary food source of coastal consumers, is delivered to the intertidal zone by certain oceanographic processes. Such processes are predicted to have a significant effect on the quality and quantity of POM supplied to nearshore intertidal and subtidal zones (Hill et al. 2006). Differences in the concentrations of phytoplankton (Chlorophyll-*a*) and kelp-derived particulate organic matter were investigated at different distances offshore and at different depths during the upwelling season, between an exposed headland (Cape Columbine) and a sheltered bay (Elandsbaai) in the southern Benguela. Three distinct oceanographic conditions, upwelling, relaxation and downwelling, were discernable from wind, current and temperature data at each site. Upwelling was most prevalent at Cape Columbine (upwelling center) in contrast to relaxation at Elandsbaai (upwelling shadow). Significant differences ($P < 0.00001$) in concentrations of chlorophyll *a*, organic carbon and % kelp-derived carbon were found between the two sites. In addition, significant differences ($P < 0.0001$) in chlorophyll *a* concentration, quantities of organic carbon and % kelp-derived carbon were found between the different oceanographic conditions: upwelling, relaxation and downwelling. A significant interaction ($P < 0.00001$) for % kelp-derived carbon was found between site and oceanographic conditions. Percentage contribution of kelp-derived carbon (max = 36%) to POM was lower than predicted and surprisingly lower than values reported in previous works (77%). In terms of food supply to coastal consumers, upwelling episodes at Cape Columbine result in significantly high import of kelp matter into the nearshore water column. In contrast, phytoplankton, constituted the primary food source for both sites during relaxation and downwelling episodes. It is clear that different oceanographic conditions between an exposed headland and a sheltered bay have profound implications regarding the transport, composition and supply of POM, as a source of food to coastal communities.

Oral C 1

Cloning and molecular characterisation of four alginate lyase genes from the abalone enteric bacterium *Vibrio midae* SY9

Bronwen Blake, Vernon Coyne
University of Cape Town, Cape Town, South Africa

Vibrio midae SY9 was isolated from the digestive tract of the South African abalone *Haliotis midae*. Plasmid pAlg15, isolated from a *V. midae* SY9 genomic library by screening for alginate activity, was found to harbour

three alginate lyase genes designated *alyVMI*, *alyVMII* and *alyVMIII*. The full length sequences of *alyVMI* and *alyVMIII* were obtained by screening two mini-genomic *V. midae* libraries enriched for fragments of 3.5 and 5 kb, respectively. A fourth alginate lyase gene, *alyVMIV*, was found downstream of *alyVMIII*. *alyVMI* and *alyVMII* were shown to be transcribed as one mRNA and thus act as an operon. Alginase activity was maximal six hours after *V. midae* SY9 was inoculated into alginate media and remained constant for a further 18 hours. However, alginate lyase activity was delayed for 18 hours when *V. midae* SY9 was cultured in alginate media supplemented 0.2% glucose. Similarly, *alyVMIII* transcription in *V. midae* SY9 cultured in alginate media reached a maximum six hours post-inoculation, as determined by Real Time RT-PCR, whereas *alyVMIII* transcription was delayed by six hours when the bacterium was cultured in glucose-supplemented alginate media. These results indicate that *alyVMIII* is under catabolite repression. In order to purify the alginase enzymes, each gene was cloned in frame into the expression cloning vector pET29a and tested for expression in *E. coli* BL21 pLysS cells. *alyVMI* showed weak expression four hours after IPTG induction, whereas *alyVMII* was optimally expressed. Although *alyVMIII* and *alyVMIV* expression was not detected by coomassie blue staining of SDS PAGE gels, western blot analysis using an anti-His primary antibody showed that *alyVMIV* was indeed expressed. *AlyVMI*, *AlyVMII* and *AlyVMIV* were extracted from the *E. coli* BL21 cells and purified using nickel agarose affinity chromatography. The purified proteins were injected into New Zealand White Rabbits to generate polyclonal antibodies for use in future studies.

Oral A 5

Changes in kelp forest communities caused by rock lobster invasion?

Laura K. Blamey, George M. Branch
University of Cape Town, Cape Town, South Africa

Rock lobsters (*Jasus lalandii*) have increased dramatically on the south-west coast of South Africa since the early 1990's. This 'lobster invasion' coincides with declines in the Cape urchin *Parechinus angulosus* and an increase in poaching activity of the South African abalone, *Haliotis midae*. Given the known predatory effect of rock lobsters and an intricate relationship between urchins, abalone and kelp, potential trophic cascade effects due to lobster invasions are being investigated. Temporal studies showed an absence of *J. lalandii* prior to 1990 and then a regular occurrence from

1996 to 2006. Benthic community data were collected from two sites before and after the increased abundance of *J. lalandii* and a significant difference in community composition before and after the lobster 'invasion' was revealed. A more detailed spatial study was then carried out on sites with high *J. lalandii* densities ('invaded') and sites with low *J. lalandii* densities ('non-invaded'). Significant differences in both *J. lalandii* abundance and benthic community composition were found between 'invaded' and 'non-invaded' areas. In the 'invaded' areas where *J. lalandii* densities were high, grazers were scarce and *P. angulosus* was completely absent, whereas algal abundance was high and encrusting corallines reduced. The 'non-invaded' areas were characteristic of encrusting corallines, increased grazers and a high abundance of *P. angulosus*, whereas algal abundance was reduced. These dramatic changes are likely to have serious impacts on fisheries operating within this area.

Oral B 9

The Role of the Agulhas Current in an Extreme Weather Event

Ross C. Blamey, Chris J.C. Reason
University of Cape Town, Cape Town, South Africa

Previous research has shown the importance of the Agulhas Current in supplying moisture to fuel extreme rainfall events in coastal South Africa. This study reviews previous strong events and then focuses on one case over northern KwaZulu-Natal. From observations and model results, it is found that low-level onshore flow of moisture from the Agulhas Current region played an important role in fuelling the extreme rainfall. The model (MM5) was also used to investigate the sensitivity of the storm to changes in sea surface temperature in the Agulhas Current region.

Oral B 4

The use of Principle Response Curve to explain meiofaunal community response to two runoff events different in pesticide input in a temporarily open estuary, South Africa

Silke Bollmohr^{1,3}, Paul J. van den Brink², Ralf Schulz³

¹ Department of Water Affairs and Forestry, Pretoria, South Africa

² Wageningen University and Research Centre, Wageningen, The Netherlands

³ University Koblenz-Landau, Landau/Pfalz, Germany

Spatial and temporal variations in particle bounded pesticide contamination, natural environmental variables and meiofauna abundance were measured during the dry summer season within a temporarily open estuary (Lourens River). During this study we focused on the effect of particle associated pesticides on the dynamics of the meiofauna community by comparing two runoff events, differing in their change in pesticide concentration and environmental variables. Additionally different methods of community description are explored and compared with each other in order to determine which environmental variables and which taxa contribute to spatial and temporal differences, including community indices (like species richness and Shannon Diversity Index), change in sensitive and tolerant species towards salinity and pesticides and a multivariate approach, namely Principle Response Curve. The two chosen sites were situated within the upper and middle reaches of the estuary and differ significantly mainly in salinity ($p=0.001$), flow ($p=0.5$), temperature ($p<0.001$) and particulate organic carbon in the sediment ($p<0.001$). Generally higher particle associated pesticides were found in the upper reaches. The first runoff event was characterized by an increase in pesticides and hardly any change in natural environmental variables, whereas the second runoff event was characterized by no increase in pesticide but a significant change in natural environmental variables like salinity, temperature and flow. However the Shannon Diversity Index did not reflect the change in variables, since the index does not take the increase in freshwater species into account, which coincide with a runoff event within an estuary. Therefore the contribution of species being sensitive to salinity and pesticides was found to be an important additional measure. The use of the Principal Response Curve showed a clear difference between the two sites but also a high temporal variability in environmental variables and meiofauna community. The most evident spatial difference in community structure was shown after the first runoff event, whereas no response was shown after the second runoff event. The environmental variables explaining most of the differences are lower Total Organic Carbon and salinity and higher phosphate and endosulfan concentrations within the upper reaches. The species contributing most to the differences between the sites are the estuarine harpacticoid Mesochra and Canthocamptus (lower abundance at the upper reaches) and the freshwater species Dunhevedia and Thermocyclops (higher abundance within upper reaches). Therefore Principal Response curve was shown to be a useful tool for explaining temporal and spatial variability within a temporarily open estuary using biomonitoring data.

Poster Mon 9

Investigation of heat shock protein 70 as a possible molecular biomarker for monitoring the short-term stress response in the commercially important agarophyte *Gracilaria gracilis*

Taryn Boom, Vernon Coyne

University of Cape Town, Cape Town, South Africa

The Rhodophyte genus *Gracilaria* is a commercially important source of food grade agar world-wide. Over 80 000 dry weight tons of *Gracilaria* species has been harvested annually from wild stocks and cultivated seaweed since 2003. *Gracilaria gracilis* is an indigenous species that occurs naturally along the Saldanha Bay coastline, South Africa. A number of sporadic population collapses of the natural stocks over the last decade has led to an increased focus on the development of cultivation techniques and methods for monitoring and averting population collapses. Hsp70 is a central member of the heat shock protein super family, facilitating the refolding of denatured proteins into functional proteins during stress. This study is investigating Hsp70 as a possible molecular biomarker for monitoring the short-term stress response of *G. gracilis* to heat stress, disease induction and nitrogen limitation. A 421 bp DNA fragment of hsp70 from *G. gracilis* has been cloned and sequenced. Preliminary studies have shown increased expression of Hsp70 in *G. gracilis* incubated at 30°C for 8 h. In addition, Hsp70 levels also increased after 24 h when *G. gracilis* was incubated in artificial seawater supplemented with 4 units of agarase / ml which elicits a disease response in the seaweed. These results indicate that Hsp70 could act as a molecular biomarker for monitoring stress in *G. gracilis*.

Oral B 4

The importance of river flow in small Temporarily Open/Closed Estuaries along the southern Cape coast, South Africa

Tom G. Bornman, J.B. Adams

Nelson Mandela Metropolitan University, Port Elizabeth, South Africa

The Klipdrif, Slang and Tsitsikamma estuaries along the southern Cape coast are classified as intermittently open estuaries (i.e. closed most of the time). These estuaries were on a trajectory of change because of increased freshwater abstraction from the catchment that resulted in more frequent and longer mouth clo-

sure. The mouth state, i.e. open, closed or semi-closed, is determined by a large sand berm that is in turn controlled almost exclusively by river flow. The intermittently open nature of these estuaries were significantly changed in August 2006 by a large flood event (> 1:30 year flood). The flood altered the geomorphology and thereby the hydrology of the estuaries resulting in an increased frequency and duration of mouth opening (became intermittently closed). Flow data for the Tsitsikamma River indicates that since that large flood five flood events of a 1:2 year magnitude have occurred. The frequent flushing of the estuary by flood flows and the short residence time of water within the estuary had a major impact on the biota. At least one month of mouth closure is required for the berm to build up sufficiently to allow the water level within the estuary to increase creating more stable vertical and longitudinal stratification. The longer the water residence time the greater the development and increase in phytoplankton and ichthyofaunal biomass and diversity. The results of this study indicated that although freshwater input from the catchment is the main driver maintaining the estuaries, too much freshwater can have a negative impact on the nutrient status, biomass and biodiversity of these small black water estuaries.

Oral B 10

A sigmoidal shoreface-connected ridge field: Aliwal Shelf, KZN, South Africa

Charl Bosman¹, Alan Smith², Ron Uken¹

¹ University of KwaZulu-Natal, Durban, South Africa

² AS Consulting, Durban, South Africa

Shoreface-connected ridges (SCRs) are described from the southeast African Shelf for the first time. SCRs are generally ascribed to storm-current formation and have been linked to coastal retreat and sea-level rise, although no consensus on the exact process has been reached. They occur in groups with crests usually parallel to the regional wave propagation direction. They open into the prevailing coast-parallel current at an acute angle, merging offshore and becoming larger and more asymmetric. The Aliwal SCRs emerge from the shoreface at about -13 m and persist to depths of -60 m. They are 3 to >8 km long, 1 to 6 m high, spaced between 480 to 1350 m apart and open into the prevailing northerly-directed, shore-parallel current. Inshore asymmetry is directed northwards (-13 and -20 m) but further offshore (-22 m to -30 m) a bi-directionality is noted. This geometry supports a northerly unidirectional coast-parallel current inshore and a bi-directional coast-parallel current offshore. The SCRs occur in two

bedform fields. One displays a sigmoidal pattern where the bedforms merge offshore against the Aliwal Shoal. The other merges offshore to form a submerged spit-bar with a lee of slope ± 25 m high. It has long been known that in the absence of obstacles, current reversal is the mechanism responsible for bedform climbing and upward growth. It is suggested here that the SCRs, through the action of an alternating current regime, have climbed to form the submerged spit bar. We suggest that this sediment model has been operating in the area throughout the Holocene.

Oral C 2

Transient Expression of Two Reporter Genes, *lacZ* and EGFP, in the Red Algae *Gracilariopsis longissima* and *Gracilaria gracilis*

Suzanne M. Botha, Ann E. Meyers, Vernon E. Coyne
University of Cape Town, Cape Town, South Africa

The South African phycocolloid industry depends solely on the natural gracilarioid resource growing in Saldanha Bay. Recent evidence shows that this population is in fact a mixed population of *Gracilaria gracilis* and *Gracilariopsis longissima*. Hence, collections of beach cast *G. gracilis* at Saldanha Bay in recent years for commercial use may very well include *Gs. longissima*. The industry has experienced a number of setbacks over the past few years due to major collapses in the seaweed population. A possible approach to overcoming these collapses is to select and/or engineer strains that are either more tolerant or resistant to stress and to make this possible, it is essential to characterise algal genes expressed in response to environmental stress and disease. A genetic transformation system for *Gs. longissima* and *G. gracilis* is needed for this to be possible. Microparticle bombardment was successfully employed to transform *Gs. longissima* and *G. gracilis*. Two reporter genes, *lacZ* and EGFP, were transiently expressed under the influence of the SV40 promoter. *LacZ* expression was detected by histological staining only in thalli bombarded with recombinant DNA. PCR analysis revealed the presence of the *lacZ* gene in plasmid-bombarded thalli but not in thalli bombarded with gold particles lacking recombinant DNA. In addition, microparticle bombardment at different rupture disc pressures was tested with EGFP to optimise transformation efficiency. EGFP was visualised in thalli bombarded with recombinant DNA by fluorescent microscopy. These results form an important foundation for the development of a successful transformation protocol for both *Gs. longissima* and *G. gracilis*.

Oral A 3

Inter-nesting Behaviour of Leatherback Turtles in iSimangaliso Wetland Park and the usefulness of this MPAs to provide protection

Marie Botha¹, Mike Meyer², Ronel Nel¹, Herman Oosthuizen², Jeff Gaisford³ Deon Kotze²

¹ NMMU, Port Elizabeth, South Africa

² Marine & Coastal Management, Cape Town, South Africa

³ Ezemvelo KwaZulu-Natal Wildlife, South Africa

Leatherback sea turtles are characterised by three aspects; firstly they are the largest, and only “soft-shelled” marine turtle; secondly, they are declining the fastest of any of the turtle species in the world; and thirdly, are the only completely pelagic turtle species (except during nesting). This project investigated the inter-nesting behaviour, i.e. activity in between successive nesting events, of *Dermochelys coriacea* in the 2006/07 nesting season to test the effectiveness of a current long-term nest monitoring programme, and the utilization by individuals on the nesting grounds of the iSimangaliso marine protected area, or at least the likelihood of staying inside the EEZ of South Africa. This was investigated with the use of ARGOS satellite spot tags mounted using external harnesses on six nesting females. From the satellite positions it is clear that animals tend to move widely, exceeding 100km away from the coast on a single inter-nesting excursion (~ 10 days). Secondly, nesting per individuals seems to be concentrated in regions of the park eg south, central or north. Animals nesting in the south, are thus unlikely to enter the monitoring area to be tagged/coded. Further, there is no significant difference in the time spent inside and outside the park per individual (Paired T = -1.13, p= 0.31). None of the excursions outside of the park ventured into the high seas, but half of the turtles ventured into the coastal waters of Mozambique. However, there is a significant difference in the time spent across the border (F= 4.16, p= 0.04) with the majority of the time spent in SA waters. It is therefore concluded that even though leatherback turtles are gaining from having a protected habitat to nest in, they are not gaining much by a 3NM offshore extent to this marine protected area.

Oral A 10

Long-term monitoring of the arrival, expansion and effects of an alien mussel *Mytilus galloprovincialis* relative to wave action

George M. Branch, Francois Odendaal, Tamara B. Robinson

University of Cape Town, Cape Town, South Africa

The Mediterranean mussel *Mytilus galloprovincialis* is the most widespread marine alien species along the South African coast. Long-term monitoring of the mid-to-low intertidal zone in the Groen-Spoeg area on the west coast between 1988 and 1993 tracked the establishment and expansion of this aggressive invader along a gradient of wave action. Concurrently, the impacts of this mussel on other dominant species were quantified. The rate of increase and abundance of *M. galloprovincialis* was found to be promoted by wave exposure. The tube-building polychaete *Gunnarea capensis* remained the dominant space occupier on sheltered shores but was negatively correlated with the *M. galloprovincialis* expansion on more exposed shores. In contrast, the indigenous mussel *Aulacomya ater* demonstrated no significant changes in abundance through time as it simply became incorporated into the spreading *M. galloprovincialis* beds. While overall density of the limpet *Scutellastra granularis* was positively impacted by the *M. galloprovincialis* invasion, adults and recruits occupying primary space showed a negative correlation with *M. galloprovincialis* abundance, the strength of which increased with wave exposure. Conversely, adults and recruits occurring on secondary space were positively affected by the invasion as *M. galloprovincialis* beds enhanced settlement. Again the strength of the interaction increased with wave action. Thus, abundance of *M. galloprovincialis* and its impacts on other elements of the rocky shore community were found to be linked with wave intensity.

Poster Wed 11

The effect of the limpet, *Cymbula granatina*, and various predators on community succession in wave-exposed and sheltered rocky intertidal west-coast shores

George M. Branch, Maya Pfaff, Erika Kean

University of Cape Town, Cape Town, South Africa

Understanding the differing community structure between wave-exposed and sheltered rocky shores and the influences of competition and predation on local patterns is important to understand rocky shore ecology. A test of the influence of a key grazer and common predators (i.e. whelks, rock lobsters, birds, and fish) on rocky intertidal community succession was carried out. A series of caging experiments that in-

cluded or excluded *Cymbula granatina*, small and large predators was monitored monthly over six months. Six 25x25cm, stainless steel mesh cage treatments were involved: (1) a complete cage (fence+roof), (2) a roof only cage, a fence only cage- (3) one including *C. granatina* and (4) one excluding *C. granatina*, and two controls- (5) one that is an open 25x25cm plot (delineated by four bolts) and (6) one half fence (two sides only). The study included a comparison between wave-exposed and sheltered bays at two sites, Jacob's Bay and Eland's Bay, along the west coast of South Africa. There were six replicates at each of the four localities. It is hypothesized that a statistically significant pattern of distinct community succession between the different treatments and between exposed versus sheltered locations will occur. Results are still forthcoming and will be reported up to date at the symposium.

Oral A 6
Analysis of annuli on otoliths and growth rates of the Namibian hake (*Merluccius capensis*)

Faye R.V. Brinkman¹, Margit R. Wilhelm^{1,2}, J. Pedro Andrade³

¹ Ministry of Fisheries and Marine Resources, Swakopmund, Namibia

² University of Cape Town, Cape Town, South Africa

³ Faculdade De Ciências Do Mar E Do Ambiente, Faro, Portugal

Age and growth estimates of Namibian Cape hake (*Merluccius capensis*) were described from 804 specimens collected from the annual biomass survey conducted off Namibia during January and February 2003. Each specimen was aged using whole otoliths. Otolith diameter measurements (tip-to-tip measurements of hyaline bands, OD) were taken and used to back-calculate lengths-at-age (fish total length in cm, FL). OD measurements showed that up to three false rings formed prior to the first true annulus. Frequency plots of OD demonstrated the differences in OD between true annuli and false rings. A linear regression of fish length against otolith diameter was used to estimate back-calculated FL at the first four annuli. The average back-calculated lengths for the first four years of life of *M. capensis* were 19.3, 25.6, 31.8 and 38.2 cm FL. These mean lengths were confirmed by the modes apparent in the survey length frequency distributions and thus corroborated the readings of the first four annuli on the otoliths of *M. capensis*. The von Bertalanffy growth parameters were calculated at: growth coefficient, $K = 0.07$; asymptotic length, $L_{\infty} = 123.13$ and $t_0 =$

-1.5. Sexual maturity was reached at age 1.7 years.

Oral A 7
Profile of the illegal abalone fishery in South Africa : Is a sustainable, legal fishery achievable?

Peter Britz, Serge Raemaekers
 Rhodes University, Grahamstown, South Africa

Illegal, unregulated and unreported (IUU) abalone fishing in South Africa has grown to such an extent that the legal total allowable catch has been progressively reduced from 640 tons in 1995, to a proposed zero for 2008. We present research on the socio-economics of the IUU abalone fishery and the quantification of illegal fishing effort. Our data show that the IUU activities are much more widespread and sophisticated than previously acknowledged, and that the total IUU catch is estimated to be well over 2000 tons per annum worth ca. \$60 million. 100% of the product is exported, mainly to Hong Kong. Factors responsible for the complete shift to illegal fishing include the high price of abalone, a flawed fishing rights model and allocation process, an ineffective compliance authority, and a failure to design institutional responses appropriate to the scale of the problem. The proposed closure of the legal fishery raises questions of fishery governance and equity. Abalone fishing rights holders have challenged the decision to close the fishery in court, arguing that they are being unfairly discriminated against because of government's failure to control illegal fishing. Biological evidence suggests that while the current levels of fishing are unsustainable, the fishery has not yet collapsed, and that the yield could be stabilised if fishing effort was regulated. We argue that institution of a territorial user right fishery (TURF) based on the rehabilitation of local abalone populations, either by means of effort control or reseedling, could shift the fishery back to a legal footing.

Oral C 8
New Marine Observing Systems Around Africa

Geoff Brundrit¹, Mika Odido², Lucy Scott³, Stewart Bernard^{1,4}, Justin Ahanhanzo¹

¹ Global Ocean Observing System in Africa

² Ocean Data and Information Network in Africa

³ African Coelacanth Ecosystem Programme

New capabilities in marine observing and information systems are being brought into use on the coasts and in the oceans around Africa. These initiatives are pan-African in extent, covering many countries and all the

regions of Africa. They are being developed in support of the Global Earth Observation System of Systems (GEOSS) vision of a future in which decisions and actions for the benefit of humankind are informed by coordinated, comprehensive and sustained Earth observation and information. At the same time there is intensive promotion of the scientific and technological capacity needed to take advantage of the new capabilities. Further advances are planned, to be undertaken within ocean partnerships established by Africans for Africans. Key players within these partnerships are IOC/UNESCO's Global Ocean Observing System in Africa (GOOS AFRICA), the IOC/IODE's Ocean Data and Information Network in Africa (ODINAFRICA), and the pan-African Large Marine Ecosystem (LME) and related programmes of the Global Environment Facility. Three case studies (ODINAFRICA sea level monitoring, GOOS AFRICA remote sensing pilot projects, and the ODINAFRICA African marine atlas) illustrate the new capabilities and future prospects in marine observing and information systems. Sustained benefits from the efforts illustrated in these case studies will not be realised without the simultaneous empowerment of African scientists and their national institutions to enhance the capabilities for earth observation; human capital, scientific and technological expertise, operational infrastructure, and mechanisms to maximise societal benefit must all be developed cohesively. The aim must be to make the nations of Africa optimally self-sufficient in using these systems to protect the economic needs of society in the coastal ocean.

Oral C 6
The Role of Ocean Processes within Coupled Ocean-Atmosphere Variability in the Tropical Atlantic

Natalie Burls, Chris Reason
University of Cape Town, Cape Town, South Africa

Along the west coast of southern Africa, episodes of anomalously warm and cold sea surface temperature, referred to as Benguela Niños and Benguela Niñas respectively, represent an important mode of variability in the Benguela upwelling system. These events affect rainfall variability within the region as well as impact local fish populations. Unanswered questions surround the relationship between Benguela Niños and the zonal mode of variability in the tropical Atlantic often referred to as the Atlantic Niño mode because it resembles the Pacific El Niño Southern Oscillation (ENSO). There are however several differences between the nature of the zonal mode in the Atlantic and its counterpart in the Pacific. Local coupled ocean-atmosphere

feedbacks in the Atlantic are weaker than they are in the Pacific and so tropical variability within the Atlantic is more susceptible to external influences. The dynamic ocean processes that control sea surface temperature changes in the Tropical Atlantic Ocean are complex and poorly understood. In order to improve seasonal to inter-annual climate prediction over southern Africa, we need to advance our understanding of the ocean dynamics controlling large-scale modes of climate variability over the tropical Atlantic and refine their treatment in couple ocean-atmosphere models. Identifying the most important feedback mechanisms controlling the evolution of sea surface temperature in the Tropical Atlantic will shed light on the primary parameters that need to be observed for the initialisation and assimilation of coupled models.

Oral A 7
On controversial issues in South African renewable marine resource management

Doug S. Butterworth
University of Cape Town, Cape Town, South Africa

The essence of some controversial issues in South African renewable marine resource management will be summarised and critically discussed. Those to be covered will include: 1) is local protected status for the great white shark and listing of the Cape fur seal on Appendix II of CITES scientifically defensible given the evidence available on the status of these populations?; 2) do older mature female hake make a disproportionately large contribution to hake recruitment?; 3) is the hake resource shared with Namibia and in need of joint management?; 4) do pelagic fishing activities threaten the penguin population?; 5) does spatial management in general, and MPA's in particular, offer benefits for the management of non-sessile species that outweigh their disadvantages?; 6) is possible indicator-based management to be developed from, or a defensible alternative to stock assessment analyses?; 7) in what way and how soon might multi-species/ecosystem models replace single species models as a basis for scientific advice for management under an ecosystem approach?; and 8) are fads being promoted out of proportion to fundamentals in research in the renewable marine resource management area ?

Oral B 1
Zooplankton of the St. Lucia Estuary during the current drought cycle: a comparison between open- and closed-mouth conditions

Nicola K. Carrasco¹, Renzo Perissinotto¹, Deena Pillay²

¹ *University of KwaZulu-Natal, Durban, South Africa*

² *University of Cape Town, Cape Town, South Africa*

Throughout its existence, the St. Lucia Estuary has experienced cyclical wet and dry periods. However, alteration of the system's catchment combined with the well below average rainfall over the past 5 years has magnified the severity of this last drought period. Physical implications have been manifested mainly through the drastically reduced water levels and hypersaline conditions. The focus of this study deals with the change in zooplankton abundance, biomass and community structure before and after the mouth opening in March 2007, when a combination of climatological events resulted in the breaching of the estuary. Zooplankton, phytoplankton and microphytobenthos samples were collected in conjunction with physico-chemical data during quarterly surveys undertaken throughout 2006 and 2007. Results show a dramatic decline in taxonomic richness of zooplankton communities associated with the drought. The loss of taxa is mainly attributed to the high salinities, low water levels, and exclusion of marine recruits. Of the 95 taxa recorded by Grindley (1976) only 18 were present during closed-mouth conditions, the most dominant being the copepods, *Pseudodiaptomus stuhlmanni* and *Acartia natalensis* and the mysid *Mesopodopsis africana*. After the mouth opened, marine recruits which were previously excluded, such as the prawn *Penaeus indicus*, crab zoeae and fish larvae, once again re-entered the system. While diversity increased dramatically to at least 43 taxa, abundances of previously dominant species such as *M. africana*, decreased considerably. It is anticipated that global climate change will be associated with an increase in both frequency and intensity of extreme weather events, such as floods and droughts. Having an extensive account of the changes that occur under open-mouth conditions would, therefore, contribute to the synthesis of information on St. Lucia's zooplankton and add to the understanding of the ecology of this system, especially in response to environmental fluctuations.

Oral C 3

Sea Level Rise Impacts for Cape Town - 2. Risk Assessment and Adaptation Measures

Anton Cartwright¹, Gregg Oelofse², Lucinda Fairhurst³

¹ *Stockholm Environment Institute*

² *City of Cape Town, South Africa*

³ *LaquaR Consultants, Cape Town, South Africa*

The City of Cape Town administers approximately 307 km of coastline, arguably its single greatest economic and social asset. The City's coast provides a range of social and economic opportunities including recreational and amenity areas, sought after housing and development opportunities as well as core economic attributes. In addition, the City's coast is a dynamic ecological system that supports a wide range of species, ecological systems and ecological services. Global climate change predictions suggest that amongst others, sea level rise and an increase in the intensity and frequency of storm events may have significant impact on coastlines across the globe. Cape Town with its extensive coastline may be particularly vulnerable to these predicted changes. This study follows on from the biophysical scenarios of the GIS inundation modelling, and involves an assessment of the risks to the City and its citizens, and an identification of the adaptation and mitigation measures that might be adopted. These will be illustrated in a generic as well as particular context. This will involve the identification of critical infrastructure that cannot easily be replaced or moved, and particularly vulnerable communities that have restricted capacity for relocation. A number of guidelines will be given for adaptation options, their costs and their benefits, and for dealing with social vulnerability and appropriate adaptation.

Oral C 6

1984: Benguela Niño or Turning Point?

Fabienne M. Cazassus^{1,2}, Sakhile Tsotsobe², Coleen L. Moloney¹, Hans M. Verheye²

¹ *University of Cape Town, Cape Town, South Africa*

² *Marine and Coastal Management, Cape Town, South Africa*

Zooplankton was analyzed from ichthyoplankton-directed samples collected monthly at nine stations along a transect at 23°S off Walvis Bay (Namibia) between 1978 and 1989; a time frame that included the 1984 Benguela Niño that affected the Northern Benguela. From this dataset, seasonal and interannual variations of zooplankton community structure were studied. The general trend of high zooplankton abundance and biomass that prevailed from 1978 to 1983, ended in 1984, when it reached its minimum, it slowly increased afterward but never recovered its prior 1984 levels. A multivariate analysis of the community structure prior, during and after the event of 1984, showed three distinct communities: a) a community of cool

water with high abundance and biomass, b) a community of warm oceanic water with low abundance and biomass and c) a community of “mixed” waters where cool upwelled species prevailed but where warm oceanic species maintained their presence. The fact that the zooplankton community did not return to its previous stage prior to the warm event of 1984 implies more than an annual anomaly. Using sea surface temperature as proxy of upwelling index, we observed a shift of upwelling intensity in the mid 80s, going from a high intensity regime to a low intensity regime. Thus bringing the question whether the warm event occurring in 1984, in the Northern Benguela, qualifies as a Benguela Niño or a Turning Point?

Poster Wed 20

The diel feeding biology of the pelagic goby *Sufflogobius bibarbatus* off Namibia

Cedras R.B., Gibbons M.J.
University of the Western Cape, Bellville, South Africa

The pelagic goby *Sufflogobius bibarbatus* is commonly found off the southwest coast of Africa between the Kunene River and St Sebastian Bay. The stomach contents of 1485 pelagic gobies were examined from two diel stations inshore and offshore off the Namibian coast during January 2006. The pelagic goby is a predator and the most frequently occurring prey items included polychaetes, euphausiids, copepods and amphipods. Larger fish mainly fed on polychaetes, whereas the diet of smaller and intermediate size classes appeared to be more diverse. Food containing ratios were lower during the night than by day, but more diverse. The results shed new light on the ecology of the species which is becoming increasingly important in the region.

Oral A 4

Strategic Planning for the Greater Addo MPA – Understanding the key issues

R.Chalmers¹, A. Götz², W.H.H. Sauer¹
¹*Rhodes University, Grahamstown, South Africa*
²*South African Environmental Observation Network (SAEON), Grahamstown, South Africa*

A Marine Protected Area (MPA) is planned for the Eastern Cape, adjoining the Greater Addo Elephant National Park (GAENP). The proposed MPA footprint incorporates habitat types thought to be poorly represented in existing MPA's in South Africa. Due to the extent of the footprint both recreational and commercial socio-economic activities will be affected.

In conjunction with National Parks, a spatially based multiple-use MPA is being designed to meet both conservation and social objectives. This presentation provides an overview of the research being undertaken to assess the biological and socio-economic environments within Algoa Bay, as a precursor towards the formulation of a Management Plan. Key areas within the proposed MPA were identified and the ichthyofaunal and macro-benthic communities were assessed. Ichthyofaunal communities were assessed by means of controlled angling, underwater visual census techniques, or a combination of both. Macro-benthic invertebrate communities were assessed using photo quadrants. An assessment of the recreational/subsistence shore fishery was undertaken by means of roving creel surveys. The recreational offshore linefishery was assessed by means of weekly access point effort counts, and interviews and catch surveys during peak holiday periods. The spatial distribution of fishing effort by the linefish and squid sectors was assessed by means of aerial surveys, and the Marine and Coastal Management Vessel Monitoring System. Catch data was obtained through the National Marine Linefish System. Results show clear differences between ichthyofaunal and macro-benthic community structure between areas. Fisheries surveys revealed that recreational fishing effort was concentrated around access points within the study area. Subsistence activity was found to be minimal and limited to a small coastal area. Commercial fishing activity varied seasonally and predominated by the squid sector. Results are used to identify key areas for conservation and highlight issues regarding the proclamation and spatial zoning of the proposed GAENP MPA.

Oral B 9

ROMS model results of the seasonal structure and circulation on the Agulhas Bank

N. Chang¹, P. Penven², F. A. Shillington¹
¹*University of Cape Town, Cape Town, South Africa*
²*IRD, Institut de Recherche pour le Développement, Plouzane, France*

The results from a high-resolution model embedded in the ROMS model configuration SAfe (South African Experiment) are used to show the seasonality in the circulation and structure of the Agulhas Bank (AB). The model is forced with monthly climatologies and resolves features at a resolution of 8km and with 32 vertical terrain-following levels. The model reproduced seasonal structure and circulation over the AB as well as the Cool Ridge, a subsurface cold tongue fea-

ture. Domination by the Agulhas Current over both the outer east and west AB was apparent. The Inner-AB, along the coast, appears wind-driven whilst the central shelf is a transitional region. The Cool Ridge was identified as the vertical doming of isotherms on the AB. This feature appeared to be created by the interaction of the Agulhas Current with the topography of the AB and its behaviour determined by the prevailing circulation in the region.

Comparison with an adjusted-model, where no AC influences the AB, shows regions where the AB is dominated by the AC. Without the AC the complex structures over the AB are not apparent. Current speeds over the AB decreases, particularly the north-westward convergent flow on the outer WAB. The thermocline appears deeper and winter-mixing allows greater deepening than with the AC. Doming is still found on the east AB although this appears not related to the wind but to currents further west.

Oral B 7

Using acoustic telemetry to monitor estuarine movements and habitat use of spotted grunter *Pomadasys commersonnii*

Amber-Robyn Childs¹, Paul D. Cowley², Tor F. Næsje³, Bronwyn A. O'Connell¹, Eva B. Thorstad³, Anthony J. Booth¹, Warren M. Potts², Finn Økland³

¹ Rhodes University, Grahamstown, South Africa

² South African Institute for Aquatic Biodiversity, Grahamstown, South Africa

³ Norwegian Institute for Nature Research, Trondheim, Norway

Acoustic telemetry is increasingly being used to monitor real-time movements of individual fish. This information provides fine-scale temporal and spatial data that is essential for behavioural ecology and effective management of studied species. Movement patterns of an important estuarine-dependent fishery species, the spotted grunter *Pomadasys commersonnii*, were investigated using acoustic telemetry in the permanently open Great Fish Estuary and the intermittently open East Kleinemonde Estuary. Home range characteristics (home range size, core area size, number of core areas) and general behavioural traits (mostly resident behaviour) of tagged individuals were similar in both estuaries. Similarly, in each estuary, there was considerable overlapping of tagged fishes' home ranges, which coincided with the area of high prey abundance. In the Great Fish Estuary a fish size effect was observed. Larger fish were more mobile, had larger home ranges

and more core areas than smaller individuals. Unlike the land-locked fish in the East Kleinemonde Estuary spotted grunter in the Great Fish Estuary spent 67% of their time in the estuary, interspersed with a number of marine excursions. The number and duration of marine excursions varied among individuals and were significantly correlated with tide, time of day and environmental conditions, such as barometric pressure, wind direction and sea temperature. The importance of estuarine habitats and management implications of this important fishery species will be discussed.

Oral C 9

Inlet hydrodynamics and sediment transport at the St Lucia Estuary

Clinton P. Chrystal¹, Derek D. Stretch¹, Renzo Perissinotto¹, Ricky H. Taylor²

¹ University of KwaZulu-Natal, Durban, South Africa

² Ezemvelo KwaZulu-Natal, St Lucia estuary, South Africa

The St Lucia estuary in northern KwaZulu-Natal is an ecologically important system that was proclaimed a World Heritage site in 1999. The estuary has been strongly influenced by anthropogenic activities resulting in reduced freshwater inflows reaching the system and increased sediment loadings. The role of the Mfolozi River in the functioning of St Lucia is a key issue for the sustainability of the system. The Mfolozi estuary was historically linked to the St Lucia estuary but was artificially separated in 1952 due to the perceived threat of high sediment loadings entering the St Lucia Lake. The mouth state of the St Lucia estuary is of fundamental importance to the state of the lake system - it is the main factor that controls water levels by allowing sea water into the system and hence changing the salt loading. During the breaching of the St Lucia mouth in March 2007 the tidal exchange flows were investigated. Measurements were obtained at several stages from open through to constricted mouth conditions. Preliminary results indicate the flood tide duration is approximately four hours as opposed to an eight hour ebb tide duration. However, a net inflow into the lake system of approximately 500 000 to 1 000 000m³/day was the result which was corroborated by water level changes. In order to address sedimentation issues, suspended sediment samples were collected from the water column during tidal flow measurements. The results indicate that the total suspended solids ranged from 0.07 to 0.33 grams per litre. The sediment transport, although appearing low, must be evaluated in conjunction with the estimated monthly net inflow of ap-

proximately 21Mm³. Seven shallow water vibracore samples were also obtained from the St Lucia southern lakes and the Mfolozi River. The data provides clarity regarding the role of Umfolozi sediments entering the lakes.

Oral C 13

Towards a National Estuarine Monitoring Programme in South Africa. The DWAF Perspective

Gerhard Cilliers, Dr Neels Kleynhans, Barbara Weston

Department of Water Affairs and Forestry, Pretoria, South Africa

The Department of Environmental Affairs and Tourism through Marine and Coastal Management (MCM) is mandated to manage South Africa's coastal zone, while the Department of Water Affairs and Forestry is mandated to manage South Africa's water resources through the National Water Act (Act 36 of 1998). This includes estuaries as they are inclusive of South Africa's water resources. Therefore both government departments have a responsibility for aspects relevant to estuarine management. Various other government institutions including conservation bodies, provincial, regional and local authorities also play a role in estuarine management at different scales. In order to give effect to chapters 3 and 14 of the National Water Act (Act 36 of 1998) an integrated national estuarine monitoring programme is proposed. This monitoring programme will need to address biotic and abiotic aspects relevant to estuaries, and will therefore not only provide an indication of the health of estuaries, but will also provide information to be used in determining estuarine flow requirements and resource quality objectives. It is proposed that a series of indicators are selected which will form the bases for a national monitoring programme through consultation with relevant experts. Some of these indicators may form part of existing monitoring programmes being undertaken by DWAF: RQS. The determination of estuarine health need to be in line with the current ecoclassification process used in the National Aquatic Ecosystem Health Monitoring Programme. The proposed monitoring programme should be tested on selected sub-tropical, warm-temperate and cold temperate estuaries in South Africa. Constraints and opportunities within the proposed National Estuarine Monitoring Programme are discussed. In order for the proposed programme to be effective, a co-operative approach needs to be followed, in which all role-players are involved.

Oral B 3

From flow to fishes: a new understanding of links between physic-chemical parameters and biota in the Berg estuary

Barry Clark

Anchor Environmental Consultants & University of Cape Town, Cape Town, South Africa

Anchor Environmental Consultants were commissioned by the Department of Water Affairs (DWAF) to develop a conceptual model of ecosystem functioning in the Berg estuary and its link to freshwater flows. Data on the natural and present state of the system were collected over a period of three years, 2003-2005, and together with available historic data, were used to populate the model and to define conceptual linkages between flow and other physic-chemical parameters and between these physic-chemical parameters and the biota (microalgae, macrophytes, invertebrates, fish and birds). The primary purpose of developing the model was for assessing likely impacts on the estuary arising from the newly constructed Berg River dam. Results of key interest emerging from the model to be discussed in the presentation include variations in the primary drivers of water level fluctuations in the estuary (freshwater flow, tidal and longer-term fluctuation in sea-level) and extent of flooding on the estuary floodplain and their influence on biota using this environment (primarily birds), the influence of flow on water quality (salinity, turbidity and nutrient levels) in the estuary and consequences for primary producers (microalgae) and other biota (invertebrates, fish and birds) in the system, and the possible effects of an altered flow regime on these parameters.

Oral A 1

Marked fluctuations in numbers of whale sharks in northern KwaZulu-Natal, South Africa

Jeremy Cliff^{1,2}, Michael Anderson-Read¹, Graeme Charter¹

¹ *Natal Sharks Board, Umhlanga, South Africa*

² *University of KwaZulu-Natal, Durban, South Africa*

Aerial surveys to count whale sharks were initiated in 2001 to assess the potential for dedicated whale shark diving on the northeast coast of South Africa. The survey area lies between Ballito and the Kosi Bay mouth, a distance of some 350 km. As over 97% of sharks were observed along the northernmost stretch of coast (Kosi Bay to the wreck of the Jolly Robino, south of St.

Lucia), results are only presented for this 187 km long stretch of coastline. Between October 2001 and May 2005 densities ranged from 0 to 5 sharks per 100 km of coastline, with no sightings on 13 of the 24 flights. In the summer of 2005/6 densities rose as high as 20 sharks, with a further rise in the summer of 2006/7 to a maximum of 36 sharks per 100 km of coast. The extremely low sighting rates over an extended period clearly cannot support a dedicated whale shark diving industry. Another index of whale shark abundance is KZN beach strandings, which appear to be the highest in the world. This database was initiated in 1983 and shows considerable interannual variation, with peaks of eight (1991), seven (1997) and 12 (2007). The most recent peak coincides with the high densities reported above. On the other hand, there does not appear to be any link between either sightings or strandings and incidental catches of whale sharks in the shark nets off central and southern KZN, which have averaged 0.9 animals (range 0-3) per annum since 1979. The animals entering KZN are generally smaller than 9 m and therefore sexually immature. Availability of food appears to be the primary factor influencing the movements of these highly nomadic animals. Sources of such food would either be through upwelling or the result of mass animal spawning. The magnitude of such events in coastal waters of Mozambique and further north may well determine the number of whale sharks which eventually make their way into KZN.

Oral C 5

The feeding behaviour of the fish parasitic larvae of *Gnathia africana* Barnard, 1914 (Isopoda), from Tsitsikamma National Park, South Africa

Maryke L. Coetzee¹, Nico J. Smit¹, Angela J. Davies²
¹ University of Johannesburg, Johannesburg, South Africa

² Kingston University, Kingston upon Thames, United Kingdom

The majority of behavioural studies on cleaning symbiosis in fishes have focussed on the behaviour of cleaners and their clients. Studies on the behaviour of the parasites, and how they might adapt over evolutionary time, have attracted much less interest. The main reason for this is the difficulty in observing or obtaining experimental evidence of possible evolutionary change. In Australia and the Caribbean, tropical larval gnathiid isopods attach to their host fish mainly at night. It was thus hypothesised that this trait was a counter-adaptation against the presence of diurnal cleaners. To test this hypothesis, the emergence behav-

our of the larvae of *Gnathia africana* parasitising intertidal fishes on the South Coast of South Africa was observed. No cleaning behaviour has been reported from any fish, or invertebrate, from this temperate region and it was thus assumed that the activity of *G. africana* would represent gnathiid behaviour in the absence of cleaners. Caged fish (*Clinus superciliosus*) were placed in infra- and intertidal pools and exposed to gnathiid attacks for 4 hours, over a 24 hour period. Following removal from cages, fish were screened for gnathiid larvae. Results indicated that gnathiid loads were highest around midday and late afternoon (average 20 gnathiids per fish), and lowest during midnight to sunrise (average 4 gnathiids per fish). In contrast to coral reef gnathiids, the intertidal species showed preference for midday and late afternoon attacks, thus supporting the hypothesis that the nocturnal behaviour of tropical gnathiids is a result of pressure from cleaners.

Oral B 8

How many sardines in a sardine run and other interesting observations

J.C. Coetzee, D. Merkle, L. Hutchings, C. D van der Lingen, M. van den Berg, M. Roberts
Marine and Coastal Management, Cape Town, South Africa

The annual migration of sardine up the east coast of South Africa during winter is a spectacular natural event that has recently generated increased interest from particularly a tourism and business perspective. Despite the heightened public awareness around this annual phenomenon, very little dedicated scientific research has been conducted to investigate the cause, nature or size of the "sardine run". This is largely due to the perceived relative insignificance of the sardine run component to management of the sardine population as a whole. Only three acoustic surveys have been conducted on the east coast of South Africa since the inception of the acoustic survey programme in 1984. These surveys found comparatively low estimates of sardine biomass on the east coast at a time when the sardine population size was small. Evidence of a recent eastward shift in the distribution of sardine and sardine spawning, coupled with dramatic increases in sardine abundance, may be indicative of a larger sardine run and increased east coast spawning. If this were true, the results of annual assessment surveys which do not extend past port Alfred may be contested on the grounds of incomplete coverage of the distributional range of sardine spawners and recruits. For this

reason, a dedicated multi-disciplined sardine run survey was conducted in June and July of 2005 timed to coincide with the annual sardine run. This paper aims to summarise the findings of this survey and to put them into perspective in terms of the sardine population as a whole. Results pertaining to measurements of the physical properties and structure of the water column as well as levels of primary and secondary production and how these relate to the distribution and biology of sardine and other small pelagic fish on the east coast are presented.

Oral A 10

Mussels as ecosystem engineers: does density influence the strength of engineering?

Victoria J. Cole

Rhodes University, Grahamstown, South Africa

Modification of the abiotic environment and creation of habitat by ecosystem engineers is an important and widespread ecological process. Illustrating that the abiotic environment has been modified by ecosystem engineers, over and above those in non-engineered habitats has, however, been largely ignored. In addition to the need to make comparisons between engineered and non-engineered habitats, it has been proposed that the density of engineers influences the scale and intensity (modification of the environment, numbers of unique species, and numbers and densities of species) of engineering. Engineers at large densities were predicted to have much greater effects than their cumulative per capita effects so that interactions between neighbouring organisms may lead to broader-scale impacts on the environment. Using the native mussel, *Trichomya hirsuta* as a model organism, in Sydney Harbour, Australia, theories were tested about the role of ecosystem engineers and whether effects of engineering depend on their densities. Mussels engineered habitat that was cooler and more humid during low tides and that trapped large amounts of fine sediment. These important physical differences resulted in engineering effects at the scales of patches and landscapes, with engineered habitats enhancing the number of species by more than 300 % ("Landscape Richness Effect"). Mussels at large densities had much smaller engineering-effects than the same number of solitary mussels. Contrary to our current understanding of landscape ecology, fragmentation of mussel beds may not be detrimental to intertidal habitats but may actually lead to the provision of habitat for over 50 % more species.

Oral C 7

Defining coastal zones: Implications for coastal sustainability

D. Colenbrander¹, L. Celliers¹, C. Oelofse²

¹ *Oceanographic Research Institute, Durban, South Africa*

² *University of KwaZulu-Natal, Durban, South Africa*

South Africa is shortly about to promulgate its first legal tool that is designated towards the integrated management of the coastal zone. This currently exists in the form of the Integrated Coastal Zone Management Bill. Considering the intent of the Bill to promote sustainable coastal development and considering its legal context, it becomes necessary to determine what exactly is meant by the term 'coastal zone'. This research has applied concepts of space as well as the theory of systems and scale to determine, through stakeholder engagement and the analysis of their perceptions, what constitutes the coastal 'space'. The importance of this is substantiated from the premise that the manner in which people perceive the coastal zone, has direct implications for the manner in which the coastal zone is managed. Similarly, the definition of a system is dependant upon the scale at which we perceive such a system. The question therefore arises: what are the implications of a definition that is founded from a reduced scale? The significance of this is realised when one considers that definitions form the basis from which any legislative bodies are enacted. The Bill is no exception. The vast array of perceptions surrounding the coastal zone, the varying degrees in spatial location of coastal boundaries and the associated rights and responsibilities that are influenced by the location and nature of these boundaries, has, in the past, lead to serious socio-economic and environmental implications. This research indicates that the phrase 'coastal zone' and the growing hype surrounding such a term is beginning to naturalise, what is essentially a geographic construct. This research indicates that the coastal zone is made up of a multiplicity of relative coastal 'spaces', where the footprint and subsequent influence of these spaces cannot be contained and managed in terms of absolute parameters.

Oral B 7

Assessment of estuarine-dependency and multiple-habitat use patterns in dusky kob *Argyrosomus japonicus*, using a multi-faceted approach

Paul D. Cowley¹, Tor F. Næsje², Audrey Darnaude³, Amber-Robyn Childs¹, Sven E. Kerwath⁴, Eva B.

Thorstad²

¹ South African Institute for Aquatic Biodiversity, Grahamstown, South Africa

² Norwegian Institute for Nature Research, Trondheim, Norway

³ University of Montpellier, Montpellier, France

⁴ Marine and Coastal Management, Cape Town., South Africa

High levels of juvenile exploitation in estuaries has contributed to the collapse of the South African dusky kob stock, highlighting the need to better understand spatial and temporal aspects of estuarine-dependency and multiple-habitat use patterns. The use of technologically advanced methods, such as acoustic telemetry and otolith micro-chemical constituent analysis allows for the collection of empirical data to better understand estuarine-dependency in fishes. The deployment of acoustic receivers (listening stations) throughout an estuarine system can provide fine scale movement and habitat use data of fish tagged with uniquely coded transmitters for a period of more than one year. The lifetime use of salinity reduced environments (estuaries), on the other hand, can be assessed by calculating the ratio of calcium and strontium concentrations at discrete sites taken across the face of sectioned otoliths using laser ablation inductively-coupled plasma-mass spectrometry (LA ICPMS). Furthermore, the multiple element chemical composition of otoliths from estuarine associated fishes can be used to identify estuary-specific signatures and ultimately ascertain whether individuals make use of single or multiple estuaries during their life. Here we present available results from an acoustic telemetry study conducted on dusky kob in the Great Fish Estuary and outline the future prospects of adopting a multi-faceted approach to studying the movements, multiple-habitat use and estuarine-dependency of dusky kob in Algoa Bay and its associated estuaries. Besides having pertinent management implications, the findings of this research will enhance our understanding of the ecology of this species.

Oral C 1

Identification of differentially expressed genes in the commercially important agarophyte, *Gracilaria gracilis*, following nitrogen deprivation

Vernon Coyne¹, Tanya Lebi²

¹ University of Cape Town, Cape Town, South Africa

² University College London, London, UK

The red seaweed, *Gracilaria gracilis*, occurs naturally in Saldanha Bay, South Africa. *Gracilaria* species are commercially exploited as a source of agar, valued at US\$ 132 million per annum (FAO, 2002). *G. gracilis* could be an important resource for South Africa in terms of generating foreign currency through export. However, nitrogen limitation caused by stratification of the water column in Saldanha Bay during the summer to autumn months is a major limiting factor with regard to *G. gracilis* aquaculture since this phenomenon severely affects the growth rate and yield of raft-cultivated seaweed. In the current investigation, microarray technology was utilized to identify *G. gracilis* genes expressed in response to nitrogen limitation. A total of 34 differentially expressed genes were sequenced, of which 13 were assigned a putative identification. The remaining sequences corresponded to unknown hypothetical proteins. The current investigation has provided a foundation for future research into the biological role(s) of the identified differentially expressed genes *in situ*. Future studies may lead to the production of transgenic *G. gracilis* strains that have an improved tolerance to nitrogen limitation and environmental stress, thus enabling commercial production of this valuable agarophyte in South Africa.

Poster Tue 15

Do long-term nutrient fluctuations in the southern Benguela reflect changes in upwelling intensity?

Jock C Currie¹, Mike I Lucas¹, Larry Hutchings², Howard N Waldron¹

¹ University of Cape Town, Cape Town, South Africa

² Marine and Coastal Management, Cape Town, South Africa

One predicted result of climate change on upwelling systems is that increasing pressure gradients between land and sea will result in greater equatorward wind stress and therefore increased upwelling intensity. Notable ecosystem changes have been documented in eastern boundary upwelling regions in recent decades, including the southern Benguela, where striking changes in zooplankton, pelagic, demersal, line, squid and rock lobster fisheries and seabird abundances have been shown. Nutrient availability has undeniable bottom-up influences on trophic structure and food-web pathways by mediating phytoplankton competition and succession. In this first long-term study of nutrient variability in the Benguela system, we compiled and interrogated historical nutrient, oxygen and hydrographic data from a defined geographic area incorporating St Helena Bay. General linear models (GLMs)

were applied to archived nutrient data to establish long-term concentration trends where seasonal effects are excluded. Surface concentrations were also excluded as these are modified by phytoplankton productivity. Nitrate and phosphate concentrations both increased between 1983 and 2004 by ~40% and ~50% respectively, while silicate showed no trend over this period. Oxygen concentrations declined by ~30% between 1960 and 2004. The prominent increases in nitrate and phosphate, together with decreasing oxygen concentrations, suggest a parallel increase in primary (new) productivity, leading to elevated POC/N flux and later decomposition processes that utilize oxygen below the pycnocline. Both processes have important future implications for biogeochemical cycles, ecosystems and commercial fisheries that we discuss here. Furthermore, due to the retention of upwelled water and biogenic material in St Helena Bay, the region could provide early indicators of change.

Oral C 7

Use of stable isotope signatures in the macroalga *Ecklonia maxima* and the filter-feeder *Mytilus galloprovincialis* to determine the extent of sewage dispersal from the Green Point Outfall, South Africa

Mark D. Cyrus¹, John J. Bolton¹, Robert J. Anderson², Edmund C. February¹

¹ *University of Cape Town, Cape Town, South Africa*

² *Marine & Coastal Management, Cape Town, South Africa*

Over the last decade natural abundances of stable isotopes ¹³C and ¹⁵N have been used to investigate the transport pathways of nutrients within aquatic ecosystems, and have contributed new understanding to many aspects of ecology, including tracking the spatial extents of nutrient discharges. In order to assess the uptake of nutrients from the Green Point sewage outfall in Cape Town South Africa, we selected a primary producer, the kelp *Ecklonia maxima* (for dissolved nutrients) and a filter-feeding organism, the blue mussel *Mytilus galloprovincialis* (for organic particulates). We hypothesized that biota close to the outfall would have isotopic values (signatures) which were closer to the values recorded for sewage and that this signature would become weaker (more positive) with increasing distance from the outfall as the sewage would be diluted and dispersed. Results indicated that the stable isotope abundances of biota near the outfall were significantly affected by sewage. *Ecklonia maxima* closest to the outfall had a d¹⁵N of 1.2±2.3 ‰, which was

extremely depleted relative to our control (8.3±1.1‰), collected at Mauritzbaai (>100km from the study site). The d¹⁵N recorded for raw sewage (0.4±0.4‰) was very similar to that of *Ecklonia maxima* situated closest to the outfall. *Mytilus galloprovincialis* were also affected by sewage organic matter although the effects on the stable isotope abundances were less pronounced as mussels relied on more than one source of food. The isotopic values recorded in this study demonstrated that sites in close proximity to the outfall and even those just within the study area (> 5km from the outfall, Camps Bay) were contaminated by sewage effluent. From this study we conclude that the d¹⁵N signatures of *Ecklonia maxima* and *Mytilus galloprovincialis* in marine environments can provide a useful means of tracing sewage dispersal in well-mixed ocean conditions, where conventional methods may fail to reveal the extent of dispersal.

Oral C 9

Lake St Lucia at the Cross Roads: The impact of reduced rainfall on the fish fauna

Digby Cyrus, Leon Vivier

University of Zululand, KwaDlangezwa, South Africa

The mouth of the St Lucia Estuarine System closed in June 2002 as a result of a major drought event in the catchment. Reduced river flow coupled with high annual summer evaporation rates resulted in the system reducing in size to <25% of its 325km². The lake partitioning into five compartments with the fish fauna trapped there at the time of separation. Apart from two short duration overtopping events from the Mfolozi River, due to flooding, no recruitment into St Lucia was possible until the 4th of March 2007 when high seas resulting from Cyclone Gamede passing offshore caused the mouth to breach. Due to the extremely low lake level sea water poured into the St Lucia system for almost five months before sand bar buildup closed the mouth on 24th August 2007 with the system approximately 65% full. Field data indicates that a major recruitment event took place during the mouth open period and that the lake currently holds juvenile stock of most species that traditionally use the system as a nursery ground. Currently the mouth is closed and the lake has a more than 700mm rainfall deficit based on average monthly precipitation over the past six years. Data from the adjacent coastal Marine Protected Area indicate that, as a direct result of the lack of adult recruitment from St Lucia to the spawning stock, only an aging population is present. This paper reviews the status of the fish fauna since 2002 and considers the future of

the St Lucia ecosystem in the face of the continuing drought and the fact that the role of the Mfolozi system in sustaining this St Lucia World Heritage Site has been dramatically altered for more than 50 years.

Oral A 1

The status and prognosis of the Smoothhound Shark (*Mustelus mustelus*) fishery in the Southeastern and Southwestern Cape coasts, South Africa

C. Da Silva

Marine and Coastal Management, Cape Town, South Africa

Global abundance trends in commercially valuable teleost fisheries have decreased to a point where limited potential is available for increased harvests. Consequently there has been an increased focus towards harvesting chondrichthyans. The decline in linefish species in South Africa has led to increased exploitation of demersal sharks, including the smoothhound shark *Mustelus mustelus*. The smoothhound shark resource off the south-eastern and south-western Cape coast was assessed by three dynamic pool models; yield per recruit, spawner biomass per recruit and an extended yield and spawner biomass per recruit. $F_{0.1}$, F_{SB40} and F_{MAX} are estimated as 0.034 yr^{-1} , 0.045 yr^{-1} and 0.031 yr^{-1} respectively. Current fishing mortality was higher than all Biological Reference Points investigated. The extended per-recruit model tested the outcome of different management scenarios. The management intervention, *Size and effort control* showed the least probability of pristine biomass falling below 20% of current levels in 20 years (where selectivity was set at 3 years). A comparison of the models showed that current catches need to be halved and selection needs to be set at 3 years of age. The results of this study indicate an urgent need for management intervention for the *M. mustelus* resource in South Africa. A management plan is presented that outlines concepts that would improve the quality of data collected and increase monitoring of fishing activities.

Poster Wed 5

Spatial dynamics of mesozooplankton in Algoa Bay, South Africa.

Luzuko Dali¹, Kim S. Bernard¹, P. William Froneman², Angus W. Paterson¹

¹ *South African Environmental Observation Network, Grahamstown,, South Africa*

² *Rhodes University, Grahamstown, South Africa*

Algoa Bay is a long spiral-shaped embayment located on the southern Cape coast facing the southwest Indian Ocean. The western sector of the bay is influenced by two operational harbours, industrial development and the presence of estuaries. In contrast, the eastern sector is influenced by the oceanography to the north-east of the bay and the presence of the Bird Island group. This paper presents the preliminary results of a long term monitoring survey that was recently initiated in Algoa Bay by SAEON-Elwandle Node. Sampling sites were randomly selected on the western and eastern sector of the bay without any bias to locations of islands or estuaries within the bay. Mesozooplankton samples were collected using a WP-2 net with a 90µm mesh, at selected depths, and separated into different size fractions, <500 µm, 500-1000 µm and >1000 µm by reverse filtration. The 90µm mesh was selected to account for the smaller copepods (e.g. *Oncaea* spp. and *Oithona* spp.) that are mostly lost when using the 200µm mesh. In addition, physical variables (temperature, salinity, dissolved oxygen and turbidity) were measured at selected depths using a YSI data logger, while nutrients, size fractionated chlorophyll-*a* and particulate organic matter (POM) were measured from seawater collected at selected depths using a Niskin bottle. Phytoplankton biomass was greatest in the eastern sector of the bay, which could possibly be attributed to the presence of a tongue of colder, oxygen-poor sub-surface water that was observed in that region of the bay. Mesozooplankton samples were dominated by small copepods throughout the investigation, primarily *Oithona similis*, which comprised up to 65% of the total mesozooplankton counts.

Oral B 5

Trophodynamics of selected mesozooplankton in the region of the Subtropical Convergence in the Indian sector of the Southern Ocean.

R. Daly, P.W. Froneman

Rhodes University, Grahamstown, South Africa

The trophodynamics of selected mesozooplankton in the region of the Subtropical Convergence in the Indian sector of the Southern Ocean was investigated in austral autumn (April/May) 2007. Total integrated chlorophyll-*a* biomass within the region of investigation ranged from 11.9 to 40.1 mg chl-*a* m⁻² and was always dominated by the small picophytoplankton (< 2µm). The total mesozooplankton and biomass during the study ranged from 13 to 1028 and from 0.8 to 23.1 mg dwt m⁻², respectively. There were no significant

spatial patterns in total integrated chl-a biomass and the mesozooplankton abundance and biomass during the study ($P > 0.05$ in all cases). Throughout the study area, the total mesozooplankton abundance was numerically dominated by copepods (mainly *Clausocalanus breviceps*, *Pleuromamma abdominalis*), the pteropod, *Limacina retroversa*, and euphausiid furcilia. Grazing activity of the seven most abundant mesozooplankton species constituting up to 65% of total mesozooplankton abundance was investigated using the gut fluorescent technique. Results of the grazing studies indicated that all seven species of mesozooplankton exhibited diel variations in gut pigment contents with maximum values recorded during the nighttime. Ingestion rates of the mesozooplankton ranged from 147 to 5495 ng [pig] ind d⁻¹. The combined grazing impact of the seven most abundant mesozooplankton species ranged between 1.6 and 190% of the integrated production with the highest values recorded at those stations where the salp, *Salpa thompsoni*, and the pteropod, *L. retroversa*, numerically dominated the total mesozooplankton abundance.

Oral B 12

***Siphonaria compressa*: a genetic investigation into South Africa's most endangered marine invertebrate.**

Paula M. de Coito¹, George M. Branch¹, Rauri C. K. Bowie²

¹University of Cape Town, Cape Town, South Africa

²University of California, Berkeley, USA

Siphonaria compressa is South Africa's rarest and most endangered marine invertebrate and for long was known only from the population in Langebaan Lagoon on the west coast. In 2005, a second population of this endemic pulmonate limpet was discovered in Knysna Estuary by Professor Brian Allanson. Analyses were performed on mitochondrial cytochrome oxidase 1 and 16s sequences to explore the genetic structure of these two extant populations. The results indicate 6 mutational steps (for CO1) and one mutational step (for 16s) between the two populations. This opens the possibility that the two populations may be separate species; but verification of this awaits ongoing examination of nuclear data. The differences detected in the mitochondrial genes can be explained by the present-day distribution pattern which would almost certainly prevent gene flow. Over the last 36 years *S. compressa* has twice been threatened with extinction in Langebaan due to eelgrass fluctuations and the population in Knysna has suffered a similar depletion as a result of severe

flooding in 2006 and 2007. Probing the genetic composition of the populations will reveal whether they have been subject to bottle-necks, and if this adds to their vulnerability to extinction.

Oral B 6

Lessons learnt: Two decades of human disturbance research in the Antarctic and sub-Antarctic

M.S. de Villiers

University of Cape Town, Cape Town, South Africa

Major categories of negative effects of human disturbance on wildlife include injury or death, disrupted activities or increased stress levels, and habitat loss or modification. Disturbance research has received increasing attention in the Antarctic and sub-Antarctic, where human presence has grown alarmingly over the last six decades. A comparison of published disturbance studies over two decades (1988-1997, n=17 and 1998-2007/08, n=37) revealed that the focus was initially almost exclusively on penguins, especially Adélie Penguins, but in the second decade included seals and more seabird species. In the latter period, over half of studies investigated the impacts of pedestrian approaches and relatively few considered aircraft impacts, but for the first time vehicles and boats were considered. There was a marked decrease in the percentage of long term studies in the second decade. The commonest approach in both decades was spatial comparisons at sites with different levels or types of disturbance. For response variables, most studies used behavioural correlates of fitness but in the last decade these were usually used together with physiological correlates, e.g. heart rate or corticosterone concentration. Population trends and breeding success were measured more often in the first decade. Conclusions regarding the impact of disturbance ranged from "none" to "devastating." Various mitigation measures for the spatial and temporal regulation of visitors at wildlife breeding sites have been suggested but only minimum approach distances have been thoroughly explored. Independent variables that require attention are visitor behaviour, distribution and group size, frequency of visits, and noise associated with human activities. Studies could usefully focus on visitor compliance with guidelines and visitors' assessments of their wildlife experiences. Attention could also be given to disturbance impacts during stressful life stages such as moult. Recent disturbance studies outside the region suggest several new directions for consideration.

Poster Wed 16

***Etmopterus sculptus* sp. nov.; a new species of lantern shark (Squaliformes: Etmopteridae: *Etmopterus*) from South Africa**

M.J. De Vries¹, L.J.V. Compagno², M.J. Gibbons¹

¹ *University of the Western Cape, Bellville, South Africa*

² *South African Museum, Cape Town, South Africa*

A new species of squalid shark of the genus *Etmopterus*, *Etmopterus sculptus* sp.nov., is described from the Western Indian Ocean at depths greater than 400 m around the coast of South Africa. The new species bears a strong resemblance to other members of the “*Etmopterus lucifer*” group through the presence of linearly arranged dermal denticles along the head, trunk, back, as well as the caudal and second dorsal fin. The new species can be distinguished from other member of the *E. lucifer* species complex through the following combination of characters: the length and arrangement of flank and caudal markings, tooth morphology, and the shape, size, and arrangement of dermal denticles along the body. An important distinguishing character of *E. sculptus* is the presence of a photophore pattern on the dorsal surface of the head, which proves to be the first documentation of the occurrence of an elaborate photomark on the dorsal surface of the head within the group. In addition the species shows slight sexual dimorphism in the upper teeth, a condition currently known for only one other member of the “*E. lucifer*” group, *Etmopterus splendidus*.

Oral C 13

Durban Bay fish kill – system and management responses

N.T. Demetriades¹, A.T. Forbes², C.G.M Archibald², A. Mather³

¹ *Marine & Estuarine Research, Hyper by the Sea, South Africa*

² *KZN Aquatic Ecosystems, Durban, South Africa*

³ *Coastal and Catchment Policy, eThekweni Municipality, South Africa*

The increasing occurrence of fish kills is an obvious indicator of declining water quality in Kwazulu Natal's estuaries. Major kills attributed primarily to eutrophication and algal blooms have sparked interest in fish kill phenomena in general. However, these events seem to have become an accepted part of the functioning of these systems and the usual management response is to open the estuary mouth and flush the sys-

tem. While this removes the immediate pressure there has been no systematic investigations of these events. This has resulted in a gap in the understanding of the drivers of these events and estuarine system responses

The magnitude of the most recent fish kill in one of KZN's largest estuarine systems has forced the most intensive investigation yet of the drivers of these events and the subsequent spatial and temporal system responses. The discharge of sewage to a poorly circulated and ecologically compromised area of Durban Bay resulted in severe hypoxia and culminated in a large fish kill (> 15 tons) in December 2007. This paper will present the results of the monitoring programme initiated prior to and after the fish kill which focussed on key parameters to inform understanding of the ecological status as well as human health implications. Physico-chemical conditions were monitored at several points along the estuary immediately prior to the event and at intervals over the following three months. These were coupled with measurements of nutrients (N & P) and pathogens in the water column and sediments. Algal blooms were recorded during the sampling period and the dominant species identified to provide some understanding of the successional stages of microalgae following a large organic input. This event has triggered a positive response from the eThekweni Municipality in the form of a proposal to develop an Estuarine Management Plan for Durban Bay.

Oral B 11

Distribution, Abundance and Production Rates of *Acartia natalensis* (Calanoida: Copepoda) Eggs in Soft Sediments: Implications to Ecological Interpretations

Shaun H. P. Deyzel^{1,2}, Tris H. Wooldridge¹

¹ *Nelson Mandela Metropolitan University, Port Elizabeth, South Africa*

² *South African Environmental Observation Network, Grahamstown, South Africa*

Acartia natalensis is the most abundant calanoid copepod in the zooplankton in the Mngazana River Estuary. The estuary is located in the biogeographical transition zone between the warm-temperate and subtropical biogeographical provinces. This study focused on aspects of the reproductive strategies of the species, in particular its ability to produce dormant eggs which settles in sediments. In addition attempts were made to monitor egg production rates over a 24 hour period through *in situ* incubation chamber experiments. Three sediment cores were collected with a microphytobenthos sedi-

ment core sampler (diameter = 25 mm) at ten stations from the mouth to the upper reaches of the estuary to quantify egg densities. Sediments were also collected for particle size analysis and organic content at each station using a Van Veen Grab (211 cm² sampling area) to investigate relationships with sediment type. In the laboratory, eggs were extracted with the Sugar Flotation Method and counted. Eggs were mostly concentrated from the middle to upper reaches (> 24 000 m⁻²). Although no significant relationship between egg and adult densities could be found, overall egg distribution patterns were consistent with that of the adult females. Incubation chamber experiments indicated that eggs were produced both day and night. Spatial and temporal differences in production rates as well as relationships with environmental variables were investigated. These findings provided valuable information on the ecology of *Acartia natalensis*, through which some implications to interpretations could be highlighted.

Oral B 11

Economic valuation of tiger shark diving within the Aliwal Shoal Marine Protected Area

M. L. Dicken¹, S. G. Hosking²

¹ *Straits Research. Office, Port Elizabeth. South Africa*

² *Nelson Mandela Metropolitan University. Port Elizabeth, South Africa*

Understanding recreational aspects of the tiger shark diving industry, including data on participant expectations, experiences and expenditure is crucial for the effective management of the Aliwal Shoal Marine Protected Area. Between January and December 2007 a total of 2133 tiger shark dives were conducted by 1065 divers (95% C.I. = 946 – 1198). An onsite questionnaire survey of 197 divers indicated that the direct value of tiger shark diving to the Aliwal Shoal MPA region was R12, 404, 564 (95% C.I. = 10, 800, 240 – 14, 272, 037). On a ranking from 1 to 5, with 5 as the highest, the average participant response to overall quality of dive and quality of dive operator was 4.6 and 4.7, respectively. The majority of divers (98.0%) observed a tiger shark, with an average number of 4 per dive. Although tiger sharks approached to an average distance of 1.6 m from divers, the majority (95.9%) felt safe and would recommend the dive to their friends (99.5%). The majority of interviewees (88.5%) supported the use of chumming for a closer tiger shark experience.

Poster Tue 29

A month in the Southern Ocean – Studying the

Conrad Rise

L Dlamini, J. Durgadoo, Z. Gebhardt, S. Rainier, M. Smith, J.R.E. Lutjeharms, I.J. Ansonge
University of Cape Town, Cape Town, South Africa

As implied by its name, the Antarctic Circumpolar Current (ACC) freely carries water around the whole continent of Antarctica, but not without obstructions. Some, such as the Drake Passage, constrict its path, while others, such as mid-ocean ridges, may induce meandering in the current cores and the genesis of mesoscale turbulence. It has recently been demonstrated that even regions that are only relatively shallow, such as the Crozet Plateau, have a major effect on the flow patterns of the ACC. This is here shown also to be true for the Conrad Rise. Using the trajectories of surface drifters, of subsurface floats, altimetry and the simulated velocities from a numerical model, we show that the ACC bifurcates at the western side of this Rise and reconstitutes itself on its eastern side. In this process it forms two intense jets at the two meridional extremities of the Rise with a relatively stagnant water body over the Rise itself. This current configuration may have important implications for the ecology of the region. In this poster we will present results and experiences from UCT Oceanography honours students who spent April 2008 in the wilds of the Southern Ocean studying the circulation at this Rise.

Oral C 4

Towards *Porphyra* aquaculture: Propagule release and growth of the conchocelis phase of three South African species in culture

Theminkosi S. Dlaza¹, John J. Bolton¹, Robert J. Anderson²

¹ *University of Cape Town, Cape Town, South Africa*

² *Marine & Coastal Management, Cape Town, South Africa*

Porphyra is the most economically valuable seaweed in the world, especially in the Far East where it is used mainly for the production of nori. The high nutritional content of *Porphyra* makes this genus not only a valuable edible seaweed for humans, but also a possible feed source for farmed abalone. Although previous feed trials showed that *Porphyra* was a valuable supplement diet for farmed South African abalone, *Haliotis midae*, *Porphyra* biomass along the SA coastline is insufficient to support the growing abalone farming industry. Cultivation of the filamentous conchocelis phase of *Porphyra* is necessary for large-scale

cultivation of this genus. This study, therefore, aimed at cultivating three local *Porphyra* species (*P. aeodis*, *P. capensis* and *P. saldanhae*) under different conditions. To test for propagule release, experiments were conducted under different salinities (0, 10, 20, 30 and 40‰), irradiances (0, 40, 80, 120 and 160 $\mu\text{mol m}^{-2} \text{s}^{-1}$) and temperatures (5, 10, 15 and 20°C). The conchoceleis of the three species were also grown in four temperatures under two photoperiods: long days (16h light : 8h dark cycle) and short days (8h light : 16h dark cycle). Propagule release was greatest in *P. capensis* ($P < 0.05$) under all conditions. Although propagule release occurred at all salinities tested, the spores died at salinities below 20‰ for all species. The growth of the conchoceleis of both *P. aeodis* (21.1% day^{-1}) and *P. saldanhae* (20.7% day^{-1}) was best at 15°C long days, while *P. capensis* grew best (22.4% day^{-1}) at 20°C long days. Growth of conchoceleis under long days was significantly higher ($P < 0.05$) than that recorded in short days for all three species. Effects of culture conditions on propagule release and growth of conchoceleis are therefore species-specific.

Poster Mon 8

Nitrogen excretion of marine fish held under experimental conditions

Carmen Dobberstein, Mark Goodman, Trevor C. Probyn
Marine and Coastal Management, Cape Town, South Africa

The aim of this study was to collect nitrogenous excretion data that would be of value for culture management and environmental impact assessment, as well as providing preliminary information on the bioenergetics of dusky kob (*Argyrosomus japonicus*). The fish (average weight = 11.5g) were kept in a closed respirometer, and given two ration sizes (1 & 2% body weight) to quantify the effect of meal size on faecal and non-faecal losses of nitrogen (N). N excretion rates were highly variable over the experimental period for all experiments. Therefore, excretion rates for both ammonium (NH_4^+) and urea were calculated only for the postprandial period. The predominant excretion product, NH_4^+ accounted for 70-85% of non-faecal loss of N, while 15-30% was excreted as urea. Hourly excretion rates of NH_4^+ peaked at 4 h after feeding whereas the peak for urea varied with ration size. While NH_4^+ excretion rates increased with ration size, no differences were observed for urea excretion rates. The larger ration size generally showed higher total N excretion rates than the smaller ration size.

Oral A 6

Towards greater accuracy in the estimation of time-based nominal effort for a boat-based linefishery

Bruce Donovan, Thomas Hecht, Olaf Weyl
Rhodes University, Grahamstown, South Africa

Fishing effort is one of the key parameters used in assessing fisheries and developing management protocols, including linefisheries. Together with catch data it can be used as an index of fish abundance (CPUE) and this forms the basis of many stock assessment methods. Total fishing effort has two major components, nominal fishing effort (basic units of effort such as time or number of hooks) and a catchability coefficient (the effectiveness of the gear). The product of nominal effort and the catchability coefficient is known as effective fishing effort (standardized according to gear). Traditionally, much work has been focused on developing greater accuracy in the estimation of effective fishing effort. The aim of this study was to examine a method to increase the accuracy of a time-based nominal effort component of a recreational and commercial boat-based linefishery. Data were collected by monitoring the access point (Kowie river mouth) of the Port Alfred linefishery using a CCTV system. Different 'pseudo' sampling regimes were generated and replicated from the 100% nominal effort data captured by CCTV and then a correction factor was introduced that can be applied to the roving-creel sampling regime of any number of days a month. There were significant differences between the absolute errors of the estimated effort for each of the different sampling regimes. A correction factor for the roving creel survey data was generated from the slope of a natural logarithmic curve that is fitted to the plot of the average absolute error over a six month period. It takes the form: $\text{Sampling error} = \pm 3.5095 \times \ln(\text{Number of days sampled})$. Comprehensive sampling of a fishery is not always possible and is often limited by budgets and manpower (particularly small-scale commercial and recreational fisheries). This paper takes a step towards reducing the man-power and money needed to get reliable effort data from roving-creel surveys for such fisheries.

Oral A 12

Reproductive Strategy of Cape horse mackerel *Trachurus Trachurus Capensis* inferred from ichthyoplankton data collected in the southern Benguela upwelling system, 2000 – 2005

Mbulelo T. Dopolo, Carl D. van der Lingen
Marine and Coastal Management, Cape Town, South Africa

Africa

The reproductive strategy of Cape horse mackerel (*Trachurus trachurus capensis*) in the Southern Benguela is not well documented, and the time and location of spawning by this species has primarily been derived from analysis of gonadosomatic data. These analyses have indicated that Cape horse mackerel show two spawning peaks, the timing of which differs for fish on the southwest and southeast coasts, and have also suggested the possibility of a south-westerly spawning migration by fish on the south coast during summer. We assessed the reproductive strategy of Cape horse mackerel by analyzing ichthyoplankton samples collected with a continuous, underway fish egg sampler (CUFES) during surveys along the South African coastline conducted in both summer (November) and winter (May) over the period 2000-2005. In addition, we also analyzed vertical samples collected off the southeast coast using a multinet from a maximum depth of 100 m to the surface. Continuous underway fish egg samples (CUFES) and multinet samples were collected while the vessel was underway at 5.6-9.3 km intervals and when the vessel was on-station in areas of moderate to high egg abundances. Preliminary results indicate that major spawning occurs in the shelf area off southeast, predominantly in the upper 70 m of the water column in the southern Benguela upwelling ecosystem.

Oral B 13

Phylogeography of elf, *Pomatomus saltatrix* (Linnaeus 1756), along the southern African coast

S.M.R. Dos Santos¹, A.W. Klopper¹, W. Potts², P. Bloomer¹

¹ University of Pretoria, Pretoria, South Africa

² South African Institute for Aquatic Biodiversity, Grahamstown, South Africa

Pomatomus saltatrix, commonly known as elf in South Africa, is a cosmopolitan but discontinuously distributed coastal marine fish species. It is found mostly in temperate and warm-temperate waters, in all oceans except the eastern Pacific. Along the southern African coast it is found from southern Mozambique to southern Namibia, where there is a break in distribution with only occasional recording from Lüderitz and Walvis Bay. The species is once again abundant off a section of the Angolan coast, from the Cunene river mouth to the Benguela Province. *Pomatomus saltatrix* is a popular linefish in South Africa, but is currently overexploited. Although short-term conservation measures

have been implemented to protect the species, based on biological and life history information, it is necessary to formulate an effective management strategy to contribute to its long-term survival and sustainable utilization. One of the aspects that can contribute to such a strategy is the investigation of genetic variation and gene flow in the species. To understand the processes that underlie the current distribution of the species, we used nuclear and mitochondrial DNA markers to analyse the extent of population substructuring within *P. saltatrix* along the southern African coast. Analyses of mtDNA variation show historical isolation between Angola and South Africa. Within their South African distribution, indications of reduced gene flow between the west and east coast is further investigated through the use of newly developed species-specific polymorphic microsatellite markers. We consider the implications of these results for the future sustainable utilization of the species.

Oral C 11

Determining the influence of upwelling on chokka squid spawning behaviour

Nicola J. Downey, Michael J. Roberts

Bayworld Centre for Research and Education, Cape Town, South Africa

Several studies suggest that the environment influences chokka squid catches, which in turn, are mostly based on the successful formation of inshore spawning aggregations. None of the evidence, however, is direct observation. Acoustic telemetry offers such a means to determine the behavioural response of spawners to changes in the environment. During the squid fishery closed seasons of November 2003 to November 2006, an array of VR2 receivers were moored in Kromme Bay (St Francis Bay) on and around active squid spawning aggregations. Squid were caught on jigs and tagged with V9 acoustic pressure telemetry tags. A total of 45 animals were tagged. The squid showed a mixed diurnal presence/absence pattern in the spawning area with some animals having moved off the egg beds during the day and others staying throughout the nights. This is in contradiction with the findings of the 1994 telemetry experiment which showed males moving off the egg bed during early evening and females eventually following near mid night. Overall the data indicate dynamic migrational behaviour in spawning aggregations. Pressure sensor data showed that both males and females stayed persistently near the seabed during the day, but at night this pattern was broken with common activity higher up in the water column,

on occasion almost reaching the surface. It is important to note that they did not remain exclusively in the water column and regularly made excursions to the seabed. CTD and thermistor data indicated the appearance of a cold bottom layer (due to upwelling) at the spawning site on a number of occasions. It is interesting that spawning behaviour does not seem to be affected by these upwelling events.

Oral B 9

The influence of the annual sardine run on catches of large sharks in the protective gill nets off KwaZulu-Natal, South Africa, and the occurrence of *Sardinops sagax* in shark diet

Sheldon F.J. Dudley, Jeremy Cliff
Natal Sharks Board, Umhlanga, & University of KwaZulu-Natal, Durban, South Africa

Shark catches in the protective nets set off the beaches of KwaZulu-Natal (KZN), South Africa, are strongly affected by the sardine run, the winter influx of shoals of *Sardinops sagax* from the southwest. The effect of the sardine run is greatest in the months of June and July and at beaches to the south of Durban, and is highly variable from year to year. Total annual shark catch and effort are presented for the period 1952-2005, as well as total monthly shark catch on the south coast for the months May-August, 1965-2005. Measures to reduce catches of sharks associated with the run have been introduced and have been increasingly successful. Reliable species-specific catch data are available 1978-2005 only. For this period, the spatiotemporal distribution of each of 14 species of shark and the frequency of occurrence of *S. sagax* in their diets is documented. Occurrence varies according to species, as does the apparent influence of the sardine run on shark distribution. During June and July and on the KZN south coast *S. sagax* was found in the diet of all but two species and frequency of occurrence was 40% or greater in eight species. The presence of *Carcharhinus brachyurus* in KZN waters appears to be strongly associated with the sardine run, as does that of certain life history stages of *C. obscurus*. *C. brevipinna* and *Sphyrna lewini* are caught in greater numbers in summer than in winter but appear to shift their spatial distribution seasonally to feed on *S. sagax*.

Oral B 5

Obstructions to the Antarctic Circumpolar Current: Case study of the circulation at the Conrad Rise

J.V. Durgadoo¹, J.R.E. Lutjeharms¹, I.J. Ansorge¹, A. Biastoch²

¹ *University of Cape Town, Cape Town, South Africa*

² *IFM-GEOMAR, Kiel, Germany*

It has been widely documented that bathymetric features in the Southern Ocean have a strong influence on the behaviour of the eastward flowing Antarctic Circumpolar Current (ACC). The increasing number of surface drifters and sub-surface floats roaming the African sector of the Southern Ocean has enabled us to recently observe an obstruction to the ACC here that has not previously been so identified. The ACC bifurcates at the Conrad Rise (53°S, 43°E). Altimetric data show two narrow jets flowing between the 3000 m - 4000 m isobath, having geostrophic velocities exceeding 20 cm s⁻¹. In contrast, current speeds over the Rise itself reach at most 5 cm s⁻¹. Model experiments provide further information and their simulations largely corroborate the satellite observations. The presence of a Taylor column over the Rise has been suggested. A first ever cruise to confirm these results hydrographically was carried out in the region in April 2008. Preliminary results are presented.

Oral A 11

The effects of long-term exclusion of *Cymbula oculus* (Born) on the distribution of intertidal organisms on the rocky shore at Kalk Bay

R.C. Eager, G.W. Maneveldt, A. Bassier
University of the Western Cape, Bellville, South Africa

Zonation patterns on rocky shores are typically as a result of both physical factors and biological interactions. Physical factors generally set the upper limits of species distributions, while biological interactions generally set their lower limits. Recent research has shown, however, that biological factors often can also determine the upward recruitment of species. While such evidence exists in the international literature, very little experimental evidence exists for South Africa. This study provided experimental evidence for the biological effects of long-term exclusion of the South African herbivore *Cymbula oculus* (Born), on the community structure of the Kalk Bay rocky intertidal. To demonstrate this, an herbivore exclusion experiment was set up in May 2003. Initially, all herbivores were removed from the exclusion plots; once recruitment occurred, only *C. oculus* individuals recruiting into the plots were continually removed. Algal recruitment (cover abundance) was determined monthly for the first 12 months and then annually thereafter, while inverte-

brate recruitment (density) was only monitored annually. The results show that the natural density of *C. oculus* has been increasing over the past four years. Secondly, grazing by *C. oculus* is the primary biological factor preventing the recruitment and colonization of algae and other invertebrates onto the Kalk Bay intertidal. Not only does herbivory by *C. oculus* prevent recruitment and colonization, but it also decreases algal diversity and prevents their succession. Herbivory by *C. oculus* is thus more important than physical factors associated with desiccation stress on the rocky intertidal at Kalk Bay.

Oral C 2

Identification of differentially expressed genes in the commercially important agarophyte, *Gracilaria gracilis*, following exposure to disease response elicitors

Christopher S. Ealand, Vernon E. Coyne
University of Cape Town, Cape Town, South Africa

The red seaweed, *Gracilaria gracilis*, occurs naturally in Saldanha Bay, South Africa. *Gracilaria* species are commercially exploited as a source of agar, with an international value of US\$132 million per annum (FAO, 2002). In recent years, the *G. gracilis* resource at Saldanha Bay has experienced a number of setbacks in the form of complete or partial die-offs of the agarophyte which may be attributed to bacterial infection (Schroeder *et al.*, 2003). In the current investigation, microarray technology was utilized to identify *G. gracilis* genes expressed in response to elicitors of disease. *G. gracilis* thalli were exposed to concentrated beta-agarase and agar in order to generate oligosaccharides in the culture media, and consequently, elicit an oxidative burst and defence response in the seaweed. A microarray experiment was initiated which hybridized mRNA from seaweed that had not been exposed to the polysaccharide elicitors and mRNA from elicitor-treated thalli against cDNA clones obtained from stressed or diseased *G. gracilis*. Forty three of the 50 sequenced cDNA clones, representing differentially expressed genes, could be assigned a putative identification. The remaining seven cDNA fragments failed to exhibit significant homology to any known proteins in the genetic databases. The current investigation has provided a foundation for future research into the biological role(s) of these putative *G. gracilis* defence-response genes. Possible applications of this research include the production of transgenic seaweed with increased resistance to disease and/or stress, thus enabling commercial on-shore aquaculture of this valuable

resource in South Africa.

Oral C 8

The potential of GIS as a maritime operational platform for modelled meteorological data

Russel Egypt¹, Carl Wainman¹, Julian Smit²
¹*The Institute for Maritime Technology, Simon's Town, South Africa*
²*University of Cape Town, Cape Town, South Africa*

The South African Weather Services (SAWS), together with other role players, creates daily real time and predictive weather model output and products for a variety of users. The underlying source datasets are spatial by nature and created for various applications such as air pressure maps or synoptic charts, wind speed, rainfall, cloud coverage etc. Modelled gridded weather data such those generated by the SAWS and other weather modellers, by their very nature are spatial (depicted at a location with an associated value). These spatially modelled weather data products therefore ultimately exist as discrete uniformly spaced information. Various value added products may be further derived from these gridded data sets, such as interpolated contours, coloured pixel values as images and extracted lines and polygons. However, when combining (overlying) this weather information with other relevant spatial data sources, such as maps and photos, at a common geographic location, its value can be increased considerably. Integrated within an underlying spatial engine such as a Geographic Information System (GIS) its planning, management, strategic and tactical benefit becomes apparent, leading to an enormous increase in effective decision making not currently possible in the maritime context. Geospatial Technologies provides an ideal common platform for the management, process, integration, analysis and display of spatial operational maritime information not previously possible. Such meteorological integration applications within a GIS can include military and civilian maritime operations, search and rescue, and disaster management amongst others.

Oral B 2

Temporal and spatial distribution of *Oreochromis mossambicus* in the intermittently open East Kleinemonde Estuary, South Africa

Bruce R. Ellender¹, Olaf L.F Weyl¹, Paul D. Cowley²
¹*Rhodes University, Grahamstown, South Africa*
²*South African Institute for Aquatic Biodiversity, Grahamstown, South Africa*

The aim of this study was to contribute to the understanding of the ecology of *Oreochromis mossambicus* populations in intermittently open estuaries. The littoral zone fish community of the East Kleinemonde Estuary was sampled on a bi-monthly basis from March 2005 to September 2006 using a seine net. On each sampling day six hauls were performed in each of the mouth, lower, middle and upper reaches of the estuary. The findings revealed longitudinal differences in the overall species composition in the East Kleinemonde Estuary (X^2 test of independence: $X^2= 6105$, $df= 75$, $p\leq 0.001$) and there was a significant difference in the CPUE of *O. mossambicus* in the upper reaches and the mouth of the estuary (Kruskall-Wallis ANOVA; $p\leq 0.05$). Seasonal differences in CPUE were also noted (Kruskall-Wallis ANOVA $p\leq 0.05$). Frequency of occurrence (percentage of hauls containing *O. mossambicus*) was higher in summer than winter (X^2 test of homogeneity: $X^2= 66$, $df= 9$, $p\leq 0.001$). Historical multiple-year length frequency data indicated that a small adult population exists relative to the juvenile population. This together with large annual changes in CPUE suggests that large scale winter mortality occurs. Estuary mouth opening events during the breeding season may also impede inter annual recruitment success by either limiting spawning sites for adults or by washing juveniles out to sea.

Oral A 1

Are catsharks as homely as tabby cats?

Jessica Escobar-Porras¹, Warwick Sauer¹, Paul Cowley²

¹ Rhodes University, Grahamstown, South Africa

² South African Institute of Aquatic Biodiversity, Grahamstown, South Africa

Sharks are particularly vulnerable to over-exploitation. Although catsharks are an important component of the near-shore marine biodiversity in South Africa and most of the species are endemic, little is known about their movement patterns, home range and population size. With an increasing number of recreational fishers and illegal targeting by commercial operators, this information is crucial for management purposes. The aims of this study were threefold. Firstly, to identify and analyse existing data sources for four catshark species: pyjama (*Poroderma africanum*), leopard (*P. pantherinum*), puffadder (*Haploblepharus edwardsii*) and brown (*H. fuscus*). This highlighted a number of shortcomings of existing datasets, largely because studies were not aimed solely at catsharks, and had diverse objectives. Secondly, a dedicated study was carried out

over a limited area, and the data was analysed to determine movement patterns and population numbers. Thirdly, the most appropriate methodology was identified for future studies and the results obtained were used to propose a number of conservation measures. In short, results confirm that catsharks appear to share traits of the common tabby cat, homely for much of the time but apt to wonder off on occasion.

Oral A 4

An investigation into the functioning of Sardinia Bay MPA, Port Elizabeth

A Evans¹, R. Nel¹, M. Smale²

¹ Nelson Mandela Metropolitan University, Port Elizabeth, South Africa

² Bayworld Centre for Research and Education, Port Elizabeth, South Africa

Sardinia Bay Marine Protected Area is a relatively small reserve situated in the eastern-most section of St Francis Bay. The Sardinia Bay MPA is 7km long and comprises the area between the high-water mark and a line one nautical mile seaward of the high-water mark covering a total of 55 ha. Established in 1976 and proclaimed as a MPA in 2000 the reserve was considered one of the most pristine and valued urban beaches in the world. Together with Tsitsikamma, De Hoop and Bird Island the theoretical minimum conservation target of 20% has nearly been reached in the Agulhas Bioregion. However the true contribution in terms of biodiversity has never been assessed. Illegal activities including intensive abalone poaching have been reported and observed within the reserve and little is known about the resources in the reserve. Results from the inter-tidal sampling will be presented. A total of 8 sites were sampled along the coast with three positioned inside the reserve. Three transects were undertaken perpendicular to the shore at each site ranging from exposed to sheltered.

Poster Wed 19

Age, growth and reproduction of the pelagic goby *Sufflogobius bibaratus* from the west coast, Southern Africa

Lucinda Fairhurst¹, Mark J. Gibbons²

¹ Laqua'R Consultants, Cape Town, South Africa

² University of the Western Cape, Bellville, South Africa

Aspects of the biology and the pelagic goby *Sufflogobius bibaratus*, a Southern African inshore marine go-

bioid, are described from samples collected during hake and horse mackerel demersal trawl surveys off the coast of Namibia in March and August of 2007. A total of 919 gobies (39 – 154 mm total length) were sampled, macroscopic examination of the gonads identified 220 as juvenile or immature, 243 females, 451 males and 5 undefined. Male specimens were present in all thirteen size classes but were the only sex found in specimens of 118 mm TL or larger (the four largest size classes). Small males identified as being in the ‘ripe and running’ sexual stage may imply sneaker males being part of the reproductive strategy adopted by pelagic gobies. Age estimates of a sub sample of 100 *S. bibaratus* (covering the entire size range), were compared by counting the number of growth rings visible using a stereomicroscope (assumed deposition of annual frequency) in otoliths that were whole, transversely sectioned and otoliths that were sectioned along the longest growth axis. Methods incorporating the sectioning of otoliths achieved higher age estimates than those from whole otoliths, suggesting the phenomenon of stacking of growth zones to be true in this species. Reproducibility of otolith readings were compared using average percentage error indices (APE %) and coefficient of variation values (CV %). The preparation method which involved sectioning the otolith along the longest axis was selected to process the remaining samples as it resulted in the lowest results namely, 8.11 (APE %) and 10.94 (CV %). The Von Bertalanffy growth curve was fitted to the age-length data and preliminary results indicate a maximum age of ten years signifying a longer life span than previously documented. Preliminary results suggest *S. bibaratus* may be better adapted to sustained targeting of a commercial fishery than previously documented.

Oral C 3
Sea Level Rise Impacts for Cape Town -
1. Inundation Scenarios

Lucinda Fairhurst¹, Geoff Dekker², Gregg Oelofse², Geoff Brundrit³

¹ *LaquaR Consultants, Cape Town South Africa*

² *City of Cape Town, South Africa*

³ *GOOS AFRICA*

The City of Cape Town administers approximately 307 km of coastline, arguably its single greatest economic and social asset. The City’s coast provides a range of social and economic opportunities including recreational and amenity areas, sought after housing and development opportunities as well as core economic attributes. In addition, the City’s coast is a dynamic eco-

logical system that supports a wide range of species, ecological systems and ecological services. Global climate change predictions suggest that, amongst others, sea level rise and an increase in the intensity and frequency of storm events may have significant impact on coastlines across the globe. Cape Town with its extensive coastline may be particularly vulnerable to these predicted changes. A computer based GIS model has been developed to take current estimates of sea level rise, and build them into a series of representative scenarios of the corresponding levels of inundation. The GIS model will be demonstrated, and the scenarios will be used to illustrate the possible impacts of future sea level rise on infrastructure and services along the coastline of the City of Cape Town.

Oral A 8
Indicators of sustainable fishing for the South African hakes (*Merluccius capensis* & *M. paradoxus*) - management applications/implications

Tracey P. Fairweather
Marine and Coastal Management, Cape Town, South Africa

South Africa is in the process of implementing an Ecosystem Approach to Fisheries (EAF) management using a multi-disciplinary approach of classical stock assessment, ecosystem models, decision support systems and indicators. Current emphasis is that indicators should provide solid bases for decision-making, contributing to a self-regulating system of sustainable development. Indicators are intended to convey crucial technical information to non-technical users. This a key issue in achieving sustainability in fisheries management. The South African demersal fishery targets, and is dominated by, two Cape hake species: shallow-water hake *Merluccius capensis* and deep-water hake *M. paradoxus*. Since 1994, transformation of the fishing industry to include historically disadvantaged population groups has resulted in an expansion of the demersal fishing industry through the introduction of new participants and the allocation of rights to use longline vessels. Data collected from commercial catches and research surveys are used to derive indicators which are intended to inform the management of the species. The candidate indicators investigated are: mean length of catch, total mortality, exploitation rate, proportion of by-catch, length at 50% maturity and centre of gravity of commercial catches. Pertinent results are presented and their implications and applications are discussed.

Oral PL 5

Exploring the BOFFFF hypothesis using a model of South African deepwater hake (*Merluccius paradoxus*)

John Field¹, Coleen Moloney¹, Louis du Buisson¹, Astrid Jarre¹, Tore Stroemme², Marek Lipinski³, Paulus Kainge⁴

¹ *University of Cape Town, Cape Town, South Africa*

² *Institute for Marine Research, Bergen, Norway*

³ *Marine and Coastal Management, Cape Town, South Africa*

⁴ *Department of Fisheries, Swakopmund, Namibia*

The Big Old Fat Fecund Female Fish (BOFFFF) hypothesis is explored quantitatively using an age-structured stock production model in which the usual stock : recruit relationship is replaced by a three-stage recruitment process based on maternal age. The recruitment process is decomposed into three age-dependent stages: 1) number of eggs spawned per batch per female, 2) number of batches spawned per year (related to the length of the spawning season), 3) increased survival of young stages with maternal age. The first two stages together give the stock recruitment potential and can be well justified by experimental observation in many fish species. The third stage is affected by both maternal age and also environmental conditions. The results indicate that the number of batches spawned per year is the most important component. They also indicate that a few old fish potentially contribute many times more recruits to the population than many younger fish. It is argued that the concept of spawner stock biomass (which is heavily weighted by the large numbers of young first time spawners, especially in heavily exploited populations) should be replaced by the concept of stock recruitment potential, which takes the age-structure of the population into account. The conclusion is that for many long-lived fish populations such as hake and cod, management should aim to maintain the age-structure of the population, rather than encouraging, or even targeting, exploitation of large, old fish.

Oral PL 6

SAMCA: Progress towards a new dispensation in South African Marine Science

John Field¹, Sheldon Dudley²

¹ *University of Cape Town, Cape Town, South Africa*

² *Natal Sharks Board, Umhlanga & University of KwaZulu-Natal, Durban, South Africa*

This will give our personal views of the proposed South African Marine and Climate Alliance (SAMCA) and the recent history of a move to invigorate South African Marine Science. It will report on two informal meetings at which NRF, SANCOR, MCM, SAWS, CSIR, ORI, SANBI, CpUT, Rhodes University, UCT and others were represented, aimed at drawing together the marine and atmospheric communities in order to get significantly more funding into marine research. A draft proposal was formulated and subsequently taken to a hastily convened Department of Science and Technology workshop on the Global Change Grand Challenge. Here the marine and atmospheric communities provided a large proportion of the delegates and made a significant input. Developments since then will be outlined. The marine component of the India-Brazil-South Africa alliance (IBSA-Ocean) will also be outlined as it fits into the draft proposal to the DST well. The DST is calling for individuals to register on its website and comment on the draft Global Change Grand Challenge Science Plan and it is hoped that the SANCOR Community will present a united front and make a strong group input too.

Oral A 4

Differing fish communities on sanctuary and open reefs reveal impacts of recreational fishing and diving on the Maputland coral reefs of South Africa

C. Floros¹, M.H. Schleyer¹, D. Schoeman²

¹ *ORI, Durban, South Africa*

² *University of KwaZulu-Natal, Durban, South Africa*

Increasing anthropogenic pressures on the world's coral reefs mean more marine protected areas (MPAs) are created to meet conservation goals and provide economic benefits through fisheries and ecotourism. While 21% of the world's coral reefs are located in MPAs, 85% of these still experience threats such as sedimentation, pollution, coastal development and overfishing. An MPA's biodiversity clearly remains at risk if managers cannot assess whether its objectives are being fulfilled. Fishing, the most widespread form of extractive use on coral reefs, is generally managed, but irreversible shifts in community structure and reef function may still ensue. While SCUBA diving is non-extractive, its popularity on coral reefs has its own suite of effects. South Africa's coral reefs all lie in an MPA, with some open to recreational game fishing and SCUBA diving, and others located within sanctuaries. SCUBA diving and fishing are restricted to non-sanctuary areas, and bottom fishing is prohibited. De-

spite these restrictions, fishing effort is high and its effects on the ecosystem are uncertain. To date, the effects of recreational fishing and SCUBA diving on fish communities on South Africa's coral reefs have not been studied. Differences in the density, diversity and trophic structure of fish communities in 'open' and fully-protected (sanctuary) reefs are thus being investigated. Methods include visual point counts using a fish-diversity index, and timed counts to assess total fish populations. The diversity index comprises 27 selected fish species in 13 families, which together represent 7 distinct trophic groups. These include specialist feeders, targeted game fish, slow-growing, territorial predators and species susceptible to hobbyists. Reef rugosity is recorded so that analyses can be standardised with respect to substratum complexity. Results thus far indicate that sanctuary reefs have significantly higher densities of predatory fish as well as significantly larger fish and greater species diversity.

Poster Tue 32

Seasonality and abundance of jellyfish in the northern Benguela ecosystem with preliminary observations on their fish associates

B. A. Flynn, M. J. Gibbons

University of the Western Cape, Bellville, South Africa

The biomass of jellyfish off Namibia is currently thought to exceed that of finfish there, and this has implications for our understanding of ecosystem functioning in the region. Our knowledge about even the basic biology of jellyfish is scant. Here we examine seasonality of jellyfish off Namibia using information provided by the Namibian Ministry of Fisheries and Marine Resources from the commercial fisheries sector. The data span the period from the mid 1990s until 2006 and include information from both the demersal and pelagic sectors. The data cannot be considered quantitative and we are restricted to presenting information on seasonal changes in the percentage of trawls containing jellyfish; subdivided by depth and latitude. Jellyfish represent just one (the pelagic) life-history phase of the organisms and their release by the benthic life-history phase is often cued by sudden changes in temperature. Given that upwelling ecosystems are characterized by often sudden changes in temperature throughout the year, we hypothesize that jellyfish will be present all year around off Namibia. We also present some preliminary information on the possible associations between finfish and jellyfish.

Oral C 13

The Fate of South African Estuaries – the KZN Experience

A.T. Forbes¹, N.T. Demetriades²

¹ *Marine & Estuarine Research, Hyper by the Sea, South Africa*

² *University of KwaZulu-Natal, Durban, South Africa*

Marine & Estuarine Research have been contracted by the eThekweni municipality to produce a status report on the 16 estuaries that lie within the 80 km of coastline that falls within the greater Durban area with the aim of developing a long term management policy. The 16 systems bracketed by the Tongati in the north and the Mahlongwa in the south include an estuarine bay and 12 intermittently open systems. The Mkomazi is considered permanently open but does close and could qualify as a river mouth, the Isipingo has been drastically modified and the "mouth" consists of two concrete pipes while the intermittently open Mgeni is not permitted to close. The catchments vary greatly in size, in some cases stretching to the Drakensberg. Catchments within the eThekweni area are in a few cases relatively undisturbed and rural but are mainly under intensive agriculture or are highly urbanised and industrialised. Historical information is patchy. Durban Bay was surveyed over 50 years ago but conditions have changed dramatically since then. Beam trawl surveys of the other systems were done in the late 70s and fish surveys on some of the systems have been done since then. Systems such as the Tongati, Mdloti and Mhlanga are reasonably well known but in others the benthic fauna has never been sampled. The presentation will deal with a preliminary assessment of the present status of these systems and the problems and possibilities for maintaining or improving these conditions.

Oral C 4

Comparing the growth of market-size abalone fed kelp versus the new low protein, commercially available Abfeed@-K26

T.L. Francis¹, GW. Maneveldt¹, J. Venter²

¹ *University of the Western Cape, Bellville, South Africa*

² *Jacobsbaai Sea Products, Jacobsbaai, South Africa*

Kelp (*Ecklonia maxima*) constitutes the major feed for farmed *Haliotis midae* Linnaeus on the West and western South coast of South Africa. However, kelp is relatively low in protein content and is approaching limits

of sustainable harvesting, particularly in kelp concession areas with high abalone farm concentrations. This has largely been the motivation for the development of a nutritionally complete, high protein feed, Abfeed®-S34 which contains 34% protein. Two of the negative effects of using Abfeed®-S34 is the higher incidence of sabellid infestation as the worms feed on the nutrient-rich faeces produced by the abalone, and the potentially negative impacts on water quality. This is particularly prevalent in culture environments with abalone of shell lengths >50mm and at relatively high water temperatures, and has prompted the development of a new low protein Abfeed®-K26 (26% protein) which does not induce these effects. The aim of our research was to compare the growth of grow-out abalone (abalone with a shell length >20mm) fed kelp with those fed the new Abfeed®-K26 in a flow-through system on a local west coast commercial abalone farm. Such research has not been attempted on a commercial farm before. The results show that while both feeds generally produce similar growth in shell length ($P = 0.469$), Abfeed®-K26 did outperform kelp in producing better weight gain ($P = 0.014$). Abfeed®-K26 is doing exactly what it was designed to do and may no doubt prove to be of tremendous benefit to the abalone aquaculture industry as a kelp and Abfeed®-S34 substitute because it has most of the benefits of the high protein Abfeed®-S34, and none of its apparent disadvantages. However, in terms of purchasing costs, kelp is still the cheaper alternative for the commercial abalone farm at which this research was conducted.

Oral B 5

The influence of Prince Edward Islands (Southern Ocean) in mediating trophic interactions among the plankton: evidence from trophic cascading experiments

P.W. Froneman, E.L. Allan
Rhodes University, Grahamstown, South Africa

The influence of the phytoplankton size structure in mediating the trophic interactions between the bacteria, phytoplankton, nanoheterotrophs (2-20 μm), microheterotrophs (20-200 μm) and mesozooplankton (< 1000 μm) was investigated in the upstream region and shallow shelf waters of the Prince Edward Islands in the Indian sector of the Antarctic Polar Frontal Zone during April 2004. The mean total chlorophyll-*a* concentration at the offshore station ranged from 0.06 to 0.10 mg chl-*a* m⁻³ and between 0.09 and 0.16 mg chl-*a* m⁻³ at the inshore stations. The total chl-*a* concentration at the offshore stations was dominated by the pico-

phytoplankton (< 2.0 μm) and by the nanophytoplankton (< 20 μm) in the inshore stations. There were no significant differences in the estimated growth rates of bacteria between offshore and inshore waters ($P > 0.05$). Nanoflagellates were identified as the most important consumers of bacteria and phytoplankton in both inshore and offshore regions. In the presence of microheterotrophs (20-200 μm) the impact of the nanoflagellates on both the bacteria and phytoplankton was reduced indicating that the larger heterotrophs were preying upon the nanoflagellates. Mesozooplankton however, appeared to exert the greatest impact on nanoflagellates. In the cascading experiments, the data suggest that mesozooplankton consume nanoflagellates, which resulted in a decrease in the predation impact of these organisms on the bacteria and total chl-*a*. This result is consistent with the expectations of predator-prey cascades. In the inshore region where the total chlorophyll-*a* was dominated by the nanophytoplankton, the mesozooplankton appeared to feed on both the phytoplankton and the nanoflagellates suggesting that the nanoflagellates maybe an important alternative food source for the larger zooplankton.

Poster Tue 3

Characterization and comparison of Autumn and Spring spawning habitat of Sardine (*Sardinops Sagax*) and Round Herring (*Etrumeus Whiteheadi*) on the Eastern Agulhas Bank, South Africa

Irene García Fernández¹, C.D. van der Lingen², C. Moloney¹

¹ *University of Cape Town, Cape Town, South Africa*

² *Marine and Coastal Management, Cape Town, South Africa*

Eggs of Southern Benguela sardine are found throughout the year, but this species has generally been considered as spawning primarily from spring to late summer. However, substantial numbers of sardine eggs were collected over the eastern Agulhas Bank during a research survey conducted in autumn 2005, and intense spawning in this area and season has not previously been recorded. This study reports on the characterization, in terms of environmental variables, of the autumn spawning habitat of sardine on the eastern Agulhas Bank, and compares this with sardine spawning habitat in that area during spring. In addition, the autumn and spring spawning habitats of red eye round herring, a primarily winter-spawning clupeid, are also characterized and compared. Eggs were collected using a continuous, underway fish egg sampler (CUFES) during autumn and spring surveys conducted in 2005 and

2006, and egg distribution maps for each species during each survey are presented. Environmental data were collected during these surveys using a CTD (salinity, fluorescence, and dissolved oxygen), and from underway measurements of sea surface temperature, water depth, and distance from the coast. Spawning habitat was characterized using single parameter quotient (SPQ) analysis to identify the “preferred” environmental ranges of spawning of the two species. There was a large degree of overlap in preferred spawning ranges of sardine and round herring, although differences between them were more apparent during spring than during autumn. Substantial seasonal differences in the preferred range for spawning were evident for sardine, with eggs of this species being found in warmer water, of greater depth, and further offshore, during spring compared to autumn. Round herring did not show as much seasonal difference in their preferred spawning habitat as did sardine. These characterizations further our understanding of the life history strategy of sardine, and provide new information for round herring.

Poster Tue 2
Age and growth of redeye roundherring (*Etrumeus whiteheadi*) off the south African coast

Y. Geja¹, M.D. Durholtz¹, C.L. Moloney²
¹Marine and Coastal Management, Cape Town, South Africa
²University of Cape Town, Cape Town, South Africa

Age of redeye roundherring (*Etrumeus whiteheadi*) was determined along with associated errors, and used to estimate life history information such as age composition, age at maturity and mortality. Samples were collected in 2005 from two research surveys in South Africa: the sardine run and spawner biomass surveys. Weak reader bias and high precision were observed for *E. whiteheadi* samples from the sardine run and spawner biomass survey. The von Bertalanffy model was applied to estimate growth parameters to describe the length-at-age data and Kimura’s likelihood ratio test was applied to compare growth parameters between sexes. The equation describing the von Bertalanffy function for the sardine run survey data was

$$L_t(\text{cm}) = 41.38 \text{ cm} (1 - e^{-0.06 y^{-1}(t-4.47y)})$$

Male and female von Bertalanffy growth functions estimated from the spawner biomass survey data were respectively;

$$L_t(\text{cm}) = 22.95 \text{ cm} (1 - e^{-0.24y^{-1}(t-3.03y)})$$

$$L_t(\text{cm}) = 20.30 \text{ cm} (1 - e^{-0.42y^{-1}(t-2.09y)})$$

respectively. Kimura’s likelihood ratio test revealed no statistically significant difference between *E. whiteheadi* sexes. Independent ageing methods suggested that otolith length is a better predictor of age and caudal length than is otolith weight. Maturity estimates of *E. whiteheadi* were not that different to those already published in the literature. The results for *E. whiteheadi* suggest that management of the sexes should not be separate. Limited data on adult *E. whiteheadi* suggest that pelagic research surveys should be extended to the north of the west coast because of its distribution.

Poster Tue 18
Qualitative analysis of data collected during a Harmful Algal Bloom event in the Lambert’s Bay area

C. George, M. Smith, J. Basson, W. Billany, D. Farrell, C. Collins, A. Mafimbo, M. Manyilizu, J. Mungai, F. Pey, G. Wessels
 University of Cape Town, Cape Town, South Africa

The poster deals with varying levels of phytoplankton-based toxicity in the Lambert’s Bay area during a harmful algal bloom (HAB). HAB periods are important from a human perspective due to accumulation of phytoplankton toxicity in shellfish which can potentially cause fatal poisoning in humans, and have a strong impact on the fisheries in the area. The dynamics of the upwelling system which contributes to HABs are complex, and include wind and temperature forcing. Data surveyed directly include temperature, salinity, fluorescence and nutrient levels (oxygen, nitrates, silicates and phosphates) over the course of the bloom period. Wind data from QuickScat surveys were also studied to better understand the upwelling drivers. The dinoflagellate species *Alexandrium catanella* was in bloom during the period studied, and nutrient concentrations in the area were found to decrease over the course of the bloom. Towards the end of the study period, the nutrient concentrations increased, concurrent with a significant increase in wind speed. There appears to be a qualitative relationship between the upwelling strength and the wind speed, and a corresponding increase in nutrient concentration during strong upwelling periods.

Poster Tue 22

New production in St Helena Bay based on surface nitrate deficits

MJ Gibberd¹, Mike Lucas¹, Larry Hutchings², Jock Currie¹

¹ *University of Cape Town, Cape Town, South Africa*

² *Marine and Coastal Management, Cape Town, South Africa*

A 25 year long-term data set of nutrient concentrations from St Helena Bay has revealed a significant and positive increasing general trend for nitrate concentrations that is concurrent with a general and positive downward trend in bottom water oxygen concentrations (Currie et al., in prep). The implication of that finding is that new production rates may have increased over that time period, with a resulting increased downward flux of POC/N onto the shelf where microbial decomposition processes utilise oxygen, thereby creating the conditions of hypoxia that are frequently observed. This study takes the same nutrient data used by Currie et al (in prep) to calculate nitrate deficits in surface waters relative to the concentration of nitrate in newly upwelled water to estimate new production rates in St Helena Bay. These rates are compared with total productivity of the region derived from satellite imagery and we evaluate whether the rates of total and new productivity have indeed changed substantially over the last 25 year period as increasing hypoxia of bottom water implies.

Oral A 12

Eat your gobies! A review of the biology of *Sufflogobius bibarbatu* off Namibia

Mark J Gibbons¹, Bronwyn Currie², Anne Christine Utne-Palm³, Anne Gro Veia Salvanes³, Jens Otto Krakstad⁴, Jean Paul Roux⁵, Stein Kaartvedt⁶, Göran Nilsson⁶, Victoria Braithwaite⁷, Jonathon AW Stecyk⁶, Thor A Klevjer⁶

¹ *University of the Western Cape, Bellville, South Africa*

² *Ministry of Fisheries and Marine Resources, Swakopmund, Namibia*

³ *University of Bergen, Bergen, Norway*

⁴ *Institute of Marine Research, Bergen, Norway*

⁵ *Ministry of Fisheries and Marine Resources, Lüderitz, Namibia*

⁶ *University of Oslo, Oslo, Norway*

⁷ *Penn State University, Pennsylvania, USA*

The pelagic goby, *Sufflogobius bibarbatu*, is a com-

mon member of the fish community off Namibia, and it may be becoming more so. There is evidence to suggest that this species has taken over the role of pelagic fishes in the diet of seabirds and seals, following the collapse of the pelagic fishery at the end of the 1960s and that it is now playing a pivotal role in the northern Benguela ecosystem. This paper reviews what we understand about the biology, ecology and physiology of this important resource, and suggests that changes in the system over the last forty years or so may unwittingly cause us to change our eating habits in the not-so-distant future.

Oral C 8

Simon's Bay Seawatch – A ten year overview

S. Gildenhuys¹, H Waldron², W Kwak³ (Cdr), C.K. Wainman¹, B. Maritz¹, P.E. Matsapola¹, J.G.W. Scholtz¹, R. Egypt¹

¹ *The Institute for Maritime Technology, Simon's Town, South Africa*

² *University of Cape Town, Cape Town, South Africa*

³ *South African Navy, Simon's Town, South Africa*

Simon's Town Harbour, located on the western side of False Bay, South Africa, has a long-standing maritime history and is the South African Navy's (SAN) primary port. Here the Navy is also seen as the custodian of Simon's Bay, and have a social responsibility with regards to the usage of the area where industrial activities co-exist alongside recreational, environmentally protected and other history-rich areas. With the growing awareness of the importance of the natural environment in recent years, the SAN has played a more active role in the conservation, monitoring and community awareness of the Simon's Bay area. An environmental 'Health-of-the-Ocean' project was initiated in 1998, aimed at establishing baseline values while growing the understanding of the natural processes specific to Simon's Bay. This project comprised various multi-year studies performed in collaboration with the SAN, the Institute for Maritime Technology (IMT), the University of Cape Town, Cape Town, South Africa (UCT) Oceanography Department and students of the Cape Peninsula University of Technology (CPUT) Oceanography course. After six years, in 2004, the knowledge gained in areas such as local climatology, sediment health, water quality and local circulation patterns, reached a point where individual studies were consolidated, summarised and contextualised, together with conclusions and recommendations for the management of the area. Since then efforts have concentrated on long-term monitoring and specific student

studies. This paper aims to provide an overview of the measurements, studies and results from the past 10 years.

Poster Mon 5

Preliminary study on the effects of salinity on egg development, larval growth and survival of dusky kob (*Argyrosomus japonicus*) under laboratory conditions

N. Joseph Ginindza

Marine and Coastal Management, Cape Town, South Africa

The effects of salinity on eggs and larvae of dusky kob, *Argyrosomus japonicus* were studied. Experiments were conducted to determine the optimal salinity for hatching success, yolk sac consumption, oil globule consumption, growth rate and survival of both eggs and larvae under laboratory conditions. Salinities were tested in a thermo-regulated room. The effect of salinity (35ppt, 30ppt, 25ppt, and 20ppt) on hatch rate, total length, yolk sac volume, and oil droplet diameter was recorded. Hatching period durations were also recorded at each salinity. These results shows significant ($P < 0.05$) difference in hatching success, best hatching rates at 35ppt (96.4%) then decreasing with the decrease in salinity. There was a direct relationship between hatching success and salinity. At the end of the 24-hour trial, larvae that hatched at 30ppt were significantly ($P < 0.05$) the longest (6.654 ± 0.201 mm), while specific growth rate was significantly high ($P < 0.05$) at 25ppt ($1.757 \pm 0.663\%$ body length per hour). The largest ($P < 0.05$) yolk sac volumes (0.644 ± 0.124 μ l) were observed at 20ppt, while oil globule volumes were highest ($P > 0.05$) at 25ppt and 20ppt, 0.10 ± 0.05 μ l and 0.08 ± 0.027 μ l respectively. Specific growth rate in all larval treatments during the week trial was not significantly different ($P > 0.05$). Mortality was highest (100%) at 20ppt, while the other treatments had a fairly low survival rate post complete yolk resorption due to cannibalism and inability to feed exogenously.

Oral C 11

What are nepheloids and nepheloid layers, where do you find them and who cares?

Githaiga, J.M.W.¹, Roberts, M.J.¹, Lucas, M.I.², Branch, G.M.²

¹ *Marine and Coastal Management, Cape Town, South Africa*

² *University of Cape Town, Cape Town, South Africa*

Optical turbidity measurements PMC_{turb} were undertaken during routine Demersal surveys across the Agulhas Bank, South Africa over a four year period. Results showed a positive correlation of PMC_{turb} with particulate matter concentrations PMC_{filter} across the Bank. This allowed for the quantification of *in situ* turbid layers and the characterization of resultant nepheloid layers. Nepheloid layers were found to occur in discrete patches across the continental shelf in depths shallower than 200m, extending up to 80km seaward. Surface nepheloid layers (SNLs) were limited to the upper mixed layer and were best developed over the “cold ridge” especially in autumn. The inner and more intense cores of benthic nepheloid layers (BNLs) did not occur shoreward of the 100m isobath and were associated with signature $11^\circ\text{C}/34.9\text{PSU}$ waters. Bottom turbidity PMC_{turb} was highest (max 0.0504 $\text{mg} l^{-1}$) over the eastern bank in spring, but particulate matter concentrations PMC_{filter} were most intense (max 0.0819 $\text{mg} l^{-1}$) over the western bank in autumn. The SNL was associated with increased surface turbidity and PMC_{filter} levels were associated with increased concentrations of surface dissolved oxygen and surface chlorophylla. The BNL was limited to a stratified, previously un-described low oxygen, thermohaline gradient. It can be concluded that SNLs are controlled primarily by biogenic factors and BNLs appear to be controlled by hydrography, bathymetry and bottom sediment. These turbidity events and the resultant nepheloid layers occur on Chokka Squid (*Loligo reynaudii*) spawning grounds and are known to disrupt aggregations of spawning squid. Aggregations of spawning squid are targeted by squid fishermen and support a multi-million fishery. Therefore squid fishermen care about the occurrence, distribution and frequency of turbidity events and nepheloid layers. More importantly, the fishermen care about how to best minimize impacts on catches — but *that* is another story...

Oral B 3

Paleolimnology of Soetendalsvlei situated within the Agulhas Plain, South Africa: Preliminary findings

N. Gordon¹, J.B. Adams¹, F. Garcia-Rodriguez²

¹ *Nelson Mandela Metropolitan University, Port Elizabeth, South Africa*

² *Universidad de la Republica, Montevideo, Uruguay*

Climate change is an important research focus area both nationally and internationally. Although the effects of climate change, increase in global warming and sea level rise have been investigated, very few studies in South Africa have addressed past environmental

conditions since the last high sea level i.e. within the last 10,000 years. This study focused on paleo-environmental changes that occurred in Soetendalsvlei, a coastal lake situated at the southern most tip of South Africa within the Agulhas Plain. The lake is connected to the Indian Ocean via the Heuningnes Estuary and in the past experienced brackish conditions when the estuary mouth closed and back-flooding occurred. Due to anthropogenic impacts Soetendalsvlei is becoming fresh at an accelerated rate leading to changes in the biota of the lake and a loss of biodiversity. Several sediment cores were collected within the lake during 2006 and analysed for geochemistry, radio-carbon and lead (Pb210) dating, stable isotope analyses and fossil diatom assemblages. All of the cores indicated that the system was once marine dominated as they were characterised by very coarse grained sediments, the presence of bivalve shell fragments as well as marine diatom species. Clear estuarine conditions were indicated by the presence of brackish/marine diatom assemblages. When agriculture started in the region, there was a clear increase in trophic state of the lake and the artificial manipulation of the Heuningnes estuary mouth resulted in freshwater conditions dominating the lake as indicated by the presence of freshwater diatom species. At present Soetendalsvlei is situated 12 km from the Indian Ocean, but was once an estuarine lake. A GIS elevation mapping exercise showed that an increase in sea level due to climate change could result in the loss of large areas of agricultural land within the Agulhas Plain and that estuarine/ marine conditions could occur within Soetendalsvlei again.

Poster Wed 8

Towards a data management system for long term monitoring of the marine systems around Southern Africa

W.S. Goschen¹, J. Hermes¹, K.S. Bernard², A. Paterson², A. Chuntharpursat³, J.C. Pauw³

¹ *South African Environmental Observation Network (SAEON) Cape Town, South Africa*

² *SAEON, Grahamstown, South Africa*

³ *SAEON, Pretoria, South Africa*

One of the key aims of the South African Environmental Observation Network (SAEON) is the delivery of reliable environmental data and products for science, policy and management. The marine offshore node of SAEON, Egagasini (Zulu word for “Place of waves”) and the coastal node, Elwandle (Xhosa word for “Ocean”), along with the other terrestrial nodes, deliver data into the CoGIS (Collaborative GIS) platform of

SAEON. Egagasini also uploads physical and chemical oceanographic data, including meteorological data, into the longstanding and reliable archive at SADCO (South African Data Centre for Oceanography), as well as supporting the AfrObis initiative. CoGIS is a joint development venture between SAEON, the Department of Minerals and Energy (DME) and the Council for Scientific and Industrial Research (CSIR). CoGIS is open source and open standards, and complies with the specification of the Open GIS Consortium; international standards for data and metadata are built into the design. The system is rapidly developing into a Collaborative Spatial Analysis and Modeling Platform (CoSAMP), and is designed to integrate data from different sources, in different formats, scales and resolutions, into an integrated product for the end user. Data can come from different propriety or open source platforms, such as ESRI or GeoServer, and be located at different organizations so long as the relevant standards are adhered to. SAEON has also developed comprehensive data provider and data user agreements, which, although promoting free and easy access to data, allows for the protection of the data provider’s rights. Incorporated into this is the use and publication of metadata (information about the data), which encourages collaborations between remote systems and organizations.

Oral A 3

Temporal variability of protected inshore fishery populations in the Tsitsikamma National Park marine protected area, South Africa

Albrecht Götz¹, Paul D. Cowley²

¹ *South African Environmental Observation Network, Grahamstown, South Africa*

² *South African Institute for Aquatic Biodiversity (SAIAB), Grahamstown, South Africa*

The Tsitsikamma National Park (TNP) is the oldest and largest (320 km²) ‘no-take’ marine reserve in Africa. After 40 years of protection, the TNP fish communities are stable and provide a good example of a fishery exempt inshore ecosystem. An ongoing, high-resolution shore fishing (catch-per-unit-effort; CPUE) survey within a designated research area of the TNP started in 1995. Standardized fishing methods were used and effort was stratified over season and habitat types. Here, we make use of an eight-year dataset to examine temporal variability in community structure, relative abundance (CPUE) and mean sizes of the reef-associated linefish fauna. High inter-annual variability in CPUE and mean size was identified for all investigated species. The results suggest that monitoring pro-

grammes aimed at detecting exploitation related changes in abundance or size of inshore linefish species should exceed a period of three years. Furthermore, long-term monitoring in large and well established Marine Protected Areas (MPAs) using consistent methodology are crucial to determine the superimposed effect of climate change.

Poster Wed 4

Sandy beach meiofaunal communities along the Durban coastline: a baseline study

N. Govender, D.S. Schoeman, A.J. Smit
University of KwaZulu-Natal, Durban, South Africa

South Africa has in many ways been at the forefront of sandy beach research except that most studies have concentrated on the south and west coasts of the country. The east coast is conspicuously absent from the peer-reviewed literature, despite the fact that seventy nine percent of KwaZulu-Natal's coastline is composed of sandy soft substratums. Durban beaches especially remain uncharted territory in terms of ecological sandy beach research. The purpose of this study was to revise and update knowledge of Durban's intertidal sandy beaches given the paucity of information available. The research aimed to investigate aspects of the meiofaunal communities of Durban's sandy beach ecosystems and to identify the spatial determinants of beach biodiversity. Using a random-stratified sampling design, we collected meiofauna from selected beaches along the Durban coastline, and on the basis of these data describe: i) the effect of beach morphodynamic type on beach biodiversity; ii) the consequence of urbanisation for beach biodiversity; and, iii) the role of nutrient point sources (estuaries, wastewater outlets) on structuring beach biodiversity gradients. This determination of biodiversity across a range of different beaches will facilitate the establishment of a conceptual model of the beach ecosystems along the eThekweni coast that will tie in the dominant factors that might drive spatial patterns within this biodiversity.

Oral A 2

Conservation planning in spatially and temporally dynamic marine environments

Hedley S. Grantham¹, Amanda T. Lombard², Edward T. Game^{1,3}, Alistair J. Hobday⁴, Anthony J. Richardson^{1,3}, Lynnath E. Beckley⁵, Robert L. Pressey^{1,6}, Carl D. van der Lingen⁷, Samantha L. Petersen⁸, Jenny A. Huggett⁷, Janet C. Coetzee⁷, Dagmar

Merkle⁷, Jane E. Alpine⁹, Hugh P. Possingham¹.

¹ *University of Queensland, St. Lucia, Queensland, Australia*

² *Nelson Mandela Metropolitan University, Port Elizabeth, South Africa*

³ *CSIRO Marine and Atmospheric Research, Queensland, Australia*

⁴ *CSIRO Marine and Atmospheric Research, Tasmania, Australia*

⁵ *Murdoch University, Western Australia, Australia*

⁶ *James Cook University, Townsville, Queensland, Australia*

⁷ *Marine and Coastal Management, Cape Town, South Africa*

⁸ *WWF Responsible Fisheries Programme, Cape Town, South Africa*

⁹ *University of Tasmania, Hobart, Australia*

Pelagic ecosystems provide a significant and vital component of the ocean's productivity and biodiversity. They are also heavily exploited and are currently the focus of numerous ecosystem-based management exercises. Over the past ten years there has been increasing enthusiasm for marine protected areas (MPAs) as a tool for pelagic conservation. However, there remains almost a complete absence of systematic conservation planning in the pelagic realm, both within exclusive economic zones and the high seas. Here we demonstrate the use of a decision support system to guide the implementation of MPAs that consider the physical and biological dynamics typical of the pelagic realm, and propose a method for integrative planning for pelagic and benthic conservation in the Southern Benguela ecosystem. Our approach was to maximize the representation of threatened species and key fisheries species within MPAs closed to fishing. In addition to representation, we consider MPA design to address the dynamics of the system using time series data of key oceanographic characteristics and abundance of small pelagic fish. We also discuss problems associated with offshore conservation, where the features of interest are ephemeral and dynamic. Our approach explicitly involves stakeholders and we incorporate socio-economic data into decision support tools.

Oral C 4

An investigation into the protein and energy requirements of the South African abalone *Haliotis midae* cultured at optimal and elevated water temperatures

Alistair J. Green; Clifford L.W. Jones, Peter J. Britz
Rhodes University, Grahamstown, South Africa

The culture of abalone (*Haliotis midae*) is currently the fastest growing sector of the mariculture industry in South Africa. A large portion of the industry's success can be attributed to the development of formulated feeds. The majority of the feeds that are currently available were developed within the optimal temperature range of 18-20 °C and have been found to be unsuitable at elevated temperatures. As a result many farmers feed reduced volumes or no feed at elevated temperatures to avoid the usually fatal condition where undigested feed ferments in the intestine, causing "bloat". Thus, at high temperatures, cultured abalone often lose condition. The aim was to develop a feed that could be safely fed to abalone at elevated temperatures. The objectives of the project were to compare the growth and survival of abalone fed diets with varying protein:energy ratios cultured at various temperatures. Nine experimental diets were formulated with varying protein (18, 22 and 26 %) and energy (11.6, 13.5 and 16.2 MJ.kg⁻¹) contents. Diets were fed to abalone (50 mm) cultured under farm-like conditions in three temperature controlled (18, 22 & 24 °C) partially recirculating systems. Abalone grew fastest at 18 °C followed by 22 °C and 24 °C (ANOVA; $F_{(2,105)}=79.8$; $p=0.00$; Table 1). At 18 °C abalone (29.0±0.16 g) gained between 4.2 and 5.4 g.month⁻¹, which remained similar at all protein levels (18-26 %) provided energy was maintained at ca. 16.2 MJ.kg⁻¹. At 24°C abalone lost weight at low energy levels, but grew at 1.3±0.13 g.month⁻¹ if energy was maintained at ca. 16.2 MJ.kg⁻¹. It is recommended that at temperatures in excess of 22 °C protein could be reduced to 18 % provided energy is kept at ca. 16.2 MJ.kg⁻¹ to maintain body condition and to reduce the chance of bloat.

Oral A 2
Marine biodiversity and biogeography of South Africa

Charles Griffiths
University of Cape Town, Cape Town, South Africa

This presentation aims to document known marine biodiversity of South Africa, to estimate the validity of existing estimates and to describe geographic patterns of species richness, endemism and range restriction around the coast. Species counts are based on museum and literature records and distribution and endemism patterns analysed for 13 major taxa for which sufficient data exist. A total of 11 980 marine species have been recorded from South Africa, of which 32% are endemic. Comparing relative proportions of various taxa

with similar lists for Europe suggests that only some 60% of the macrofaunal species actually present in South Africa have been described, taxa with smaller body sizes and from deeper waters being particularly under-reported. Analyses of distributional data show that several taxa, including fish, decapod Crustacea and Gastropoda, increase in diversity towards the east, whereas Amphipoda, Isopoda and Polychaeta, are most species in the South-West. When all taxa are summed the Atlantic coast emerges much less species rich than the Indian Ocean coast. Rates of endemism vary greatly between taxa and peak in the South and South-West. Narrow range restricted endemics peak strongly at the borders between major biogeographic provinces, suggesting that these 'ecotonal' areas are particularly important for conservation

Oral C 8
Extensive, open, free database for marine biogeographic data in Africa: AFROBIS

Marten Grundlingh, Ursula von St Ange
SADCO-AFROBIS, c/o CSIR, Stellenbosch, South Africa

The Census of Marine Life (CoML) is an ambitious 10-year plan (2000 – 2010) to establish the most authoritative set of marine species observations. The data management of CoML is done by OBIS (Ocean Biogeographic Information System) through its 13 global Nodes. AFROBIS, the African node, was established in 2005-6, and researchers at universities, museums, state department and others submitted more than 3 million records (of 22 000 species). The data base is completely open and free (if connectivity allows a demonstration will be provided). Data submitted to AFROBIS is reformatted and loaded, and then "crawled" to the Rutgers mainframe where it is checked and indexed. Searches for data interact directly with the data base at the Rutgers University in a completely transparent way, and data extracted and graphs generated in a seamless process. Access can be according to geographic area, or a known data set, or by species, or scientific name, or year of observation, or a combination of the above. Graphic distribution plots can be downloaded and are of publication quality. AFROBIS is the biogeographic "sister" of SADCO (Southern African Data Centre for Oceanography) but contains different data and has a different *modus operandi*. The presentation will provide brief background in terms of SADCO, but focus on AFROBIS and its characteristics.

Oral C 3

Post March 2007 marine storm erosion of KZN beaches

Lisa A. Guastella¹, Alan M. Smith¹, Andrew A. Mather², Simon C Bundy³

¹ AS Consulting, Durban, South Africa

² eThekweni Municipality, Durban, South Africa

³ Sustainable Development Projects, Ballito, South Africa

The 19-20 March 2007 marine storm caused severe erosion along the KZN coastline, from Zinkwazi in the north to Marina Beach in the south. After the storm the sea was 5 to 30m closer than it had been prior to the event, leaving the coastline vulnerable to erosion. The March Storm eroded mega-tonnes of sediment and transported it offshore. This loss was compounded by the fact that it occurred in autumn, when there was little or no seaward transport of river sediments to replenish the system. This meant that the coastline entered the winter erosion cycle in a depleted state. There was a gap of nearly two months between the March storm and the post-March storm erosion. This probably represents the conclusion of summer and the onset of the winter erosion patterns. Progressive erosion began towards the end of June and took place in the southern part of sandy bays, often those areas relatively unaffected by the March storm. The KZN coast was subsequently struck by two south-easterly storm swells on 30 July and 29 to 30 August. Both events packed 3.5m swells (H_{s0}) and coincided with spring-high tides. At Kelso an estimated 75 m of beach was eroded, while at Amanzimtoti some 100 m of beach disappeared. This resulted in the loss of beachfront structures, including the double storey lifesaving tower at Amanzimtoti. Coastal defences were hastily improvised with geofabric sandbags proving successful. With the return of the summer 2007/08 onshore wind cycle the coastline has slowly recovered to varying degrees. The severity of the 2007 winter erosion cycle was due to the catastrophic sand loss caused by the March storm and its precursors (tropical cyclone swells). The intense winter erosion was the system's response to try and restore the geomorphological balance of the inner shelf.

Oral C 5

The biodiversity of marine fish parasitic isopods of the family Cymothoidea from southern Africa

Kerry A. Hadfield, Nico J. Smit

University of Johannesburg, Johannesburg, South Africa

Isopods are one of the most morphologically diverse groups in the class Crustacea. Those isopods from the family Cymothoidae are found in or on many species of marine fish. Researchers have shown that high infestation rates on commercially exploited fish can impact negatively on the industry, as these isopods destroy the skin and thus, the market value of the fish, or may even cause death of caged fishes. Despite this, there is very little information on the biodiversity of these parasites on South African fishes. Over the last few years, a variety of collection trips were undertaken to different localities on the South Coast of South Africa, specifically to investigate the diversity of cymothoid fish parasites. Fish were captured by means of a German 180ft bottom trawl, hook and line as well as hand held nets. Isopods found were studied using scanning electron and light microscopy. In total five different fish species were found to be parasitised by four species of cymothoid isopods. The buccal cavity parasite, *Cinusa tetradontis*, was found in the pufferfish, *Amblyrhynchotes honckenii*, and the tongue-replacement isopod, *Ceratothoa imbricata*, was found parasitizing both the black tail, *Diplodus sargus capensis* and the mussel cracker, *Sparodon durbanensis*. The Cape gurnard, *Chelidonichthys capensis*, was parasitised by the external *Nerocila orbignyi*, with the last isopod, *Ceratothoa* sp being found on the steenjie, *Spondylisoma emarginatum* and the musselcracker, *Sparodon durbanensis*. The results thus indicated both new host and locality records for these species of parasites as well as a new *Ceratothoa* species not yet discovered in South Africa.

Oral B 9

The influence of ocean ridges on the circulation in the Mozambique Channel and south of Madagascar

I. Halo, I. J. Ansorge, J. R. E. Lutjeharms, P. Florenchie

University of Cape Town, Cape Town, South Africa

From a hydrodynamic and bathymetrical point of view the dominant features characterizing Mozambique Channel and the region south of Madagascar are high variability due to mesoscale eddies, and oceanic extensive ridges, such as the Davie, Mozambique and Madagascar Ridges. The water flowing through the channel propagates as a train of anti-cyclonic eddies at a frequency of 4 – 5 per year South of Madagascar eddies propagate in a south-westward direction as dipolar vortices. Hydrographics and modelling studies on mesoscale circulation in these regions reveals that the

eddies are very deep, and that the seafloor topography is very shallow in some parts of the domain. Therefore the interaction between eddies and bathymetry may have a strong influence on the pathway of eddies and associated mesoscale features. We have used sea surface height data derived from altimetric observation retrieved from TOPEX-Poseidon and a climatological model simulation, using ROMS, with a horizontal grid resolution of 1/6 to study this interaction. Two different simulations were performed. In the first the model runs with no modification of the Madagascar Ridge, and in the second the model runs with modification of the Madagascar Ridge, where the upper 3000 m was removed. These simulations indicate that Madagascar Ridges regulates the level of intensification, position and direction of propagation of the eddy kinetic energy in a south-westward direction. Removing the Ridge the level of intensification of the eddy kinetic energy increases, and the eddy corridor is shifted northwards with eddies moving in a westward direction.

Poster Wed 9

Why *Carcinus maenas* cannot get a grip on South Africa's wave-exposed coastline

Shannon L. Hampton, Charles L. Griffiths
University of Cape Town, Cape Town, South Africa

The European green crab *Carcinus maenas* has established considerable breeding populations in harbours and sheltered bays in the South-Western Cape, South Africa, but appears unable to flourish on the wave exposed coastline. This study compares the abilities of *C. maenas* and those of an indigenous rocky-shore crab, *Plagusia chabrus*, to resist hydrodynamic forces. *C. maenas* had less than half the vertical tenacity of *P. chabrus* (371.5g and 780.5g respectively) and was unable to grip against as fast a unidirectional flow (0.23m s⁻¹ vs 0.53m s⁻¹) as *P. chabrus*. *C. maenas* also has significantly shorter and lighter limbs than *P. chabrus* and the dactyls of its walking legs are poorly adapted to grip onto rocky substrata. We conclude that *C. maenas* is poorly adapted to survive in wave-swept conditions and hence unlikely to displace indigenous crab species along the open wave-exposed coastline of South Africa. However, it may invade other sheltered locations, particularly Saldanha Bay and False Bay.

Oral C 10

Lagrangian observations of the Tsitsikamma coastal current, South Africa

Lisa Hancke, M.J. Roberts

Bayworld Centre for Research and Education, Cape Town, South Africa

Data from 18 satellite tracked drifters released on the south coast of South Africa, between Plettenberg Bay and St. Francis Bay, confirm the occurrence of a jet-like current off the Tsitsikamma coast. Inshore of the 100m isobath displacements were alongshore, either eastwards or westwards with sustained flow of up to three days in either direction. Eastward flow dominated close inshore and drifters followed the coastline, reaching maximum velocities of 90cm/s before changing direction to the west. Westward flow had a strong offshore component associated with coastal upwelling and showed clear links between the Tsitsikamma coast and the region of the cold ridge. Potential for the retention of biotic material on the Tsitsikamma coast is shown in some drift tracks, while others demonstrate transport to the western Agulhas Bank and offshore loss.

Oral C 2

Identification of genes expressed in response to bacterial infection of the commercially-important South African Abalone *Haliotis midae*

David G. Harding, Vernon E. Coyne
University of Cape Town, Cape Town, South Africa

Increased stress imposed on farmed abalone leads to an increase in disease outbreaks that result in significant mortalities. One factor hindering the control of disease outbreaks is the lack of knowledge concerning the functioning of the abalone immune system. In this study, immunological assays were employed to characterise the abalone's response to pathogen infection. *Vibrio anguillarum* 5676, a pathogenic bacterium previously isolated from diseased *Haliotis midae*, was used to induce disease in the abalone. Messenger RNA isolated from haemocytes sampled from diseased and healthy animals was used in microarray experiments to identify genes expressed in response to infection. Sequence analysis revealed 21 different genes, of which 13 could be assigned a putative function on the basis of similarity to DNA and/or amino acid sequences in various genetic databases. The nucleotide sequences of the remaining 8 cDNA samples corresponded to genes coding for unknown hypothetical proteins. Thus, we have identified a number of genes that are expressed in the commercially important South African abalone *H. midae* following challenge with a pathogenic bacterium. Moreover, a number of these genes have not been previously associated with immune function in

molluscs. Future work will lead to a better understanding of abalone and invertebrate immune function, as well as generating a platform for establishing possible immune markers for commercially-important molluscs.

Poster Wed 1
Port Alfred Upwelling Cell

Nazeera Hargey, Michael Roberts
Marine and Coastal Management, Cape Town, South Africa

Evidence for upwelling has been confirmed by the data collected from 3 ADCP's mounted to the sea floor for a period of 12 months off the coast of Port Alfred. Although previous studies have focused on the upwelling activity in the vicinity of Port Alfred, mostly by analysing surface data (thermal infra red satellite imagery, VOS sea surface temperatures and limited hydrographic data) this study takes a closer look at details of the upwelling along the Agulhas Bank at Port Alfred. A study of upwelled water at depth provides a better understanding of the phenomenon. Data used to investigate the upwelling included ADCP, CTD, Drifter tracks and Satellite imagery. Upwelled water is clearly seen in satellite images of chlorophyll and sea surfaced temperature. Inshore of the Agulhas Current intense cold water can be seen from the SST satellite images. CTD transect data, provides an insight to the extent of upwelling and its temperature salinity profile. ADCP measurements indicate the coastal currents switch between a north flowing current to a more southerly direction. Drifter tracks support this – we find drifters deployed off the coast of Port Alfred go north on occasion as far as East London and even Port St Johns and then return to Port Alfred area, before continuing south into the southern Agulhas Bank region, swept by the Agulhas current.

Poster Tue 26
Bio-physical controls on new production in the Iceland Basin, N. Atlantic

Amy Harington¹, Mike Lucas¹, Sandy Thomalla¹,
Sophie Seeayave², Anastasia Charalampopolou²
¹ *University of Cape Town, Cape Town, South Africa*
² *National Oceanography Centre, Southampton, UK*

The Iceland Basin region of the N. Atlantic is important for two reasons. Firstly, the biological carbon pump here exhibits one of the strongest signals of any of the world's oceans. Secondly, the food-web of this region supports the important herbivorous calanoid

copepod, *Calanus finmarchicus*, that forms an important dietary component of the commercially important juvenile Cod stock. Both carbon export via the biological carbon pump and the transfer of energy to herbivorous zooplankton depends primarily on the amount of nitrate-based new production relative to total primary production. However, climate change scenarios for this region predict that ocean stratification may become stronger, and as a consequence, the upward flux of nitrate may become constrained. Furthermore, there are some recent indications that new nitrate-based production in this region may be somewhat iron limited. To test these ideas, we therefore undertook a cruise to the Iceland Basin region in July / August 2007, to examine controls on new production. We undertook measurements of phytoplankton new and regenerated production using ¹⁵N-NO₃, ¹⁵N-NH₄ and ¹³C tracers and we compared nitrate uptake with the upward diffusive flux of nitrate determined from turbulence measurements. We also assessed phytoplankton new production rates in response to ambient light and Fe gradients and further assessed Redfield C:N fixation rates from dual-labelling (¹³C, ¹⁵N) experiments since the Redfield stoichiometry of particle flux has important consequences for relative rates of carbon and nitrogen export. In this presentation, we report on some of our key findings.

Poster Tue 12
Fine-scale at-sea movements of Cape fur seals

Autumn-Lynn Harrison¹, John P.Y. Arnould², Herman Oosthuizen³, Steve Kirkman³, Deon Kotze³, Daniel P. Costa¹
¹ *University of California, Santa Cruz, California, USA*
² *Deakin University, Victoria, Australia*
³ *Marine and Coastal Management, Cape Town, South Africa*

The use of satellite tracking data yielding one or two locations per day, has allowed for the study of long distance movements by marine predators. These data reveal much about the at-sea distribution of animals that otherwise elude human observation. Not possible with such data is the extraction of fine-scale biological signals important to the ecology of such animals, for example, search behavior. In a patchy environment, marine predators are expected to increase their turning rate and decrease their speed upon encountering prey, concentrating their search effort in an area restricted search (ARS). As such, a track is expected to become more tortuous. Global positioning system tracking methods (GPS) elucidate fine-scale movement patterns, allowing for the evaluation of track tortuosity as a

proxy for search behavior. For the first time, we deployed GPS tags on Cape fur seals (*Arctocephalus pusillus pusillus*) to understand the distribution, fine-scale movement patterns, and at-sea habitat associations of these top predators in the Benguela Current. In June 2007, we deployed six GPS tags on adult female Cape fur seals at Kleinsee seal colony. Tags were recovered in July 2007. Tracks were interpolated at 5 second intervals and regions of area restricted search were evaluated using a fractal landscape method. Our results provide novel insights into the at-sea behavior of Cape fur seals, including fine-scale analysis of search behavior, broad-scale distribution, and the oceanographic and baythmetric conditions related to each.

Oral B 5

The influence of SST's and Ocean Modes of Variability on Mid-latitude Cyclones over South Africa

Neil C.G. Hart, Chris J.C. Reason

University of Cape Town, Cape Town, South Africa

Mid-latitude cyclones and their associated rain-bearing cold fronts are a dominant feature of South African weather and climate. They are the primary rain producing systems for the South African winter rainfall region, contributing the most to the total annual rainfall in this region. This study uses an automated cyclone tracking scheme to identify mid-latitude cyclones and calculates statistics of cyclone frequency and intensity in a 28-year atmospheric dataset. The statistics are then used to investigate possible relationships of these mid-latitude storms with sea surface temperatures and ocean modes of variability in the South Atlantic and South Indian Oceans.

Poster Mon 1

The Pacific oyster *Crassostrea gigas* as a vector for marine invasives in South African aquaculture

T. M. Haupt¹, C. L. Griffiths¹, T. B. Robinson¹, A. Tonin²

¹*University of Cape Town, Cape Town, South Africa*

²*Mariculture Development Services, South Africa*

Aquaculture is one of the fastest growing sectors in the World food economy and the oyster industry is no exception. In the past, the introduction of biotic invaders occurred mainly through the ballast of ships, but as aquaculture increases in both scale and geographical extent, this activity has become a significant vector for introduced species. A wide spectrum of organisms can

hitchhike on, or in, introduced oysters. In South Africa, the history and current extent of the introduction of exotic oysters for aquacultural purposes has not been well documented. Most of the oysters cultured here are raised from spat imported from Chile or France. The aims of this project include investigating the occurrence of marine invasives associated with the importation of *C. gigas* by conducting surveys at oyster farms in South Africa. Oysterspat will also be imported and examined for any organisms accompanying these oysters. The risks of translocation, where the possibility of organisms residing on *C. gigas* in one location, being transferred together with the oysters to another location within South Africa, thus expanding the range of the introduced species, will also be examined. An interesting result so far is the occurrence of marine invasives in isolated aquacultural areas away from harbours or recreational activities that might otherwise serve as vectors. At Alexcor oyster farm in Alexander Bay, seven out of the 45 species sampled were invasive. An interesting finding is a newly listed marine invasive sea urchin *Tetrapygus niger*, which originates from Chile. Results have also shown that the numbers of species present on oysters before they are relocated (35) are substantially reduced (11) after the standard cleansing procedure. However, the survival rates of species approximately 24hours after being translocated are relatively high (9). Soaking of oysters in freshwater is suggested as a method of removing any organisms and possible invasive species before oysters are relocated. An establishment of a local spat culture facility will also prevent the introduction of organisms associated with oyster spat imports.

Poster Tue 33

Planktic cnidaria along the South and West coast of South Africa – mesoscale coupling the physical environment

Rebecca Helm^{1,2}, Mark J Gibbons¹

¹*University of the Western Cape, Bellville, South Africa*

²*Marine & Coastal Management, Cape Town, South Africa*

Planktonic cnidarians are a common and little understood component of the South African marine pelagic ecosystem. With the use of transect samples from Hondeklip Bay to Mossel Bay, collected during the 2000 Marine and Coastal Management Pelagic Spawner Biomass Survey cruise, we have identified the distribution and abundance of hydromedusae species occurring along the South and West coast of South

Africa, and compared our data to those previously collected on physical and environmental factors. Results indicate that medusa species vary in distribution and abundance in relation to coastal proximity, water mass and coastal location. These data provide insights into the distribution of hydromedusa cnidarians, animals which may serve as important predators of, and competitors with, species of conservation importance, such as commercially important pelagic fish larvae and eggs.

Oral A 9

The nematodes of Saldanha Bay – Is Squiggler Park a high or low octane community?

Hendricks, M.G.J.¹, Gibbons, M.J.¹, Lamshead, P.J.D.²

¹ University of the Western Cape, Bellville, South Africa

² Natural History Museum, London, England

Free-living marine nematodes are present in most marine sediments and they occur at all depths, from the intertidal to hadal zones. The study of South African marine nematodes is in its infancy and this paper introduces aspects of their ecology. This paper examines the effect of eutrophication and selected trace metals on the abundance, diversity and species composition of nematodes in six sample sites in Saldanha Bay. Sediments accumulate trace and heavy metals and this condition is especially evident at the most heavily polluted site (beneath a mussel raft). This station and adjoining areas are characterised by high levels of mud and nitrogen. This paper will explore the species composition and feeding guild structure with respect to concentration Cd, Pb, Cu, coupled with sediment structure.

Oral PL 9

An introduction to the South African Environmental Observation Network's two marine nodes – Elwandle and Egagasini

Juliet C. Hermes¹, Kim Bernard², Angus Paterson², Johan Pauw³

¹ SAEON, Cape Town, South Africa

² SAEON, Grahamstown, South Africa

³ SAEON, Pretoria, South Africa

The South African Environmental Observation Network (SAEON) aims to provide a comprehensive, sustained, co-ordinated and responsive South African Earth observation network that delivers long-term reliable data for scientific research and informs decision making for a knowledge society and improved quality

of life. SAEON addresses the environmental observation and information needs of future generations, reaching far and wide, nationally, regionally and globally, and its success as a platform for environmental observations depends on delivery of reliable environmental data and products for science, policy and management. Education-Outreach, based on environmental sciences, has a specific focus on science educators, learners and research students. Egagasini, the marine offshore node of SAEON aims to fill the gaps in long-term ocean monitoring, helping to understand the impact of climate change on oceans and their resources surrounding South Africa, as well as improving our knowledge of the oceans' influence on climate change. It is vital that we better understand these oceans as they have been shown to play a major role in the weather and climate patterns over southern Africa, as well as our coastal systems. The coastal node of SAEON, Elwandle, aims to improve our understanding of the structure and functioning of coastal ecosystems. Focusing on the influence of land-sea interactions, nearshore-offshore coupling and resource use by man, Elwandle hopes to gain perspective on the potential impacts of long-term global change on our precious coastal ecosystems. The impacts of global change through factors such as increases in temperature and sea level rise, which are already evident, are likely to have devastating effects on the lives of millions of impoverished people. Improved long term monitoring, information dissemination and education are essential to help us understand and adapt to future situations.

Poster Wed 17

The age structure, growth and diet of the Risso's dolphin, *Grampus griseus*, Cuvier, 1812

E. R. Heyns¹, S. Plön², P.W. Froneman¹

¹ Rhodes University, Grahamstown, South Africa

² Port Elizabeth Museum, Port Elizabeth, South Africa

The trophodynamics of male and female Risso's dolphin, *Grampus griseus* were investigated in 2007. Age estimates, determined by counting of the growth layer groups (GLGs) deposited annually in the teeth, indicated that the maximum age of *G. griseus* is 10 years for males and 13 years in females. The growth rate constant ($k \cdot \text{year}^{-1}$) of males was calculated as 0.25 and 0.47 for females. An Index of Relative Importance (IRI) calculated from gut content analysis, indicate that the diets of male and adult female Risso's dolphin are broadly similar and consisted mainly of the cephalopods *Lycoteuthis lorigera*, *Loligo vulgaris reynaudii* and *Ancistrocheirus lesueuri*. The most important spe-

cies targeted by *G. griseus* female juveniles were *Cranchia scabra*, *L. lorigera* and *Octopoteuthis sp.* This suggests possible ontogenetic partitioning of food resources.

Oral B 6

Increase in populations of sympatric species of fur seals at Marion Island

G.J. Greg Hofmeyr^{1,2}, Marthán N. Bester¹, Azwienewi B. Makhado^{1,3}, Pierre A. Pistorius^{1,4}

¹ University of Pretoria, Pretoria, South Africa

² Port Elizabeth Museum, Port Elizabeth, South Africa

³ Marine and Coastal Management, Cape Town, South Africa

⁴ Seychelles Island Foundation, Mahe, Seychelles

Intensive harvesting prior to the 20th century brought most species of fur seals close to extinction. Since the cessation of most forms of direct exploitation, many populations have increased substantially, some approaching carrying capacity. The population of Subantarctic fur seals *Arctocephalus tropicalis* at subantarctic Marion Island (46°54'S, 37°45'E), and the much smaller sympatric population of Antarctic fur seals *A. gazella* have both experienced considerable growth in recent years. We examined recent trends in abundance to determine whether either of these populations has reached carrying capacity. Pup production was assessed during the 2003/04 breeding season and compared to past censuses. The Subantarctic fur seal population has increased at a mean annual rate of 5.2 % over the last 10 years, approximately half the rate recorded between 1951 and the late 1980's. The Antarctic fur seal population grew at more than three times that rate over the same period (17.0 %). Neither population has therefore reached carrying capacity. Since the diets of the two species are similar, we suggest that the dissimilarity in population growth between them is due to differences in the availability of preferred terrestrial habitat and the effects of density dependant pup mortality. Together with the neighbouring Prince Edward Island, this island group supports populations of approximately 150 000 Subantarctic fur seals and approximately 5 800 Antarctic fur seals.

Poster Mon 7

The Mariculture Potential of the Indigenous Sea Urchin *Tripneustes Gratilla* (Linnaeus, 1758) in South Africa

D A Horstman¹, M.S. Stekoll², Y.C. Melo¹, F.M. Swanepoel¹

¹ Marine and Coastal Management, Cape Town, South Africa

² University of Alaska Southeast, Juneau, Alaska, USA

As most sea urchin fisheries worldwide are overexploited, aquaculture is increasingly utilized in an effort to sustain sea urchin production. Several species of sea urchins are now being cultivated for commercial purposes. With the continued increasing demand for sea urchin gonads as a food product, new species are being assessed for their aquaculture and market potential. In this context, we evaluated the potential of a land based, closed cycle echiniculture. *Tripneustes gratilla* found along the East Coast of South Africa was chosen as a candidate as it exhibits excellent potential as an aquaculture species. Larvae of *T. gratilla* were successfully cultured in a controlled environment. The life cycle was completed in culture. A dual feeding trial was undertaken using juvenile sea urchins to determine their growth fed on a diet of three local seaweed species in land based tanks. One experiment was carried out under controlled conditions (temperature, light and water quality) at a research aquarium, whilst the second experiment was conducted in a flow-through system under ambient light and temperature conditions at a working abalone farm. Larval culture and the effects of natural diet and temperature on post-metamorphic growth during on-growing experiments on juveniles were assessed. *Tripneustes gratilla* exhibited a fast rate of growth, reaching 70 to 80 mm test diameter and reproductive maturity within one year. Results suggest that a production cycle of 12 to 15 months post-settlement to reach a market size >80 mm is feasible, that *T. gratilla* readily consumed a variety of sea weeds and that this species is easily maintained in culture, making this species a good candidate for aquaculture. Key words: algae, aquaculture, indigenous sea urchin, seaweed, development.

Oral C 2

Characterisation of an intracellular bacterium infecting the digestive gland of the South African abalone, *Haliotis midae*

Rael Horwitz, Vernon Coyne

University of Cape Town, Cape Town, South Africa

During a health management programme in 2000, a Rickettsiales-like organism was observed in the digestive gland of the farmed South African abalone, *Haliotis midae* (Mouton, pers. com.). Histological examination showed that the intracellular, unknown bacterium was proliferating within cytoplasmic vacuoles

which resembled the Rickettsiales-like prokaryote *Candidatus Xenohalictis californiensis* which is the causative agent of withering syndrome currently affecting the black abalone *Haliotis cracherodii* Leach and the red abalone *Haliotis rufescens* Swainson. As yet none of the abalone infected with the Rickettsiales-like organism show clinical symptoms of disease. However, it is important to note that one of the characteristics of withering syndrome is that it can develop under stressed conditions, such as starvation or elevated water temperature. This study aimed to characterise the bacterium using the rRNA approach and determine its relationship to other microorganisms, particularly *C. Xenohalictis californiensis*. Total genomic DNA was extracted from samples of infected digestive gland of cultured *H. midae*. The majority of the 16S rRNA gene of the intracellular bacterium was sequenced by performing nested PCR with universal eubacterial primers fD1/Rp2 and broad spectrum primers EHR16SD/EHR16SR which are specific for the Anaplasmataceae family within the Rickettsiales order. PCR performed with *C. Xenohalictis californiensis* specific primers RA 5-1 and RA 3-6 did not yield any positive results, indicating the withering syndrome agent was not present. Phylogenetic and evolutionary distance analysis determined the *H. midae* digestive gland isolate to be a unique member of the α -proteobacteria that is closely related to Rickettsiales and Rhizobiales species. The location of the intracellular bacterium *in vivo* was confirmed by *in situ* hybridization performed on sequential sections of infected *H. midae* digestive gland using a combination of three digoxigenin-labeled probes specific to various portions of the 16S rRNA gene of the Rickettsiales-like organism.

Oral C 7
Quantifying PSP toxins on the west coast of South Africa

Bernadette Hubbart^{1,2}, Grant C. Pitcher², Alan Cembella³, John J. Bolton¹

¹ University of Cape Town, Cape Town, South Africa

² Marine and Coastal Management; Cape Town; South Africa

³ Alfred Wegener Institute for Polar and Marine Research; Bremerhaven; Germany

PSP (Paralytic Shellfish Poisoning) is a syndrome caused by consuming shellfish with high concentrations of saxitoxins (STX) and its derivatives. PSP occurs globally, with 2000 recorded cases every year, one in every seven of which are fatal (Van Dolah, 2000). In South Africa PSP occurs on the west coast, the first

confirmed cases in 1948 (Sapeika, 1948). There is a regulatory limit of 80 μg STX eq/100g shellfish for human consumption; monitored using the mouse bioassay. Off the west coast of South Africa, PSP toxins have been linked to the dinoflagellate *Alexandrium catenella*. Composition and potency of PSP toxins vary depending on where the alga is found and environmental conditions (Pitcher & Calder, 2000). HPLC/mass spectrometry was used to elucidate percentage composition of PSP toxins, and to determine a cell toxin quota for *A. catenella* found off Lamberts Bay in March 2007. Concomitant with the *A. catenella* bloom, high concentrations of PSP toxins were recorded in the black mussel, *Choromytilus meridionalis*. The PSP toxin profile in the black mussel differs from that in *A. catenella* and changes with time, suggesting biotransformation of PSP toxins takes place. Different techniques used to detect PSP toxins were compared: the standard mouse bioassay, RBA, ELISA and HPLC/mass spectrometry. *A. catenella* disappeared within two weeks of a month long survey, after reaching a maximum 600 000 cells/l of seawater after three days. However PSP toxins persisted in the black mussel, peaking a few days after the bloom maximum at 12 000 μg STX eq/100g mussel, at the end of the month barely falling below 2 000 μg STX eq/100g mussel. The regulatory limit at 80 μg of STX eq/100g shellfish far below the minimum concentration recorded. A one compartment model describes uptake and clearance of PSP toxins from the black mussel using the field data.

Oral C 2
Molecular characterisation of the extracellular proteases of *Vibrio midae* SY9

Robert J. Huddy, Vernon E. Coyne
University of Cape Town, Cape Town, South Africa

There is mounting experimental evidence showing that the health and physiology of aquacultured species can be improved through the use of probiotic bacteria. In this study, the extracellular proteases of *Vibrio midae* SY9, a putative nutritional probiotic for aquacultured abalone, were investigated. Previous research has shown that abalone fed a high protein artificial diet supplemented with the bacterium *V. midae* SY9 have both an increased growth rate and an improved immune response. In this study, substrate SDS-PAGE showed that *V. midae* SY9 produces three extracellular proteases, including a 68 kDa detergent resistant protease. The *V. midae* SY9 detergent resistant extracellular protease was purified from the culture medium by making use of a combination of ion-exchange and gel filtration

chromatography. The purified enzyme was found to be most active at 50°C and has an optimal pH range between 9 and 10. The gene encoding the detergent resistant protease was cloned and characterized. Nucleotide sequencing and analysis indicated that the 1.6 kb ORF encodes a 534 amino acid protein which has high similarity to that of a *Vibrio alginolyticus* detergent resistant exoprotease. The putative promoter region of the *V. midae* SY9 detergent resistant protease was identified and northern hybridisation showed that the mRNA transcript is 1.69 kb in length. Two insertional inactivation mutants were constructed using modified constructs of the suicide vector pGP704. Whilst the growth of the mutant *V. midae* SY9 strains was not affected by inactivation of the detergent resistant protease gene, the extracellular protease activity of these strains was significantly reduced. *V. midae* SY9 extracellular protease activity was shown to be regulated by the concentration of protein, reducing sugar and amino acids in the growth medium. Thus, the protease gene is regulated by catabolite and end-product repression, while a suitable protein substrate is required for protease gene expression

Oral PL 13

Patterns in the Plankton: copepod abundance, biomass and distribution in the Southern Benguela-Agulhas Bank ecosystem over the last 20 years

Jenny A. Huggett, Hans. M. Verheye, Larry Hutchings
Marine and Coastal Management, Cape Town, South Africa

Copepods dominate the marine zooplankton community, and constitute the biggest source of protein in the oceans. They are central to the pelagic food web, in particular the diet of commercially important fish such as anchovy, sardine and horse mackerel. Copepod abundance, distribution and species composition over the continental shelf between the Orange River and Port Elizabeth has been monitored biannually since 1988, during routine hydro-acoustic stock assessment surveys of pelagic fish during winter (May-Jun) and spring/summer (Oct-Dec). We present data on annual and seasonal copepod biomass for the region, as well as abundance and distribution of key species. We also explore patterns of size-composition, and whether these have changed over time. Data from monitoring lines off St Helena Bay and Mossel Bay are used to compare interannual variability in copepod biomass and composition on the West and South Coasts over the last two decades. Density-dependent relationships between

copepods and pelagic fish biomass are also investigated.

Oral A 10

Stomach contents and stable isotopes: trophic ecology of a carcharhinid and a sphyrnid off south east Africa

Hussey, N.E.¹, McCarthy, I.D.¹, Cliff, G.², Dudley, S.F.J.², Fisk, A.T.³

¹ Bangor University, Anglesey, North Wales, U.K

² Natal Sharks Board, Umhlanga, & University of KwaZulu-Natal, Durban, South Africa

³ University of Windsor, Windsor, Canada

Stable isotopes are recognised as an important tool for understanding the trophic ecology of animals and have been applied extensively in the study of terrestrial and aquatic food webs. Combining stomach content and stable isotope analysis, we examined the trophic ecology of the dusky (*Carcharhinus obscurus*) and scalloped hammerhead (*Sphyrna lewini*) sharks off southern Africa. Sample numbers for both species enabled the division of the diet/isotope data by sex and into three size categories, small, medium and large individuals, approximating sexual maturity stages. Dietary data, calculated as percentage mass, found ontogenetic shifts in diet for both species with teleosts and elasmobranchs and teleosts, elasmobranchs and cephalopods dominating the diet of *C. obscurus* and *S. lewini* respectively. Trophic level calculated from diet found that female *C. obscurus* and male *S. lewini* increased their trophic position over ontogeny, however male *C. obscurus* and female *S. lewini* showed no ontogenetic switch in trophic level. The $\delta^{15}\text{N}$ values of muscle tissue were in agreement for male *S. lewini*, demonstrating an increase in trophic level with increasing size of animal, but it would appear that dietary calculations underestimated the trophic position of these sharks. For female *C. obscurus*, $\delta^{15}\text{N}$ values were not in agreement and showed no change in trophic level over ontogeny. Discrepancies between diet-calculated trophic level and $\delta^{15}\text{N}$ values are probably due to the different time frames represented by stomach contents and assimilated dietary data in muscle tissue in conjunction with movements between isotopically distinct food webs. A comparison of the ontogenetic trophic profiles derived from stomach content analysis and stable isotopes will be presented.

Oral B 9

Ecosystem considerations of the KZN Sardine run

L. Hutchings, T. Morris, C. van der Lingen, S. Lamberth, A. Connell
Marine and Coastal Management, Cape Town, South Africa

The Kwazulu-Natal sardine run is a regular seasonal migration of sardines from the eastern Agulhas bank to the coastal waters of Kwazulu-Natal. The intensity of the run, estimated as the frequency and size of shoals which occur very close inshore, displays considerable interannual variability and appears independent of the biomass of sardines found over the Agulhas Bank. This speculative contribution examines the ecosystem effects of the sardine run, in terms of: Enrichment of the east coast ecosystem, compared to enrichment from coastal upwelling, groundwater discharge, river runoff and Natal pulses; Competition between sardines and other pelagic species, such as east coast and west coast redeye, anchovies, chub mackerel and *Decapterus*; A forage supplement for top predators such as sharks, dolphins and predatory fish and how this links in with life histories of top predators on the east coast; Economic alternatives on the east coast, comparing fish as a tourist spectacle, as bait, for human consumption, or as a boat-based purse seine fishery for meal; Forecasting the intensity and/or the frequency of nearshore occurrence of shoals

Poster Tue 23

Seasonal shipboard transect monitoring in St Helena Bay in the Southern Benguela, 2000-2008

L. Hutchings, H. Verheye, M. Worship, F. Frantz, A. Miggel, S. Jones, H. Ismail, C. Illert, E. Wright
Marine and Coastal Management, Cape Town, South Africa

Two oceanographic transects (12 stations and two stations) in St Helena Bay (32oS) were sampled monthly from April 2000 to April 2008, as part of a BENEFIT initiative to monitor changes in the Benguela Upwelling system at three ecologically important sites. The other sites included Walvis Bay (23oS) in Namibia and Namibe (15oS) in southern Angola. Standardized sampling protocols were applied to all three areas. These sites are important at different stages in the life history of some of the commercially important fish stocks in the three countries and the shipboard transects were complemented by remote sensing, buoy data, mesoscale fisheries surveys and process-orientated

cruises in order to determine variability at different time and space scales through the Benguela Upwelling Ecosystem. The data also contribute to long-term data sets on dissolved oxygen and zooplankton, while providing information on seasonal changes. Inshore-offshore thermal gradients peak during summer months when maximum upwelling intensity inshore coincides with advection of water of Agulhas origin onto the west coast. Phytoplankton concentrations are high (100-150 mg chl_a/m²) throughout the year, with a slight decrease during winter months. Interannual variability is not marked. Dissolved oxygen concentrations are high in the upper mixed layer but low (<2 ml/l) throughout the bottom mixed layer inshore, particularly in late summer and autumn, when extreme low oxygen conditions may induce rock lobster strandings and mass mortalities and affect hake recruitment grounds. Intense mixing events during winter or downwelling during summer result in intermittent periods of increased oxygen concentrations. Prolonged periods of low oxygen have occurred in 1982/3, 1994-2000 and extensive low oxygen water is currently prevalent in the southern Benguela and appears to have intensified during recent years. Mesozooplankton biomass exhibited strong seasonal variability between 2000-2004 which has diminished in recent years, despite the consistently high phytoplankton concentrations. Currently the zooplankton signal appears to have diminished to a pattern similar to the 1970's. A reversal of the long term upward trend in zooplankton in autumn months is not reflected in the peak summer values, which continue to increase. Predation by pelagic fish may be a powerful factor in years when high recruitment occurs. Changes in pelagic fish condition appear to reflect food availability and will reduce energy reserves for the migration and subsequent spawning on the Agulhas Bank. These multidisciplinary data provide groundtruthing for models, a description of seasonal and interannual changes and contribute to the decadal time series from this important region.

Oral C 10

Monitoring of the linefishery in the Berg River Estuary (Western Cape, South Africa), with evidence of recovery subsequent to closure of commercial gill netting.

K. Hutchings^{1,2}, B.M. Clark^{1,2}, L. J. Atkinson²

¹ *Anchor Environmental Consultants, Cape Town, South Africa*

² *University of Cape Town, Cape Town, South Africa*

A total of 248 roving creel surveys were conducted

along the length of the Berg River estuary over the period December 2002–November 2005. Average total annual line fishing effort is estimated as 256 boat angler days, 1400 recreational shore angler days and 1448 subsistence (handline) shore angler days. The estimated total linefish catch from the estuary for the years 2004 and 2005 was approximately 36 000 and 57 000 fish (12–14 tons) per annum respectively. Compared to other estuaries along the South African east coast where angler catches have been surveyed, species diversity in catches from the cool temperate Berg River estuary was low, with only 15 species caught, of which three, elf *Pomatomus saltatrix* (56 %), harders *Liza richardsonii* (31 %) and carp *Cyprinus carpio* (11 %) dominated the catch. Average linefish catch-per-unit effort of most species increased substantially in the two years subsequent to the closure of the long existing commercial gill net fishery in March 2003. Length frequency distributions also revealed significant increases in the average size and an increased contribution of larger size class elf and harders to the linefish catch over the monitoring period. Ninety-eight percent of the 360 handline fishers interviewed lived within 10 km of the Berg River estuary, highlighting the importance of subsistence linefishing as a food source for the local community. In contrast, nearly half (42 %) of the 246 recreational rod anglers interviewed were from further a field (> 20 km from the estuary) and their presence and expenditure must contribute significantly to the local economy.

Poster Tue 17
Nutrient distribution patterns on the St Helena Bay Monitoring Line

H. Ismail, T. Lamont, C Illert, R. Barlow
Marine & Coastal Management, Cape Town, South Africa

A survey of nutrient distributions (nitrate, phosphate and silicate) was conducted during monthly cruises on the RV *Africana*, RV *Algoa* and RV *Ellen Kuzwayo* on the St Helena Bay Monitoring Line (SHBML) (32.3°S, 18.3°E to 33.7°S, 16.4°E) from March 2004–December 2007. The objective was to provide a chemical background for the physical and the biological studies undertaken on this line. Samples were obtained with a multi-bottle rosette sampler and analysed by standard auto-analyser methods on an Astoria Analyzer system. Surface nutrient concentrations were always higher in the inshore environment (nitrate, 8–26 mmol m⁻³) compared to offshore, probably reflecting upwelling processes. The patterns showed that nutrients were

distributed further offshore during winter than summer, particularly during 2006 and 2007. Surface nutrients appeared to be very low (<2 mmol m⁻³) across almost the entire SHBML during the summers of 2006 and 2007. Selected depth transects revealed that nutrient concentrations increased with depth at all stations, but inshore stations tended to display high levels of nitrates and silicates throughout the water column. Phosphates were more variable and showed patches of elevated concentrations (4–8 mmol m⁻³) at depth at 65 km offshore and at 160 km offshore.

Oral B 10
The mechanics of a dipole eddy in the western Mozambique Channel and its influence on primary production

Lee-Ann Jacobs¹, Mike Roberts²
¹ *Cape Peninsula University of Technology, Cape Town, South Africa*
² *Marine & Coastal Management, Cape Town, South Africa*

Roberts et al. (2008) proposed that the mechanics of dipole eddies in the Mozambique Channel change when they encounter the sides of the channel and consequently are responsible for the chlorophyll *a* filaments (streamers) so often observed in this region. In September 2007 a dipole eddy in the western part of the channel was surveyed by the *F.R.S Algoa* during the ACEP cruise and its structure determined using a CTD, XBTs, satellite-tracked drifters, an onboard ADCP, Bongos and samples for stable isotope analysis. ADCP data coupled with the drifter data highlighted the strong currents in these feature — in excess of 1.5 ms⁻¹ — driven by SSH anomalies of between ±30 and 35 cm. The data also confirmed that geostrophic calculated velocities were underestimating actual velocities. The CTD and XBT data showed the thermocline to be raised in the cyclonic eddy and adjacent to the shelf, but deepened in the anticyclonic eddy component of the dipole. Florescence data indicated a 30–50 m layer of chlorophyll *a* in the thermocline in response to the raised levels of nutrients — indicating that dipole eddies drive primary production. However, superimposed ocean colour imagery also showed chlorophyll *a* in the surface waters to be swept from the adjacent Mozambique shelf, between the cyclonic and anticyclonic eddies of the dipole, and into the middle region of the channel. The impact of this chlorophyll on the ecosystem in the mid channel is not yet understood but certainly dipoles play an important role in transporting biological material on the shelf offshore.

Poster Mon 13

Changes in the permanently open Bushmans Estuary, South Africa

N. Jafta, J.B. Adams, G.C. Snow
Nelson Mandela Metropolitan University, Port Elizabeth, South Africa

The Bushmans Estuary, on the south east coast of South Africa, is one of the few permanently open estuaries in the Eastern Cape that is characterized by large intertidal salt marshes. In recent years marine sediment has accumulated in the lower reaches of the estuary and freshwater inflow to the estuary has decreased as a result of abstraction by more than 30 weirs and farm dams in the catchment. The Mean Annual Run-off is naturally low ($38 \times 10^6 \text{ m}^3/\text{year}$) and thus abstraction and reduction of freshwater inflow to the estuary has resulted in a number of changes. Salinity has increased, there is a lack of stratification and possibly also a decrease in nutrient input. The objective of this study was to investigate the effect of these changes on the estuarine vegetation. This was done by mapping and comparing vegetation cover and distribution from the earliest (1942) and the most recent (2003) aerial photographs. It was evident that the intertidal salt marsh area had increased since 1942 and this was attributed to marine sedimentation in the lower reaches. Due to the highly saline conditions the area covered by submerged macrophytes (*Zostera capensis*) had increased in 2003. *Zostera capensis* extended from the lower to the upper reaches of the estuary. It colonised the entire length of the estuary because of the favourable marine conditions. Reeds and sedges only covered a small area of the estuary in 2003 at sites of freshwater seepage. The results from this study will be used in the Estuarine Health Index to determine the present status of the estuary and to develop a future monitoring programme, to track the health of the estuary.

Oral B 2

Abundance, recruitment and residency of two sparid fishes in an intermittently open estuary in South Africa

Nicola C. James¹, Paul D. Cowley², Alan K. Whitfield²

¹ *South African Environmental Observation Network, Grahamstown, South Africa*

² *South African Institute for Aquatic Biodiversity, Grahamstown, South Africa*

The recruitment of distinct year-class cohorts in two

sparid species, with contrasting life-history characteristics, *Rhabdosargus holubi* and *Lithognathus lithognathus*, were linked to records of daily mouth state in the intermittently open East Kleinemonde Estuary (Eastern Cape, South Africa), between 1995 and 2006. *Lithognathus lithognathus* only recruited into the estuary in years when the mouth opened between late August and January. This was attributed to a limited spawning season and inability to recruit during wave overwash events. In contrast, *R. holubi* recruitment was uninterrupted and not influenced by seasonality of estuary access opportunities (mouth opening and overwash events). Estuarine-dependent residency periods ranged from 27 to 48 months for *L. lithognathus* and 12 to 23 months for *R. holubi*. The inter-annual abundances of these estuarine-dependent sparids were determined by reproductive seasonality, recruitment strategy and seasonal timing of estuarine access opportunities.

Poster Wed 3

Influence of the permanently open Sundays Estuary on the nearshore marine environment of Algoa Bay, Eastern Cape

Nicola C. James¹, Mandisa Rubuxa¹, Shaun Deyzel¹, P. William Froneman², Angus W. Paterson¹

¹ *South African Environmental Observation Network, Grahamstown, South Africa*

² *Rhodes University, Grahamstown, South Africa*

This study aims to assess the influence of the permanently open Sundays Estuary on physico-chemical parameters and biology of the nearshore marine environment of Algoa Bay (Eastern Cape). Within the nearshore marine environment adjacent to the estuary, a plume of warmer ($T \approx 22^\circ\text{C}$), less saline water ($>33\text{‰}$) with a turbidity value $>10 \text{ NTU}$ was evident adjacent to the mouth of the estuary. The outflow of estuarine water into the marine environment was associated with increased chlorophyll-a (chl-a) concentrations and total zooplankton abundance and biomass. Numerical analysis indicated that the zooplankton community within the plume of low salinity water was distinct from both the marine and the estuarine environments. The initial results of this study indicate that freshwater outflow from the Sundays Estuary had an influence on physical and biological parameters in the adjacent marine environment.

Oral C 2

The role of electron transport in the defence response of the South African abalone, *Haliotis midae*

Marieke Janse van Rensburg, Vernon E. Coyne
University of Cape Town, Cape Town, South Africa

In order to establish health management systems for farmed *Haliotis midae*, it is necessary to understand how the abalone immune system functions and responds to stress and disease. Two genes of the electron transport system, cytochrome *b* and cytochrome *c* oxidase III, were found to be upregulated in a cDNA microarray experiment performed on haemocytes from immune-stimulated abalone (Arendze-Bailey, unpublished). The current study sought to elucidate the role of these genes, and thus the electron transport system, in the abalone immune response by specifically inhibiting cytochrome *b* with antimycin A and measuring haemocyte immune parameters *in vitro*. Antimycin A did not decrease haemocyte cell viability, but halved cellular ATP from 4×10^{12} to 2×10^{12} nM/cell. Inhibition of electron transport resulted in a 0.6 fold increase in cellular superoxide levels, while phagocytosis dropped by nearly 50% and the ability of haemocytes to kill bacteria was also reduced. Since cytochrome *b* and cytochrome *c* oxidase III expression is upregulated in immune-stimulated abalone, and inhibition of electron transport resulted in a decreased immune response *in vitro*, we conclude that the *H. midae* immune response is dependent on electron transport and that oxidative phosphorylation plays a role in the immune response following stimulation.

Poster Mon 22

An audit of marine protected areas in South Africa

Liesl Janson¹, Colin Attwood², Toufiek Samaai¹
¹ *Marine & Coastal Management, Cape Town, South Africa*

² *University of Cape Town, Cape Town, South Africa*

We provide useful facts and figures on marine protected areas (MPAs) in South Africa that can be used to (1) gauge the country's progress in terms of conservation policies, (2) provide information for further (systematic) conservation planning and (3) assess the state of MPA management. Data were obtained from legal statutes, published material, DEA&T internal documents and marine protected area managers (where these exist). South Africa has 21 MPAs declared in terms of the Marine Living Resources Act, and these are managed collectively by three provincial conserva-

tion agencies, the South African National Parks and the Isimangaliso Wetland Park Authority. Two MPAs are effectively unmanaged. There is no evidence of co-management in any MPA. Seven MPAs are zoned, and all but four include no-take areas. All MPAs serve multiple objectives, but the effectiveness of the MPAs in attaining these objectives is seldom evaluated. Non-consumptive activities are promoted in only nine MPAs. Monitoring programmes are sporadic. Several MPAs are used for research, usually by external research agencies. Only two MPAs are not adjacent to terrestrial protected areas, and some areas are proclaimed in terms of two national Acts, conflicting in at least one MPA. Few MPAs have staff dedicated to marine tasks. Compliance with regulations varies widely. The most compromised MPAs are those which harbour stocks of abalone. Most MPAs receive funding from national Government, but this is a recent development. The information provided here will be updated at regular intervals by MCM, but *ad hoc* updates will be made when managers submit corrections.

Oral PL 11

Multi-criteria decision support: a toolbox for integration, communication and collaboration in marine social-ecological systems under global change?

Astrid Jarre, Barbara Paterson, Margaret N. Angula et al.

University of Cape Town, Cape Town, South Africa

Decisions concerning the management of human activities in the complex marine social-ecological systems of our world need to account for multiple objectives at multiple scales, and then deal with considerable uncertainty with respect to the present and the future. Multi-criteria decision support offers a suite of techniques to structure such complex decisions, and to increase the transparency of the decision-making process. These techniques capture and integrate expertise from a variety of specialists (including practitioners, natural and social scientists, and decision makers), and therefore can provide a framework for improved communication among stakeholders, as well as for interdisciplinary research collaboration. Based on a review of existing applications of multi-criteria decision analysis in marine social-ecological systems world-wide, we compare the communicative and collaborative achievement of the methods that have been applied, and explore their potential to support holistic, adaptive management approaches.

Oral C 12

Biodiversity of fauna associated with mussel beds in relation to bed structure

Tembisa Jordaan, Christopher McQuaid, Francesca Porri
Rhodes University, Grahamstown, South Africa

Mussels are important ecological engineers on intertidal rocks and contribute substantially to species diversity in marine ecosystems. They provide secondary substratum for other free-living, infaunal or epifaunal organisms, and increase the surface area for settlement by densely packing together into complex multilayer beds. The introduction of the alien invasive *Mytilus galloprovincialis* has extended the upper limit of mussels on the south coast of South Africa, potentially increasing habitat for associated fauna. Our aim was to describe the general biodiversity associated with multi and monolayered mussel beds of *Perna perna* and *Mytilus galloprovincialis*. This was done to determine the role of mussel bed architecture and tidal height on macrofaunal community structure. Samples were collected in Plettenberg Bay, South Africa, where *Mytilus galloprovincialis* dominates the high zone and *Perna perna* the low zone. Three 15 X 15 cm quadrats were scraped off the rock in the high and low zone, and in the mid zone where the two species co-exist. The samples were collected on 3 occasions. In the laboratory the mussel-size was measured and trapped sediment was separated through 75 µm, 1 mm and 5 mm sieves. The macrofauna was sorted from the 1 mm and 5 mm sieves and identified to species level where possible. Multivariate analysis was used on the mean abundance data of the species for each treatment (Hierarchical clustering, multi-dimensional scaling, analysis of similarity and similarity of percentages). Overall, the results showed that tidal height influences the species composition and abundance of associated fauna, and mussel bed layering has no effect. Month also had a strong effect. While there was an overlap of species among January, May and March, the principal species contributing to similarity among the March samples were not found in the other two months.

Poster Tue 27

Preliminary Meridional Characteristics of Primary Productivity along 0° meridian during austral summer on BONUS-GOOD HOPE – IPY Cruise: Feb – Mar 2008

Warren Joubert¹, Pedro Monteiro^{1,2}, Howard Waldron², Sandy Thomalla²

¹ CSIR, NRE, Stellenbosch, South Africa

² University of Cape Town, Cape Town, South Africa

The Sub-Antarctic Zone (SAZ) of the Southern Ocean is considered an important area for ocean exchange of atmospheric CO₂. The main process that drives this drawdown is the “Biological Pump” through primary productivity and carbon export into the ocean interior. This region is characterised by a wide range of spatial (mesoscale features and meridional gradients) and temporal variability. The basis for these scales of variability remains uncertain and the lack of observations also limits the validation of indirect model estimates to quantify productivity. BONUS-GOODHOPE is a research cruise to investigate physical and biogeochemical processes across the major fronts in the Atlantic sector of the Southern Ocean along the 0° meridian. Its focus is on productivity and basin heat exchange. One of the potentially useful aspects of the timing of this work is that since the austral autumn of 2007, the Southern Annular Mode has shifted to a strong negative anomaly. This is an unusual state for the past 25 years and marks an opportunity to contrast the data sets over this period. Primary productivity experiments were conducted to answer questions on the role of the SAZ and specifically the biological pump on CO₂ storage in the ocean. Phytoplankton production was determined from the uptake rates of ¹⁵N and ¹³C labelled NO₃, NH₄ and Urea through deck incubation techniques. Size fractionation experiments were also conducted on surface water samples. Iron spiking experiments were conducted to test the relationship between iron supply and increased carbon export flux. Preliminary results from this cruise campaign will be presented.

Oral C 2

Is it really *Ulva lactuca* or what species are we growing in aquaculture in the South African abalone industry?

Lineekela Kandjengo, John J. Bolton, Terry A. J. Hedderson
University of Cape Town, Cape Town, South Africa

Shellfish farming is a very fast developing industry in South Africa and this is especially true for abalone (*Haliotis midae*). Most of the abalone feed is still wild harvested kelp especially *Ecklonia maxima* but this resource is fast approaching limits of sustainable harvesting especially in areas where the abalone farms are concentrated. Therefore as a result there has been a growing trend towards integrated abalone aquaculture

and this involved mainly the on farm growing of “*Ulva lactuca*”, a development which has been hailed a huge success. In order to confirm the identities of the different species that are grown in aquaculture, this study conducted a morphological and molecular investigation into the species that are farmed in abalone farms. To address this question, the study used the nuclear ribosomal DNA ITS sequences from 25 local samples, inclusive of both farmed as well as wild collections, plus data on 10 samples from Genbank. The morphological analyses positively identified two species, namely *U. rigida* and *U. lactuca*. The molecular studies however added a new dimension to the investigation. Apart from revealing that indeed there are at least two different species, the study also showed that neither the specimens collected from the abalone farms nor those from the wild were actually *U. lactuca*, if the Genbank sequences are anything to go by. This then implies that the South African species that have long been called “*Ulva lactuca*” could indeed be a different species altogether.

Poster Tue 24

Population dynamics of the calanoid copepod *Rhincalanus nasutus* (Copepoda, Calanoida) in the northern Benguela

Ignatius K.V. Kauvee¹, Coleen L. Moloney², Hans M. Verheye³

¹ University of Namibia, Windhoek, Namibia

² University of Cape Town, Cape Town, South Africa

³ Marine and Coastal Management, Cape Town, South Africa

Rhincalanus nasutus (Giesbrecht, 1888) is an eurybathic, cosmopolitan gymnopelean calanoid copepod species, distributed across diverse hydrological regimes. *Rhincalanus nasutus* appears in the northern Benguela as part of the nearshore, cool water assemblage with the herbivorous *Calanoides carinatus* (Kröyer, 1849). Comparative population dynamics studies of *R. nasutus* and *C. carinatus* necessitate the elucidation of the morphology and occurrence of all developmental stages of *R. nasutus*. *Rhincalanus nasutus* is often confused with *Rhincalanus rostrifrons* (Dana, 1849), owing to inadequate study of morphological features of copepods and their developmental stages in the northern Benguela. To test this, I examined specimens collected from 1979 to 1989 during the SWAPELS cruises. The fifth female swimming leg (P5) were found to be uniramous with three segmented rami resembling that of *R. nasutus*, whereas P5 of female *R. rostrifrons* is asymmetrical. The right

branch of the male P5 was found to be uniramous and the left branch being biramous with three equally segmented endopodites resembling that of *R. nasutus*. Naupliar stages were identified using setae on the antennule (A1). The N3 was the smallest collected naupliar stage with seven terminal setae and an aesthete on the A1. This study reaffirms the circumglobal distribution of *R. nasutus*, a distinct genetic lineage of the northern Benguela than *R. rostrifrons*. This study further proves that the first naupliar stage (N1) is suppressed during the development of *R. nasutus*.

Poster Mon 2

Mariculture as a means to add value to the east coast rock lobster *Panulirus homarus rubellus* resource: a physiological approach to defining protocols for wild harvest, transport and grow-out

Justin O.G. Kemp¹, Pete J. Britz¹, Andy C. Cockcroft²

¹ Rhodes University, Grahamstown, South Africa

² Marine and Coastal Management, Cape Town, South Africa

The east coast rock lobster *Panulirus homarus rubellus* is a high value indigenous species collected by subsistence fisherman along the former Transkei coastline in the Eastern Cape, South Africa. However, non-compliance with the minimum size limit and inefficient local enforcement results in the regular removal of sub legal sized animals (<65 mm carapace length). These under-sized lobsters are generally sold directly to tourists, often for a reduced price, or used for personal consumption. Initial indications suggest that this harvest is sustainable as no boat-based commercial fishery exists and a large proportion of the population occurs at a depth or location that is inaccessible to subsistence fishers. The potential to create a win/win scenario arises if these under-sized lobsters could be on-grown under permit from Marine and Coastal Management (MCM). Not only would this relieve pressure on the strained enforcement network but an increased market price for live lobster would add value to the resource and potentially result in a suite of cascading social economic benefits. This research initiative therefore aims to evaluate the feasibility of on-growing juvenile *P. h. rubellus*, with current effort focused in two key directions. The first involves a physiological approach to understanding the growth, survival and transport of *P. h. rubellus*. Laboratory trials have been conducted to determine the optimal temperature for growth and survival as well as the effect of a suite of extrinsic and intrinsic factors on both oxygen consumption and ammonia production. The second involves the develop-

ment of a suitable pelleted diet for *P. h. rubellus* that will allow good growth and survival while eliminating or reducing the need for fresh mussel. Some results from the physiological investigation will be presented and the biological feasibility of on-growing *P. h. rubellus* discussed in light of these findings.

Oral A 2

Can a Marine Protected Area protect mobile fish? A South African case study

Sven E. Kerwath¹, Eva B. Thorstad², Tor F. Næsje², Colin G. Attwood³, Chris Wilke¹, Finn Økland², Paul D. Cowley⁴

¹ Marine and Coastal Management, Cape Town, South Africa

² Norwegian Institute for Nature Research, Trondheim, Norway

³ University of Cape Town, Cape Town, South Africa

⁴ South African Institute of Aquatic Biodiversity, Grahamstown, South Africa

The application of no-take areas in fisheries remains controversial. Critics argue that many targeted species are too mobile to benefit from area protection, and that no-take areas are only appropriate for resident species. Ultimately, the degree of protection does not depend on the size of the no-take area but rather on the time fish reside inside its boundaries during key life-history events (i.e. spawning) and during periods of peak fishing activity. To evaluate the potential of small no-take areas in the conservation of a mobile, possibly migratory, long-lived fish species, we used acoustic telemetry to track movements of 30 transmitter-tagged white stumpnose, *Rhabdosargus globiceps* across and on both sides of the boundary of a small (34 km²) no-take area over a full year. The experimental setup made it possible to detect all incidents of fish crossing the protected area boundary and to calculate area utilisation time for individual fish. We detected frequent movements across the no-take area boundary, with strong seasonal and individual variations. There were significant differences in no-take area utilisation patterns between fish from different release points. The time spent in the no-take area by individual fish during summer (mean 50%; max 98%) was out of proportion with the size of that area (4% of total habitat). Summer coincided with peak recreational fishing activity and with the spawning season of this species. The small MPA provides an effective refuge for the spawning stock of white stumpnose. Our findings suggest that (i) if strategically placed, a small no-take area can be effective in protecting even mobile species and (ii) that models

of spill-over from no-take areas should account for seasonal and individual variation in area utilisation and the spatio-temporal match-mismatch between fish and fishers.

Poster Tue 16

Distribution patterns of *Jasus lalandii* phyllosoma larvae in the Benguela Region

F. J. Keulder

Marine and Coastal Management, Cape Town, South Africa

Commercial catches of West Coast rock lobster *Jasus lalandii* have declined on several fishing grounds along the West Coast of southern Africa, particularly in the northern parts of the distribution range of the species. A combination of overfishing, environmental perturbations and a lack of larval recruitment has been identified as the possible cause of stock decline. The localized depletion of *Jasus lalandii* subpopulations in the Benguela region is the most recent concern of lobster researchers. Poor knowledge of larval recruitment and genetic links between larvae, post larvae and the adult subpopulations has promulgated an investigation into the genetic differences between these different life history stages and into larval distribution in the Benguela region. This paper presents the results on the phyllosoma distribution of *J. lalandii* based on plankton and trawl samples collected during a research cruise conducted between Lüderitz Bay, Namibia and Danger Point, South Africa in January-February 2008. Larval aggregations, size frequencies and stage distribution are discussed in relation to post-larval settlement and recruitment.

Oral A 6

Identifying and Estimating the Variability of Namibian Hake *Merluccius capensis* Recruitment

C.H. Kirchner, C.H. Bartholomae

Ministry of Fisheries and Marine Resources, Swakopmund, Namibia

Two species of hake occur off Namibia, namely the shallow-water Cape hake *Merluccius capensis* and deep-water Cape Hake *M. paradoxus*. Although no concrete evidence is yet available to determine which of these two stocks are shared with South Africa, it is known that only shallow-water Cape hake spawn in Namibian waters. In the first year of life Cape hake are pelagic, which is the only time that they form part of the prey of seals. The change in diet of the seals results

from local changes of prey availability. It is for this reason that the strength of recruitment can be estimated by determining the number of otoliths of hake that are found in the seal scats on an annual basis. This seal scat data is used within an age-structured production model to estimate recruitment. The model estimated spawning stock biomass and recruitment is used to estimate parameters of the Beverton-and-Holt recruitment relationship, which is further used in predictions. The model estimated recruitment residuals show that it is likely that the productivity of the hake stock has changed in the mid 80's. Usually at low spawner biomass levels recruitment should be linearly dependent on the spawner biomass. However, the results show that there is no positive correlation between the spawning stock biomass and recruitment implicating that other factors are responsible for the variability in recruitment. Recruitment depends to a very large extent on the previous year's cohort strength. However, in years of abnormal environmental conditions like 1994, 1995, 2001 and 2004 this dependence fails. Therefore, in this study, upwelling and Angola-Benguela frontal movement indices before and after spawning are used to establish recruitment dependence. A total of 87% of the variability can be explained by the developed recruitment model. It is recommended that the newly established recruitment models be used for recruitment prediction in the stock assessment model instead of the Beverton-and-Holt relationship.

Poster Wed 22

Assessing interaction potential between the Cape fur seal *Arctocephalus pusillus pusillus* and fisheries in South Africa

Steve P. Kirkman^{1,2}, Laurent Drapeau³, Arne Bjørge⁴, Mette Mauritzen⁴, Mike A. Meyer², Erik Olsen⁴, W. Herman Oosthuizen², Jean-Paul Roux⁵

¹ *University of Cape Town, Cape Town, South Africa*

² *Marine and Coastal Management, Cape Town, South Africa*

³ *IRD, Paris, France*

⁴ *Institute of Marine Research, Bergen, Norway*

⁵ *Lüderitz Marine Research, Lüderitz, Namibia*

The description of interactions among components of marine ecosystems is key to understanding and forecasting the consequences of management (or lack thereof), human-influenced changes, and other modifications. In the Benguela ecosystem, complex interactions between the Cape fur seal *Arctocephalus pusillus pusillus* and commercial fisheries are a continuing source of controversy. While aspects of these interac-

tions, such as seal diet in relation to fisheries and operational conflict between fisheries and seals have been well documented, properly evaluating the extent of interactions requires an understanding of how the distributions of seals and fisheries overlap in space and time. In 2003-2004, we deployed Argos positional satellite transmitters on random samples of Cape fur seals of either sex (13 female, 11 male), replicated over 3 main seal breeding colonies representative of the range of the species in South Africa. GPS data from vessel monitoring systems of vessels in 5 major fleets (demersal trawl, inshore trawl, hake longline, pelagic purse seine and squid jigging) were overlaid on the seal tracking data in a grid-based GIS assessment model of their co-occurrence. Quantification of similarity/dissimilarity agreement in the spatial distribution of seals and the various fishing fleets was based on a robust contingency matrix approach, whereby cross tabulations of categories (high to weak) indexing the time spent by seals against each fleet in the 10 x 10 km grid cells, were performed. Results were mapped, providing spatial patterns of interactions, which display the locations and strengths of various co-occurrence levels from avoidances, good matching and random aspects. The Generalized Kappa Index of Agreement was computed as a similarity/dissimilarity measurement index based on categorical data analysis. This study introduces a novel approach to assessing the seal-fishery interface and providing spatial indices of seal-fishery interactions.

Oral PL 14

South African fisheries : the long term road to ruin?

H. Kleinschmidt¹, W.H.H. Sauer², S. Moola¹

¹ *FEIKE, Natural Resource Management Advisors, Cape Town, South Africa*

² *Rhodes University, Grahamstown, South Africa*

The Constitutional imperative in South Africa after 1994 was to build a just and equitable order that would benefit its entire people after centuries of social and legal privilege benefited ruling minorities. In 1998 new era fisheries legislation aimed to redistribute fishing access rights and reform the sector. The challenge was to take away from some and to give to others, such that fish stocks should not be compromised, social equity would be better served and yet to achieve this via democratic principles and upholding of the rule of law. Legal and social conflict was an inevitable consequence. False starts, administrative incapacity and new inequalities were given rise to. Inadequate political support, court challenges, including to the highest

Constitutional court, followed from those who felt too little had been allocated their way and from those who felt too much had been taken from them. By 2008 the conflict was still not settled. In this paper we document the results of the long term rights allocation process, and examine the outcome in terms of sustainability, economic stability, equity and governance. We attempt to answer the question; “can the monopolistic features of a modern, high investment industry, be maintained in part, but at the same time meet fishing community expectations and return historic rights in a new dispensation, but one that enshrines capitalist principles ?

Oral B 7

Seasonal trends in habitat utilization of white sharks (*Carcharodon carcharias*) in False Bay, South Africa

Alison Kock^{1,2}, Karl Laroche³, Michael Meyer⁴, Leonard Compagno¹, Deon Kotze⁴, Charles Griffiths², Herman Oosthuizen⁴

¹ Iziko South African Museum, Cape Town, South Africa

² University of Cape Town, Cape Town, South Africa

³ Simon Fraser University, British Columbia, Canada

⁴ Marine and Coastal Management, Cape Town, South Africa

White sharks (*Carcharodon carcharias*) are apex predators, and are thus predicted to have diverse and important ecosystem effects. However, critical habitats and their utilization have yet to be identified for this species, and information on population dynamics and occurrence are required to understand the role that white sharks play within their local ecosystems, in addition to ensuring that local protection and management measures are effective. To address these ecological issues, we initiated a telemetry study in May 2004 at Seal Island, False Bay, the largest island Cape fur seal (*Arctocephalus pusillus pusillus*) breeding colony in South Africa. In April 2005 the study area was expanded to integrate the near-shore (within 2.5 km from the coast) environments of False Bay, extending around the bay from Cape Hangklip to Cape Point. Thirty-five acoustic listening stations have been deployed on the seafloor around the island and in near-shore environments, and 75 white sharks (49 female, 24 male, 2 unknown), ranging in size from <200 – 500 cm, have been tagged with acoustic transmitters. Days at liberty ranged from 1 – 975 days with a mean of 228 days. The most important finding was that white sharks are present year-round in False Bay, highlighting the bay’s importance for South Africa’s white shark population.

Distinct seasonal trends in habitat utilization within the bay were also identified: occurrence is highest at the seal colony from May – September, when sharks prey on young of the year Cape fur seals; in contrast, occurrence is highest from October – March in the near-shore areas. We hypothesize that this change in habitat utilization is primarily due to a shift in prey availability within the bay throughout the different seasons.

Oral A 11

Present and past foraging ecology of the African Black Oystercatcher on the rocky shores of the Eastern Cape, South Africa

S. Kohler^{1,2}, S. Jaquemet¹, C. McQuaid²

¹ University of Reunion, Saint Denis, France

² Rhodes University, Grahamstown, South Africa

We investigated feeding ecology of African black oystercatchers in the Eastern Cape through stable isotope analysis and analysis of feeding leftovers. 56 breeding oystercatchers and 48 chicks were captured on rocky shores during the summers 2006-2007 and 2007-2008 in 3 main areas: East London, Kenton and Port-Elizabeth. Blood and feathers were collected on birds for stable isotope analysis. Biometric measurements were taken. Samples of the birds’ main available prey were also collected from the foraging territories of each pair. Historical feather samples (1871-1964) were also gathered from Museums in the Eastern Cape. Feeding leftovers were collected on 4 sites and the relative abundances of the collected prey were compared with their availability on the territories. Carbon isotope analysis segregated mussels and limpets, and oystercatchers showed intermediate values. An enrichment of 3.4 ‰ nitrogen occurred between the main prey and the oystercatchers indicating that the birds foraged both on mussels and limpets. Carbon isotope signatures were more depleted in females than males while the nitrogen isotope signatures did not demonstrate significant sex-related differences. These results indicate that while feeding at the same trophic level, males and females have different main diet, with females foraging preferentially on mussels and males favouring limpets. Comparison of Carbon and Nitrogen signatures in feathers of chicks and adults indicated shift in diet between the breeding and the wintering season for breeding adults. Comparison of historical and present feathers samples revealed no major change in the stable isotope signatures and therefore diet of oystercatchers for the last century. Comparison of prey availability and prey consumption revealed selection of the mussel *Mytilus galloprovincialis* and the limpet *Scutellastra*

cochlear by oystercatcher adults feeding their chicks.

Poster Mon 14

The Relation between Flow, Phytoplankton, Biomass in the Sundays River Estuary, Eastern Cape, South Africa

D. Kotsedi, N. Jafta

Nelson Mandela Metropolitan University, Port Elizabeth, South Africa

The Sundays River Estuary is a permanently open estuary and it is phytoplankton-dominated. Flow regimes of the estuary have been indirectly correlated to the microalgal biomass because of salinity stratification and nutrient input. Where there was high development of salinity stratification due to water retention, phytoplankton biomass was also high. In March 2007 concentrations as high as 237 $\mu\text{g}\cdot\text{l}^{-1}$ were recorded just below the water surface in the region close to the mouth. In August 2006 the highest biomass was 20.96 $\mu\text{g}\cdot\text{l}^{-1}$ and was found in the upper reaches, where the nutrients were highest. In both cases freshwater inflow was the driving factor for the productivity of the estuary although the responses were different. In 2007 biomass was highest in the lower reaches, where the river-estuary interface (REI) zone occurred due to the strong flow (1.36 $\text{m}^3\cdot\text{s}^{-1}$ in March and 10.9 $\text{m}^3\cdot\text{s}^{-1}$ in February). It was concluded that salinity is important but does not have a direct influence on the biomass of microalgae. Salinity is just an indicator of freshwater input and the stability of the water column (i.e. stratification). Of important notice, was that the REI zone migrated downstream as the freshwater flow increased. Furthermore, nitrates, had a direct correlation to the chlorophyll-*a* of the system and the Sundays River was the highest supplier of the nitrates to the estuary. Phytoplankton production will remain high in the estuary as long as the inflow of freshwater stays above 1 $\text{m}^3\cdot\text{s}^{-1}$. Input will be provided to a monitoring programme and also provide guidelines on the use of microalgae in estuary health monitoring for the Sundays River Estuary since it is now part of the Greater Addo National Park.

Oral C 13

Effects of Land Use and Urban Development : Using $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ stable isotopes to reveal river food webs structure

F.K. Kuriah¹, E.A. Pakhomov^{1,2}

¹ *University of Fort Hare, Alice, South Africa*

² *University of British Columbia, Vancouver, Canada*

The effects of anthropogenic land-use changes on water quality in Tyume River, Eastern Cape Province of South Africa were investigated to establish a relationship between the nutrient enrichment and biotic stable isotope signatures (SIS). The study involved understanding of increasing human pressures through the land use on SIS parameters of fish, invertebrates, particulate organic matter (POM), macrophytes and sediments. Field sampling programs assessed the spatio-temporal variability associated with these parameters. In total, six fish and four invertebrate species were identified and used in the analysis. All variables showed substantial spatio-temporal variability in their carbon and nitrogen SIS. The results for the investigated variables were partitioned across four trophic levels. Isotope ratios revealed how top consumers integrate isotopic variability occurring lower in the food web. A linear regression analysis for length and weight of fish had no significant effect on $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ signatures, pointing to the dominating external effect. The extent and/or intensity of anthropogenic land use resulted in higher $\delta^{15}\text{N}$ values in the riverine components. A strong relationship between the land, and SIS variables was established, indicating a situation for future concern associated with extensive anthropogenic activities. The challenge of this research was to impart integrated information on the source and influence of anthropogenically added nutrients in the riverine ecosystem. The riverine food webs appeared to utilize both C_3 terrestrial plants and C_4 grasses pathways through the detrital food web. Yet, both macrophytes and POM/sediments were identified as main energy sources in the food web. It appears that macrophytes reflected well the degree of the anthropogenic influences (e.g. land use and population density) through changes in their SIS. Hence, they have good potential to be used as the early warning tool in the water quality management.

Keywords: river; anthropogenic nutrients; stable isotopes $\delta^{13}\text{C}$; $\delta^{15}\text{N}$; non-point sources; food webs; fishes.

Oral A 2

Conservation planning and social science: cross-visions in the Indian Ocean

E. Lagabrielle^{1,2}, G. David², A. Thomassin²

¹ *NMMU: George Campus (Saasveld), George, South Africa*

² *IRD Espace Unit, Sainte-Clotilde, France*

Conservation Planning aims to identify conservation priorities in geographical space. Recently, conservation planning has attempted to integrate "human" land-

scapes into planning domains. While conservation planners understand the need to integrate social criteria into their planning procedures, this is seldom done effectively or in a way that calls new questions about the underlying paradigm guiding the integration of such criterias. To address this problem, we examined some of the social hypothesis embedded in conservation planning procedures. Our examination revealed that social and biological systems are often viewed as similar structures. However, this paradigm may not be compatible with a real-world conservation planning process. For example, while social criteria are a component of the conservation plan, the conservation plan itself can be viewed as a social construction. In conclusion, we suggest adopting more holistic paradigms that embrace social-ecological complex systems as a whole for conservation planning. This implies that conservation planning tools, mostly rooted in biological sciences, should become more integrative, flexible and adaptive, in order to be used by a broader range of participants involved in the conservation planning process. In this framework, the exclusive use of spatial optimization tools may be counter-productive as this reduces the social system to its spatial footprint. In conclusion, we propose a conceptual and technical framework to accompany a regional conservation planning process in the Western Indian Ocean. This communication is illustrated by concrete case studies in Réunion Island and in the Indian Ocean.

Poster Wed 14

The taxonomy and distribution of sea anemones in South Africa

M.C. Laird, C.L. Griffiths

University of Cape Town, Cape Town, South Africa

Many South African marine invertebrate taxa are reasonably well documented; however, the sea anemone fauna has been poorly studied. There are forty-nine anemone species known in South Africa. Of these, thirteen are found on the west coast, twenty on the east coast and sixteen species are found all around the South African coastline. Forty-nine per cent of the South African sea anemone species are endemic. Not much is known about the distribution of South African sea anemones and there are no updated, comprehensive keys for most of the species. Thus, I aim to produce a comprehensive field guide to South African sea anemones which can aid the general public in identifying sea anemones to species level. I will also address taxonomic issues that exist within the order Actiniaria. The species that I will focus on include: *Anthothoe chilensis*,

Pseudactinia flagellifera, *Pseudactinia varia*, *Anthopleura michaelsoni*, *Anthopleura annea* and *Anthopleura insignis*. Three different morphs of *Anthothoe chilensis* have been observed and it is unclear whether a variety of colour morphs exists, or if they are three distinct species. The two species of *Pseudactinia* found in South Africa may not be two distinct species but two different colour morphs and all three species of *Anthopleura* may all be the same species. These questions will be addressed by looking at the histology and genetics of the anemones collected in the field. This study will greatly enhance the knowledge of sea anemones in South Africa and will address some of the existing taxonomic issues.

Oral B 4

Comparison of, and the effects of altered freshwater inflow on, fish assemblages of two contrasting South African estuaries: the cool temperate Olifants and the warm temperate Breede

S.J. Lamberth,^{1,2} L. Van Niekerk³, K. Hutchings¹

¹ *University of Cape Town, Cape Town, South Africa*

² *Marine and Coastal Management, Cape Town, South Africa*

³ *Council for Scientific and Industrial Research (CSIR), Stellenbosch, South Africa*

This study compares the fish assemblages of the permanently open cool-temperate Olifants and warm - temperate Breede estuaries on the west and south coasts of South Africa and their responses to altered freshwater flows. Both estuaries have experienced a >35% reduction in mean annual runoff (MAR) from a historical reference condition to the present day with a >60% reduction possible under future flow scenarios. With the exception of species that have both marine and estuarine breeding populations, the Olifants Estuary fish assemblage has experienced an overall 20% decrease in abundance from reference (pristine state) to the present day and will gradually decline to 55% of reference with a predicted future 60% reduction in MAR. Consequently, future reductions in flow are likely to result in the Olifants Estuary progressing towards a low biomass, low diversity, marine-dominated system. In contrast, reduced freshwater flows in the Breede Estuary are likely to see an overall reduction in the abundance of species that breed only in estuaries, and in freshwater and catadromous species. Collectively, entirely estuarine-dependent fish will increase in abundance, but considered individually some important exploited species such as *Argyrosomus japonicus* and *Pomadasys commersonnii* will collapse to 50% of his-

torical numbers once there has been a 64% reduction in MAR. Overall, fish abundance in the estuary has increased by 6% from reference to the present day and is likely to increase to 115% of reference with future reductions in flow. Some species with a preference for fresh and brackish water will be lost from the system but overall diversity is likely to increase with the range expansion of warm-temperate and subtropical marine species westward. In all, the fish assemblage of the Breede will experience a gradual change from a relatively high-diversity low abundance freshwater-rich system under historical flow conditions to a high-diversity, high-abundance, marine-dominated system with future reductions in flow.

Poster Tue 21

Phytoplankton photosynthesis in the southern Benguela

T. Lamont¹, R. Barlow¹, M. Kyewalyanga², H. Sessions¹

¹ Marine & Coastal Management, Cape Town, South Africa

² University of Dar-es-Salaam, Zanzibar, Tanzania

Photo-physiological studies of phytoplankton photosynthesis were conducted in the southern Benguela (29°S-34.5°S) in October 2006 and May 2007, utilizing ¹⁴C photosynthesis-irradiance (P-E) experiments, fast repetition rate fluorometry, phytoplankton absorption, PAR and pigments analyzed by HPLC. Broad-band P-E parameters, (i.e. P_s^B (mg C [mg Chla]⁻¹ h⁻¹), a^B (mg C [mg Chla]⁻¹ h⁻¹ [mmol m⁻² s⁻¹]⁻¹) were estimated by fitting the chlorophyll a normalized hourly production rates to the continuous exponential model of Platt et al. (1980). The ¹⁴C P-E parameters for October 2006 showed that a^B values ranged from 0.0174 to 0.4035 mg C [mg Chla]⁻¹ h⁻¹ [mmol m⁻² s⁻¹]⁻¹. The corresponding P_s^B values ranged from 0.5750 to 12.8100 mg C [mg Chla]⁻¹ h⁻¹. During May 2007, the a^B values ranged from 0.0091 to 0.4757 mg C [mg Chla]⁻¹ h⁻¹ [mmol m⁻² s⁻¹]⁻¹, while the corresponding P_s^B values ranged from 0.1753 to 35.9500 mg C [mg Chla]⁻¹ h⁻¹. These parameters were used together with HPLC chlorophyll a concentrations and in situ PAR to estimate primary production. Integrated primary production was generally higher during October 2006, varying from 0.850 to 8.611 g C m⁻² d⁻¹, and lower during May 2007, varying from 0.690 to 3.330 g C m⁻² d⁻¹. Variability in primary production in October 2006 was more closely associated with changes in phytoplankton biomass than with P-E parameters. During May 2007, primary production variability appeared to be explained

by differences in photo-physiological parameters and selected examples are presented to illustrate these differences.

Oral A 9

Benthic invertebrate biodiversity and biogeography offshore of South Africa

L.Lange, C.L. Griffiths

University of Cape Town, Cape Town, South Africa

The offshore benthic environment of South Africa consists of unconsolidated sediments. This project aims to determine the benthic invertebrate biodiversity and biogeography of this poorly known environment. Samples along the South and West coasts were taken as by-catch trawl samples. Over 300 trawls were examined, ranging in depths between 30 m and 600 m. The Indian Ocean along the South coast supports a wide variety of benthic invertebrates, approximately 300 species, with echinoderms (35 %), anomura (20 %), hydrozoans (16%) and opisthobranchs (10 %) constituting the highest biomass in this region. On the west coast, the cold Atlantic Ocean supports a much lower benthic biodiversity, in the region of a 140 species with porifera (82 %) being the bulk contributor to the overall biomass. The anomura (7 %) and macrura (4 %) were the second and third highest contributors to biomass in this cold region. The benthic community structure is currently being determined for the offshore areas and samples are being analyzed both spatially and statistically. The results of this study and new benthic biomes will be presented at the conference.

Oral C 8

SANBI'S Marine Programme: Meeting the Challenge for the next National Spatial Biodiversity Assessment

C. M. Lawrence, K. J. Sink

South African National Biodiversity Institute, Cape Town, South Africa

The South African National Biodiversity Institute (SANBI) was established through the enforcement of the National Environmental Management: Biodiversity Act 10 of 2004. The Act expanded the mandate of SANBI's precursor, the National Botanical Institute to incorporate responsibilities pertaining to all South Africa's biodiversity both terrestrial and marine. One of the key functions of the institute is to monitor and report on the status of the nation's biodiversity. The first National Spatial Biodiversity Assessment (NSBA),

completed in 2004 mapped and evaluated biodiversity in four environments viz. terrestrial, freshwater, estuarine and marine. The current status and protection levels of marine ecosystems are assessed, and priorities for conservation action are identified. The NSBA has benefits that allow SA to be proactive about development and meets legislative requirements including national conventions that SA is signatory to. However, the assessment does have limitations e.g. lack of fine-scale data particularly at habitat level; and poor definition of key biodiversity features. SANBI is establishing a marine programme to address the marine biodiversity goals of its mandate. A major challenge is to refine and update the marine component of the NSBA. This includes identifying threatened ecosystems; classifying marine species according to their conservation status and mapping ecological processes at a national scale. We propose to take a lead role in spatial biodiversity planning, identification of spatial priorities for Marine Protected Area expansion, biodiversity assessment and monitoring, and mainstreaming biodiversity in marine industry. Potential coordinating roles for SANBI may include the development and implementation of a National Marine Biodiversity Strategy and management of marine biodiversity knowledge, including co-ordinating inventory and biosystematics work. SANBI intends to play a participatory role in providing advice on marine policy, applied marine biodiversity science, and capacity development in the marine biodiversity sector. Key areas of work for the next 2 years and SANBI's research priorities are presented.

Oral C 9

The Water Balance and Management of St Lucia

Robynne A. Lawrie¹, Derek D. Stretch¹, Renzo Perissinotto¹, Ricky H. Taylor²

¹ *University of KwaZulu-Natal, Durban, Kwazulu-Natal, South Africa*

² *Ezemvelo KwaZulu-Natal, St Lucia estuary, South Africa*

iSimangaliso, formally known as the Greater St Lucia Wetland Park was granted World Heritage status in December 1999 due to its global importance. The conservation of this wetland relies on the implementation of appropriate management decisions informed by models based on scientific research. Land-use changes and the development of the catchment over the past century have disturbed the natural balances in the system. The key issues include the response of the physico-chemical environment to climate changes and various mouth management strategies and the effect of this

on the biological activity within the system. A water balance model was developed which includes the capability to simulate the system while incorporating details such as mouth dynamics. Mouth state, average salinities and water levels have been simulated to test various management scenarios. One of the most important issues is whether to maintain an artificially open mouth state during drought periods or to allow the mouth to remain closed for those times. Simulations show that during drought periods, when the mouth is open, salinities increase approximately linearly. When the mouth is closed, salinities increase exponentially because of dropping water levels. In 1952 a separate Umfolozi mouth was dredged to reduce silt loading into the St Lucia system. Simulations performed to investigate the impact of the Umfolozi on the St Lucia system show that without the Umfolozi (i.e. current status quo), the mouth state would be predominately closed and water levels highly variable. Hypersaline conditions would generally occur during closed phases with very low water levels. Open conditions would be short and intermittent. With the Umfolozi (i.e. its "natural" state), the mouth state would be predominantly open with relatively stable water levels. Salinities under closed mouth conditions would generally be low due to dilution with the freshwater from the Umfolozi. During drought periods, hypersaline conditions combined with high water levels can occur during open phases.

Oral PL 7

Optimizing on international co-operation for marine and coastal research in South Africa: FP7 as an instrument

Reneé Le Roux

National Research Foundation, Pretoria, South Africa

South Africa needs to identify and develop its own research agenda to address issues of national relevance. However at the same time we need to internationalise our research endeavours to connect to the global research agenda and thereby integrate into the global knowledge economy. It is therefore essential that strategic research partnerships are established for co-operation and alignment with global efforts. These partnerships could also contribute to improved and co-ordinated funding allocations for research. This presentation will focus on the European's Union (EU) Framework Programme 7 (FP7) as one potential instrument for the internationalization of South African marine and coastal research. The EU could be considered, historically (due to our colonial past), as South Africa's most important partner for international science and

technology collaboration and we need to optimize on this legacy (albeit not the most desired legacy). This talk will provide an overview of FP7 in terms of its structure, modalities for participation, opportunities for marine and coastal researchers in South Africa to participate in FP7, and support actions by the South African Department of Science and Technology in facilitating the involvement of South African researchers in FP7.

Poster Wed 23

Does trawling negatively impact populations of by-catch species?

R.W. Leslie

Marine and Coastal Management, Cape Town, South Africa

It is not possible to derive reliable fishing mortality estimates for the majority of species that are potentially impacted by the trawl fishery from landings data alone. For some species the proportion of the catch that is landed is driven by market forces so that fluctuations in annual landings do not necessarily reflect fluctuations in actual catches or in abundance, whereas many species are not commercially useful and are not landed at all. Although the total annual catch of such species is not known, trends in the trawl survey abundance indices can be used as indicators of the impact of incidental mortality on their populations. The trend in abundance indices for 1985 to 2008 are presented for 100 bycatch species (or species groups) taken during research trawl surveys of the west and south coasts of South Africa. For many species the inter-annual fluctuations are greater than any apparent trend. Trend lines for the majority of species do not have significant slopes.

Oral A 2

An offshore classification for biodiversity conservation planning on the east coast of Southern Africa

Tamsyn Livingstone¹, Jean M. Harris¹, Dave Schoeman², Amanda T. Lombard³

¹ *Ezemvelo KZN Wildlife, Durban, South Africa*

² *University of KwaZulu-Natal, Westville, South Africa*

³ *Nelson Mandela Metropolitan University, Port Elizabeth, South Africa*

The waters of the east coast of the South Africa are shaped by the interplay of the strong southward flowing Agulhas and Madagascar currents, which generate marked temperature differentials and strong gyres and

upwelling cells, the influence of which are modified by a strong inshore river inflow influence from 64 estuaries and a seafloor incised by deep canyons. Much research has been done on near-shore systems, whereas the offshore biodiversity is largely unexplored. This is reflected in the level of protection: existing marine protected areas along the coast of the province of KwaZulu-Natal are limited to sensitive inshore areas of special interest (i.e. coral reefs) while offshore biodiversity is afforded zero formal protection. In this study geophysical mapping, coupled with remote-sensing biophysical data, is used to classify the offshore environment according to benthic-pelagic "profiles", and thus to map areas of similarity. Data at a scale of 1x1km from satellite imagery of sea surface temperature, chlorophyll and turbidity are combined with comprehensive bathymetry and slope data into a multivariate analysis. These have generated offshore environmental domains, an ecosystem classification system, being applied and tested for systematic conservation planning.

Oral PL 15

Fertilising the oceans to mitigate anthropogenic CO₂ accumulation : Options, problems and feasibility?

Mike Lucas¹, Richard Lampitt², John Shepherd²

¹ *University of Cape Town, Cape Town, South Africa*

² *The National Oceanography Centre, Southampton, UK*

It is now accepted (IPCC 2007) that emissions of CO₂ to the atmosphere are the dominant cause of global warming, and that cuts in these emissions (currently about 8 GtC/yr and rising) are needed in the next few years. Concurrent with these cuts, it may be possible to develop technological strategies to enhance sequestration of CO₂ from the atmosphere into the deep ocean reservoir that is isolated from the atmosphere over periods of 100's to 1000's of years. The basic geo-engineering idea is to enhance the efficiency of the "biological carbon pump" by fertilising nutrient deficient regions of the world oceans, anticipating that overall carbon export could be improved, thus mitigating anthropogenic CO₂ increases. A number of commercial organisations have recognised this theoretical band-wagon and have undertaken some relatively small-scale fertilisation experiments, with the ultimate goal of gaining and trading carbon credits. In response, concerned members of scientific community have met in various locations in the past 12 months or so to discuss the merits and problems associated with artificial ocean fertilisation options. The four most commonly

proposed geo-engineering options are a) iron fertilisation of high-nutrient-low-chlorophyll (HNLC) regions (e.g. Southern Ocean) to improve nitrate uptake, b) iron fertilisation of low-nutrient-low-chlorophyll (LNLC) regions (e.g. sub-Tropical gyres) to improve N₂ fixation, c) increase vertical nutrient flux into surface waters using “pipes” and c) pipe nutrient cocktails from the land into the ocean. In this talk I will outline the scientific rationale that underpins these options, as well as considering the potential unwanted side-effects of these ocean fertilisation strategies, concentration on iron fertilisation of the Southern Ocean.

Oral PL 10

A century of research on the Agulhas Current system

Johann R. E. Lutjeharms

University of Cape Town, Cape Town, South Africa

The greater Agulhas Current has been shown to be a key link in the global thermohaline circulation and an increased understanding of this current system is therefore of more than just local interest. Knowledge on the Agulhas Current system has in fact increased enormously over the past 30 years. This review covers some aspects of what has been learnt on the northern and the southern parts of the Agulhas Current proper and their influence on the waters and circulation of the adjoining continental shelf. It also discusses the Natal Pulse and new information that has been gained on how it is triggered and what influence it has. It deals with the Agulhas retroflection, the shedding of Agulhas rings and the movement and characteristics of these rings. The Agulhas Return Current forms the final outflow of the system and current knowledge on that current is appraised. The sources of the Agulhas Current have been a controversial subject for many years and this dispute continues. This is described and discussed, based on what information has been gained from research over the past century. Building on what is currently known, some suggestions are given on the most important remaining knowledge gaps and how these could most efficaciously be filled.

Oral B 12

Impacts of water quality on the inactivation and elimination of bacterial pathogens in oysters

Brett M. Macey¹, Ikenna O. Achilihu², Karen G. Burnett², Louis E. Burnett²

¹ Marine and Coastal Management, Cape Town, South Africa

² College of Charleston, & Hollings Marine Laboratory, Charleston, South Carolina, USA

The Eastern oyster, *Crassostrea virginica*, inhabits shallow coastal waters that frequently experience periods of low dissolved oxygen (hypoxia) and elevated CO₂ (hypercapnia). Bacteria are extremely abundant in these environments and accumulate in large numbers in filter-feeding oysters, which can act as passive carriers of human pathogens. Although hypercapnic hypoxia (HH) can affect certain specific immune mechanisms, their direct effect on the inactivation, degradation and elimination of bacteria in oysters is unknown. This research was conducted to determine whether exposure to HH reduces the ability of *C. virginica* to inactivate and eliminate the bacterial pathogen *Vibrio campbellii* following its injection into the adductor muscle. Oysters were held in fully air-saturated (normoxic; P_{O₂} = 20.7 kPa; CO₂ < 0.06 kPa; pH 7.8-8.0) or HH (P_{O₂} = 4 kPa; CO₂ = 1.8 kPa; pH 6.5-6.8) seawater at 25 °C for 4h before being injected in the adductor muscle with 10⁵ live *Vibrio campbellii*, and remained in these conditions for the remainder of the experiment (up to 24 h post-injection). Real-time polymerase chain reaction was used to quantify the number of intact (total) *V. campbellii*, while selective plating was used to quantify the number of injected bacteria remaining culturable in whole oyster tissues, seawater and feces/pseudofeces at 0, 1, 4 and 24 h post-injection. We found that oysters maintained under normoxic conditions were very efficient at inactivating and degrading large numbers of injected bacteria within their tissues. Moreover, a small percentage (~10%) of injected bacteria was passed into the surrounding seawater, while less than 1% were recovered in the feces/pseudofeces. In contrast, HH increased the percentage of culturable bacteria recovered from the tissues of oysters, suggesting an overall decrease in bacteriostasis. We suggest that poor water quality can increase the risk that oysters will harbor and transmit bacterial pathogens hazardous to human and ecosystem health.

Poster Tue 4

Fishery Independent Abalone Survey “FIAS”: hundreds of hours underwater

Angus J. Mackenzie, Genevieve Maharaj, Robert J.Q. Tarr

Marine and Coastal Management, Cape Town, South Africa

During 1995 the DEAT: MCM Abalone research section developed a new diving survey method for moni-

toring abalone populations. The target areas were the four main commercial fishing zones/Turfs A-D, along the South Western Cape as well as two islands (Robben and Dyer islands). The new survey design was derived from data and insights from earlier diving surveys during the period 1980 to 1994. The survey was designed to collect fishery independent abalone density data with a predicted Coefficient of Variation (CV), as well as size composition data, for the various zones/Turfs. Results show a steady decline in the abalone population, and this has in turn required ever decreasing Total Allowable Catch allocations. The commercial abalone fishery that has been in existence for over 50 years was finally closed at the end of January 2008. The poster will display and describe the FIAS trends in all four abalone fishing zones plus the two islands.

Poster Tue 7
Commercial Fishery for the Cape Rock Oyster (*Striostrea margaritacea*)

Liwalam Madikiza, Genevieve Maharaj
Marine and Coastal Management, Cape Town, South Africa

The commercial fishery for the oyster *Striostrea margaritacea* dates back to the late nineteenth century. Since the late 1990s, a process of restructuring the sector commenced. Prior to 1998, a handful of individuals held concessions to harvest oysters and employed large numbers of individual "pickers" to assist with the collections. During the latest allocation process in 2006, the sector was transformed and 3-year commercial rights were allocated to 145 individuals. A large number of "pickers" were accommodated in this process, the idea being that "pickers" were granted rights as a means of empowering those who are dependent on oyster harvesting as their livelihood. In the new system, right holders are required to harvest the oysters themselves. The overall Total Allowable Effort (145 pickers) has remained stable in this sector since 2002, and was based on the total number of pickers active at that time. The *status quo* is being maintained until further data becomes available. The commercial fishery occurs in two distinct areas namely: Southern Cape and KwaZulu-Natal. An average of 588087 oysters (389,286 from Southern Cape and 198,793 from KZN) were harvested per year in recent years. Preliminary resource assessments show that although the oyster stocks have declined since 1980, they have been stable for approximately the past 20 years. Results of the preliminary in the Southern Cape, particularly in the Mossel Bay, George and Knysna areas, there is concern

that the intertidal zone is being denuded of oysters as a result of being oversubscribed. Recent surveys that measured oyster density and size composition suggest that the status of the intertidal component of the oyster stock along the south coast appears to be over-exploited. This poster will describe the history of the fishery, restructuring of the sector and status of resources and to identify the future research.

Oral B 10
Analysis and modelling of the upwelling region of the Somali coast

Ali J. Mafimbo, John G. Mungai, C.J.C. Reason, F.A. Shillington
University of Cape Town, Cape Town, South Africa

During the southwest monsoon two upwelling cells (gyres) are established along the Somali coast, around 4-5°N and 10°N respectively. The mesoscale structure of the low-level wind field associated with a strong southern upwelling event was investigated. During July 2005 when a strong event occurred, the Somali jet was found to have oscillated at lower frequency of 3-7 weeks and mesoscale winds exhibited high co-variability with prevailing SSTs. Strong values of alongshore winds were observed from late June to mid-July which weakened significantly in the third and fourth week of July. A large off-shore pressure gradient due to differential thermal properties of land and sea was also observed. The results show that prolonged active (break) periods of the jet results in acceleration (deceleration) of alongshore winds. These strong wind stress values during a prolonged active period accelerate the Somali current. The strong alongshore winds result in enhanced Ekman pumping and strong upwelling. In the prolonged break period, the current decelerates, turns east and then southwards. High co-variability of mesoscale winds and SSTs was found in the upwelling zone. To improve understanding of the intra-seasonal to seasonal circulation patterns within the region, the surface circulation of the western Indian Ocean during the summer (JAS) and winter (JFM) monsoon winds was investigated using the Regional Ocean Modelling System (ROMS). The model results suggest a seasonally reversing Somali current with a sub-surface counter current, consistent with observations. The two upwelling cells (gyres) are also apparent in the simulation. The model is applied to better understand the annual cycle of SST, heat fluxes and circulation in the region.

Oral A 9
Exploring the effects of bottom trawling in the Benguela system : an experimental approach

S.K. Mafwila^{1,2}, J.G. Field¹

¹ *University of Cape Town, Cape Town, South Africa*

² *University of Namibia, Windhoek, Namibia*

Bottom fishing using towed gear is one of the most widespread sources of physical disturbance to the continental shelf seas and beyond throughout the world. Previous studies have shown that degradation and ecosystem changes have occurred in intensively fished areas. Nevertheless, to date it has been difficult to attribute ecosystem changes to bottom trawling intensities at a spatial scale that is really representative of commercial fishing effort. In this study we represent the results from the bottom trawl experiment from the Benguela system, off the coast of Namibia and South Africa, where we assessed the effects of bottom trawling in heavily and lightly trawled areas on the targeted fish species (*Merluccius capensis* and *M. paradoxus*) and non-targeted (bycatch) by the demersal fishery of the two neighbouring countries. Our study compares fish assemblages found in both heavily and lightly trawled areas using multivariate analyses (ANOSIM, MDS, Cluster, SIMPER, and Dominance Plots). We further report on the results from the univariate analysis (ANOVA) to test for interactions between fishing levels and site.

Oral A 7
The trials and tribulations of the abalone

Genevieve Maharaj, Robert J.Q. Tarr, Angus J. Mackenzie

Marine and Coastal Management, Cape Town, South Africa

In October 2007 the South African government declared an emergency in the abalone fishery and announced the suspension of all fishing of wild abalone (*Haliotis* spp). The suspension and imposition of a total dive ban in key areas came into effect on 1 February 2008. This action was a last resort on the part of government to protect the commercially important *Haliotis midae* from further declines. *H. midae* abundance has been declining since the early 1990's due to ecosystem changes as well as a highly organised illegal poaching sector. Fishery independent abundance survey trends show declines in all the major fishing zones. The latest results reflect critically low densities of from 0.25 to 0.01 abalone per m² for the main fishing zones

A to D. Results of stock assessment models also show declines of estimated spawner biomass in the four zones. Poaching has reached record highs in recent years. The amount of abalone taken illegally from the main fishing zones was estimated to have reached 927 tons in the 2006/07 season. This was 12 times the legal allocation of 75 tons for these zones! Previous attempts to combat poaching including increased compliance, the closure of the recreational sector and a new TURF-based management system achieved minimal success. The success of the most recent interventions is yet to be tested. Indeed the fishery closure has been questioned by many, in particular the 302 rights holders who are most directly affected. The matter was taken to the High Court of South Africa for review, but the judge ruled that government's decision-making process was thorough, sequential and regular, and that the decision cannot be successfully reviewed. This presentation will provide an overview of the current status of the abalone resource and will describe the reasons that led to government's decision to close the abalone fishery.

Poster Wed 7
Reef Atlas Project: Diving for 2010 National Spatial Biodiversity Assessment

Prideel Majiedt, Cloverley Lawrence, Kerry Sink
South African National Biodiversity Institute, Kirstenbosch, Cape Town, South Africa

South Africa has one of the most diverse and lucrative marine territories in the world. However, much of this extremely productive and precious area is not mapped nor protected. The 2004 National Spatial Biodiversity Assessment did not cover the reef systems of South Africa as there were insufficient data. The South African National Biodiversity Institute wishes to commemorate the International Year of the Reef 2008, and aims to produce a spatial layer of the various reef systems of South Africa that will be incorporated into the 2010 National Spatial Biodiversity Assessment. This layer will be used to not only allow us to better manage and protect reef systems, but also to detect where many vital marine processes are taking place and how anthropogenic activities affect reefs. It calls on the collaboration of government sectors and the various groups of reef users. With the aid of the diving public and business, collated photographs and GPS coordinates can be used to produce digital maps of the different reef types of South Africa. The scientific community also plays a great role in the project. Reef community experts are needed to participate in the classification process of

South African reefs. The Reef Atlas Project is the precursor to various other marine atlas projects, and will be integral in the spatial planning of future areas for protection.

Oral A 6

An aerial survey to estimate total shore angling effort along the KwaZulu-Natal coast, South Africa.

Bruce Q. Mann¹, Greg Nanni², Pierre Pradervand¹

¹ *Oceanographic Research Institute, Durban, South Africa*

² *Ezemvelo KwaZulu-Natal Wildlife, Pietermaritzburg, South Africa*

A randomised aerial survey of the KZN coast was undertaken between March 2007 and February 2008. A total of 36 flights were conducted with 18 flights along the north and south coasts respectively. Ground-truthing revealed that aerial counts of shore anglers were ~91% accurate. Angler effort was significantly higher on weekends and during good weather. Seasonality of shore angling effort showed that greatest effort occurs during the winter months (June to September) coinciding with the seasonal availability of shad (*Pomatomus saltatrix*) along the KZN coast. More developed stretches of the KZN coast with higher population densities and greater angler access (e.g. Durban Metro) had the highest angling effort. Results of the aerial survey were substantially lower than the results obtained by EKZMW shore patrols over the same time period emphasizing the importance of aerial surveys in calculating total angler effort. Total annual angler effort was calculated at 843 702 angler days.year⁻¹ which represents a 42.7% decline from a similar estimate made in 1994-96. Decline in shore angling effort was ascribed primarily to security concerns and the beach vehicle ban. This has also resulted in a change in the pattern of shore fishing which is now more focused at beach access points rather than being more evenly distributed along the coast. Current monitoring of the KZN shore fishery by patrols conducted by EKZMW was shown to be spatio-temporally biased due to their dual function of fisheries monitoring and law enforcement. Based on the results of this study, recommendations are made for the improved management of the KZN shore fishery.

Oral C 9

Linking ecosystems to society: What is the role of aquariums in conservation?

Judy Mann

Sea World at uShaka Marine World, Durban, South Africa

The world is changing – from global warming to species extinctions, habitat destruction to political changes. Conservation is no longer something to be done by a select few, if the challenges facing the planet are to be addressed. Aquariums have the potential to play a vital role in connecting people to ecosystems – the first step in generating environmental awareness and promoting action. However, there are very few studies that explore the effectiveness of an aquarium in promoting conservation action. This paper will look at some of the ways in which aquariums can contribute to promoting sustainable living. It will also start to explore methods which can be used to measure this contribution.

Oral C 11

Effects of temperature on utilization of yolk by chokka squid (*Loligo reynaudii*) paralarvae

Rodrigo S. Martins^{1,3}, Michael J. Roberts¹, Érica A.G. Vidal², Coleen L. Moloney³

¹ *Marine and Coastal Management, Cape Town, South Africa*

² *Universidade Federal do Paraná (UFPR), Pontal do Sul, Brazil*

³ *University of Cape Town, Cape Town, South Africa*

The temperature influence on the utilization of yolk by chokka squid (*Loligo reynaudii*) paralarvae was studied for starved animals at 12, 16, 18 and 19 °C. This range encompasses those temperatures which are naturally found on the inshore (warm) and offshore (cold) squid spawning grounds. Laid eggs were collected by SCUBA divers in St Francis Bay and incubated in the laboratory at 15.6 °C and 14.4 °C in January–February 2007 and January 2008, respectively. Seventy-five paralarvae were sampled daily. From these, 30 were used to obtain data on size and yolk content, which were determined using image analysis to estimate the yolk volume. All 75 paralarvae were used to obtain body wet and dry weight data. Mantle length (ML), wet weight (WW) and yolk weight (YW) for squid incubated at 14.4 °C were 2.58 mm, 2.06 mg and 0.27 mg, respectively. Squid incubated at 15.6 °C had 2.43 mm ML, 1.96 mg WW and 0.21 mg YW. Dry weights (DW) were 0.47 mg at 15.6 °C and 0.38 mg at 14.4 °C. The yolk was exponentially absorbed, and squid maintained at warmer temperatures absorbed their yolk faster and survived less than their counterparts at colder temperatures. From the energetic perspective, the sur-

vival times anticipated by using the exponential yolk utilization rates obtained agreed well with the observed survival time with 80% mortality. These results partially support the “Western Transport Hypothesis”, which postulates that paralarvae hatched on the spawning grounds off the eastern Agulhas Bank are transported westward to the nursery grounds located on the central Agulhas Bank.

Poster Wed 6

Nearshore macrozoobenthic structure in Algoa Bay: A comparative analysis

Ntuthuko F. Masikane¹, Shaun H. P. Deyzel^{1,2}, Tris H. Wooldridge²

¹ *South African Environmental Observation Network, Grahamstown, South Africa*

² *Nelson Mandela Metropolitan University, Port Elizabeth, South Africa*

The aim of this study was two fold: (1) to describe the macrozoobenthos structure in two broad categories of sediment type (coarse and fine sediment) and (2) to describe species recovery curve over a series of replicates in each sediment type. The latter is of major importance prior to the implementation of long-term monitoring of the macrozoobenthos in Algoa Bay. Macrozoobenthos was sampled with a Van Veen grab (211 cm² sample size) along a 10 m contour line in both habitats. Each habitat comprised three stations from which 20 zoobenthic replicates were sampled per station. Zoobenthic organisms retained with a 500 µm mesh were identified to highest taxonomic resolution possible and analysed with PRIMER v6 statistical package. Noticeable differences were observed between sites and are further discussed in this work. Over 80 species were recorded for this study, where coarse sediment was dominated by amphipods (>25 taxa) whilst fine sediment was dominated by polychaetes (>18 taxa).

Oral C 10

Results of an ADCP and RCM current speed comparison in moderate wave conditions in shallow water

P E Matsapola, C.K. Wainman
The Institute for Maritime Technology, Simon's Town, South Africa

Mechanical operated current meters have a reputation of being affected by wave movement and mooring vibration, thereby allegedly producing unreliable or cor-

rupted data, often reported as an over-reading in shallow water depths. The results of a study comparing paddle wheel type rotor Recording Current Meters (RCM7) and an Acoustic Doppler Current profiler (ADCP) in close proximity was undertaken in Simon's Bay, South Africa at a water depth of 22 m. Two RCM7s were deployed at depths of 12m and 18m on a single mooring for a period of 42 days (15 February to 28 March 2007). Alongside (within a 5 m distance) a single upward looking ADCP was deployed on the seafloor, programmed to measure at 1m depth bins, coinciding with the RCM7 recordings. A good dataset was obtained and results showed that the RCM7 current meters and ADCP output was comparable, resulting in an encouraging level of confidence in the RCM7 ability to measure ocean currents, under moderate wave conditions in shallow water (22 m). A mean current speed delta of 1.7 cm/sec, maximum delta of 6.6 cm/sec and minimum delta of -1.02 cm/sec was obtained for the 12 m depth bin. Similarly, a mean current speed delta of 1.97 cm/sec, maximum delta of 4.82 cm/sec and minimum delta of -0.54 cm/sec was obtained for the 18 m depth bin.

Oral PL 17

Whither Wendy? Where do right whales go when they leave the South African coast?

Bruce Mate², Peter B. Best¹

¹ *University of Pretoria, Pretoria, South Africa*

² *Oregon State University, Oregon, USA*

Twenty-one satellite tags were deployed on southern right whales in South African coastal waters in September 2001, and transmissions were received from more than one (and up to 161) days from 15 of them. Only six animals (4 males, 1 female and 1 of undetermined sex) left the coast with their transmitters still functioning. Whales departed from the coast at sites ranging from Cape Columbine to Ystervarkpunt, and on dates ranging from 24 September to 8 January. All five subsequently tracked left the coast consistently on a bearing of 201-220° before branching out over the southeast Atlantic. Each animal travelled between 3,800 and 8,200 km over the ensuing 53 – 110 days before transmissions ceased, covering the region from 37 to 60°S and between 13°W and 16°E. Their locations were categorised as being from migrating or non-migrating whales based on the relative orientation of the track over three successive locations and on the net speed. After the locations from ‘migrating’ whales were removed, there were 42 to 127 locations per whale that might represent episodes of other behaviour such as

feeding. Of these 414 'feeding' locations, 41.3% were between 37 and 45°S and 54.1% from south of 52°S, with only 4.6% in the intervening 7° of latitude, and this separation persisted throughout the period of monitoring. The more northerly group seemed to be associated with the Sub Tropical Convergence, and the more southerly with the Antarctic Polar Front. Limited stomach content data suggest feeding largely on copepods at the former and euphausiids at the latter. Switching between widely separate feeding grounds was an unexpected strategy, with obvious cost-benefit implications: two whales that migrated between high and low latitude zones had appreciably fewer "feeding" locations (29.2 – 35.9%) than the three others that stayed either in low or high latitudes (60.3 – 74.7%).

Oral B 12

Genetic signatures suggest alternative gene-flow patterns for southern African lobsters

CA Matthee¹, A. Cockcroft², S. von der Heyden¹, KA. Tolley^{1,3}, K. Gopal^{1,3}, JC. Groeneveld^{1,2}

¹ University of Stellenbosch, Stellenbosch, South Africa

² Marine and Coastal Management, Cape Town, South Africa

³ South African National Biodiversity Institute, Kirstenbosch, South Africa

Through collaborative research efforts over a period of five years our group investigated mtDNA phylogeographic structures for four species of commercially exploited lobster occurring along or close to the southern African coastline (*Palinurus gilchristi*, *P. delagoae*, *Jasus lalandii* and *J. tristani*). Although the genetic data suggest that all species have been affected by recent population bottlenecks, comparisons among the genetic signatures of each species reveal that oceanography only accounts for some of the intraspecific variation observed. The adult migrations of *Palinurus gilchristi* seem to be sufficient to allow for mtDNA panmixia in the population sampled while oceanographic factors caused significant population substructure and speciation in *P. delagoae*. Populations of *Jasus tristani* sampled at Vema seamount show some level of genetic differentiation from the remainder of the sampling sites and for this species it is suggested oceanic currents play a major role in maintaining the genetic pattern obtained. In sharp contrast, intrapopulation mtDNA diversity of *J. lalandii* implicates larval behaviour as one of the most influential factors contributing towards the distribution of adult genetic diversity.

Oral PL 12

Selection and dispersal, twin drivers for genetic structure in intertidal mussels

C.D. McQuaid¹, G.I. Zardi¹, K.R. Nicastro¹, M.J. Roberts², L. Hancke²

¹ Rhodes University, Grahamstown, South Africa

² Marine and Coastal Management, Cape Town, South Africa

Mitochondrial DNA analysis (COI) has revealed very strong genetic structure in populations of *Perna perna*, with eastern and western lineages that overlap for approximately 200km on the south coast. We examined the mechanisms maintaining this genetic structure. Field translocation experiments compared mortality rates of the two lineages under natural conditions on easterly (Haga Haga) and westerly (Schoonmakerskop) shores. A preliminary experiment showed that the western lineage had higher mortality under conditions of sand inundation. A second experiment showed that, in the absence of sand inundation, western individuals translocated to Haga Haga showed higher mortality than eastern individuals at the same site. At Schoonmakerskop there was no difference between lineages. This indicates that the western lineage cannot extend farther east because of physiological stress. Laboratory studies showed that the western lineage had significantly higher mortality rates under heat and desiccation stress, suggesting that these are the likely causes of differential mortality in the field. However, physiological stress cannot explain why the eastern lineage is excluded from shores to the west. Data from drifters suggest that larvae released east of Haga Haga where the Agulhas Current lies relatively close to the coast, are likely to be caught up in the current and so be unable to colonise the shore farther west. Thus we invoke asymmetrical drivers for the observed genetic structure, with west and east lineages being limited through selection and dispersal respectively.

Oral A 11

Times of Change: A Spatio – Temporal assessment of rocky shore communities in False Bay, South Africa

A. Mead, K. Tunley, C.L. Griffiths, M. Rouault
University of Cape Town, Cape Town, South Africa

Ten sites located in False Bay, South Africa were surveyed in 1987 to determine community structure in the intertidal zone. The surveys were repeated in 2007 in order to detect long - term changes in biodiversity. At

each site, the shore was divided into lower, mid and upper - shore zones. Multivariate and univariate analyses revealed significant temporal and spatial changes in community structure in all three zones. Two forcing factors were found to be driving the changes detected within this region: alien invasive species and climate change. The well documented alien invasive mussel *Mytilus galloprovincialis*, a predominantly cold water species, dominated at 9/10 sites in the lower and mid zone, impacting the abundances and densities of previously recorded species. The predominantly warm water mussel *Perna perna* was absent at 8/9 sites where it had previously formed extensive mussel beds. There were horizontal and vertical shifts in the abundance and distributions of warm water, cold water and cosmopolitan species. Notably, the upper / mid - shore boundary level has moved down the shore over time. The detected community shifts are considered in parallel with climate change trends identified in South Africa. Data limitations are discussed and a way forward proposed in order to assess species response to climate change with more accuracy.

Oral B 7

Developing procedures and equipment for large shark telemetry studies

M.A. Meyer¹, M. Smale², M. Paterson³, R. Johnson^{4,5}, P. Koen⁶, S. Kirkman¹, W.H. Oosthuizen¹, P.G.H. Kotze¹, S. Swanson⁴

¹ Marine and Coastal Management, Cape Town, South Africa

² Bayworld Centre for Research and Education, Port Elizabeth, South Africa

³ Sea Technologies, Cape Town, South Africa

⁴ Dias Museum, Mossel Bay, South Africa

⁵ University of Pretoria, Pretoria, South Africa

⁶ Department of Agriculture, Stellenbosch, South Africa

Research effort on sharks has recently increased in South Africa, in part because of concerns regarding the conservation status of many species and the growth of eco-tourism ventures. Furthermore, technological advances in telemetry equipment have allowed investigations into both small scale and large scale movements and behaviour of the sharks. Studies are being carried out on a variety of species including great white sharks (*Carcharodon carcharias*) tiger sharks (*Galeocerdo cuvier*) and raggedtooth sharks (*Carcharias taurus*). Each of these species are large and powerful and require a unique approach for attaching equipment. Techniques used to attach equipment differ between studies and this contribution reviews those recently in

use within South Africa. These vary from simple use of Hawaiian slings or spear guns to attach tags onto free-swimming animals to capture procedures that require mechanical restraint cradles for large white sharks. Procedures for attaching equipment that minimize post-release stress to sharks and risk to personnel are described. Also discussed are procedures for blood and tissue sampling, different approaches to anaesthesia and the development of novel attachment methods that result in passive shedding of equipment from the shark.

Oral C 10

Salinity and temperature tolerance of the alien invasive prosobranch gastropod *Tarebia granifera* (Lamarck, 1816) in the St. Lucia Estuary.

Nelson A. F. Miranda, Renzo Perissinotto, Chris C. Appleton
University of KwaZulu-Natal, Durban, South Africa

The aim of this study was to investigate the salinity and temperature tolerance of *Tarebia granifera*, a freshwater prosobranch gastropod present in the St. Lucia estuarine system. Individuals were collected from Catalina Bay, and transported to a laboratory, where they were subjected to a salinity range of 0- 40 ppt and a temperature range of 0- 50 °C. The thermal tolerance range of *T. granifera* was determined to be between 0 and 47.5 °C. *T. granifera* is able to tolerate almost the entire range of temperature that can occur at St. Lucia, where levels in excess of 50 °C have been reported during the summer. It can also survive cold snaps and may be able to invade higher altitude areas. More remarkably, this gastropod tolerates high salinity levels for long periods of time: LS₅₀ at 30 ppt was reached between 65 and 75 days. LS₅₀ at 40 ppt was reached between 15 and 25 days. This is unprecedented in the literature, as fresh-water mollusks are thought to be able to survive only in very dilute and stable brackish conditions. However, high salinities can affect the *in situ* size class distribution of *T. granifera*. Activity also seemed to decline with increasing salinity. Results from a “salinity shock experiment”, in which snails first acclimatised to fresh water conditions were then exposed to higher salinities, showed that LS₅₀ at 30 ppt was reached relatively quickly, with after 48 hours virtually 100 % of the population dying. Other characteristics of *T. granifera*, as well as the management application of the results of this study are discussed. The elimination of this invasive prosobranch gastropod from St. Lucia may not be attainable in the short term.

Oral B 8

Comparative dietary analysis of small pelagic fish species from presumed mixed shoals off South Africa's east coast during the Sardine Run

Q.K. Mketsu^{1,2}, C.D van der Lingen¹, C.L. Moloney²

¹ Marine and Coastal Management, Cape Town, South Africa

² University of Cape Town, Cape Town, South Africa

Stomach contents of sardine (*Sardinops sagax*), anchovy (*Engraulis encrasicolus*), west coast redeye (*Etrumeus whiteheadi*) and east coast redeye (*E. teres*) collected from presumed mixed shoals off South Africa's east coast during the 2005 Sardine Run Survey were analysed to determine dietary composition in terms of carbon and assess whether these species show resource partitioning by prey type and/or prey size. Fish were collected via midwater trawling, and four mixed shoals (one consisting of all four clupeid species, two consisting of three of the species and the fourth only two species) comprising a total of 128 stomachs were examined. No phytoplankton was found in stomach contents of any of the clupeid species. Sardine diet was numerically dominated by fish eggs, small calanoid copepods, and cyclopoid and poecilostomatoid copepods, but dietary carbon was dominated by fish eggs and to a lesser extent small calanoid copepods. Anchovy diet was numerically dominated by crustacean eggs, small copepods and poecilostomatoid copepods, but fish eggs and large calanoid copepods dominated dietary carbon. The diets of both redeye species were numerically dominated by fish eggs and large crustacean zooplankton and these prey types also dominated dietary carbon. Significant differences in size frequency distributions of identifiable prey items were observed between sardine and anchovy in two of three mixed shoals in which they co-occurred, between anchovy and the two redeye species in all mixed shoals in which they co-occurred, and between sardine and the two redeye species in all mixed shoals in which they co-occurred. No such difference was observed between west coast and east coast redeye. The significant differences in prey size frequency distributions and mean prey sizes are indicative of resource partitioning between sardine, anchovy, and the two round herring species, but no resource partitioning was observed between east coast and west coast redeye.

Oral B 13

Phylogeographic patterns of *Gelidium pristoides* (Gelidiaceae: Rhodophyta) and *Hypnea spicifera* (Hypnaceae: Rhodophyta) along the South African

coastline

Lucas K. Mmonwa, Christopher D. McQuaid, Nigel P. Barker

Rhodes University, Grahamstown, South Africa

Phylogeographic patterns of two South African endemic seaweeds, *Gelidium pristoides* and *Hypnea spicifera* were determined using nuclear (ITS1) and mitochondrial DNA (Cox2-3 spacer) sequence data. The aim of the study was to test the hypothesis that biogeographic boundaries along the South African coastline co-incide with phylogeographic patterns, as previously found in some marine invertebrates. Both the ITS1 and Cox2-3 spacer regions revealed two lineages of *G. pristoides*: a south-western and a south-eastern lineage. ITS1 data revealed a biogeographic boundary between the two lineages in the vicinity of St. Francis Bay, while the Cox2-3 spacer data revealed a biogeographic boundary slightly farther east, in the vicinity of Algoa Bay. The difference in phylogeographic boundary shown by the two markers is difficult to explain, but may be attributable to different inheritance patterns and / or dispersal rates and distances of gametes. The mtDNA Cox2-3 spacer region data showed no sequence variation within *H. spicifera* along the entire coastline sampled. However, the ITS1 data revealed two lineages with very little sequence variation, a more common lineage occurring all along the coast from Camps Bay (W coast) to Port St Johns (E coast) and a rare lineage occurring from Sardinia bay to Port St Johns. Interestingly, the co-existence of the two lineages starts to appear from Sardinia Bay, the same site were the south-eastern lineage of *G. pristoides* first appears. The results suggest that marine invertebrates and seaweeds do not show congruent phylogeographic patterns along the South African coastline.

Oral A 5

Changing food webs of the southern Benguela upwelling ecosystem

Coleen L. Moloney¹, Carl D. van der Lingen², Astrid Jarre¹, Lynne J. Shannon²

¹ University of Cape Town, Cape Town, South Africa

² Marine and Coastal Management, Cape Town, South Africa

The southern Benguela upwelling ecosystem exhibits variability on a number of scales. On a local spatial scale and short time scale, upwelling events punctuate the region, fueling large primary production that feeds

zooplankton populations. The productivity patches are relatively predictable in time and space, but at other times the ecosystem is affected by large-scale environmental anomalies, which may persist for only a few months or for many years. This presentation will examine the links from the physical environment, through the phyto- and zooplankton to the large vertebrates of the southern Benguela ecosystem. Current understanding of the key interactions among food web components will be described. Recent research has elucidated differences in diets of the three main small pelagic species in the region (sardine *Sardinops sagax*, anchovy *Engraulis encrasicolus* and redeye round herring *Etrumeus whiteheadi*). Sardine feed over a broad range of plankton size groups, whereas anchovy and redeye round herring feed most efficiently on the largest particles. These differences in diet selectivity have been related to different scenarios of plankton productivity, which cause differences in dominant size groups. The effects of this type of bottom-up forcing on ecosystem production will be examined. Some of the possible results of current and future changes in the system will be discussed, including the impacts of climate change and the effects of fishing.

Poster Mon 16

Ichthyoplankton from South and West coast estuaries of South Africa

Phanor Montoya-Maya¹, Nadine Strydom²

¹ Rhodes University, Grahamstown, South Africa

² South African Institute for Aquatic Biodiversity, Grahamstown, South Africa

The composition, abundance, and distribution of ichthyoplankton in selected cool temperate estuaries were investigated. The systems included the permanently open (PO) Olifants, Great Berg, Heuningnes, Breede and Goukou estuaries, the temporary open/closed (TOC) Diep and Lourens estuaries, and the Bot and Klein estuarine lakes. Mean salinity, temperature (°C) and water transparency (k) of estuaries ranged 8.3 – 26.1, 18.5 – 19.9, and 0.01 – 0.04 respectively. Larval fishes were collected by plankton towing in selected estuaries once per season over a period of one year between 2003 and 2004. A total of 49274 early stage fishes was caught, comprising 9 orders, 20 families, 29 genus, and 47 taxa. Only seven species accounted for 93.4 % of the total catch namely *G. aestuaria* (78.8 %), the prison goby *Caffrogobius gilchristi* (6.2 %), *P. knysnaensis* (3.5 %), the barehead goby *C. nudiceps* (2.5 %), the blenny *Parablennius* sp. (2.4 %), the Kappie blenny *Omobranchus woodi* (2.1 %) and *A.*

breviceps (1.9 %). Estuarine type and the associated physical conditions influenced larval fish assemblages. All the marine stragglers and marine migrants with the exception of *Liza richardsonii*, which occurred only in TOC systems, were found exclusively in PO estuaries. The river dominated PO estuaries and the Klein estuarine lake had markedly richer and more diverse larval fish assemblages than TOC systems and the Bot estuarine lake. Larval fish assemblages in the estuaries sampled exhibited the same seasonal and spatial patterns described for South African and temperate estuaries worldwide. Species diversity and densities peaked in summer and in mesohaline zones. The larval fish assemblages were less diverse and more dominated than in south east coast South African temperate estuaries. This was attributed to the characteristic decrease in taxonomic richness from the subtropical north-east toward the temperate west coast in South Africa.

Oral B 10

Comparative temperature studies on coral reef communities in Sodwana Bay, South Africa

Morris, T.¹, Roberts, M. J.², Schleyer, M. H.³, van den Berg, M. A.²

¹ Bayworld Centre for Research and Education, Cape Town, South Africa

² Marine and Coastal Management, Cape Town, South Africa

³ Oceanographic Research Institute, Durban, South Africa

During the globally devastating coral-bleaching events of 1998 and 2000, coral communities at Sodwana Bay (South Africa) experienced less than one percent total coral bleaching, suggesting these reefs to be protected from warming ocean temperatures to some extent. A long-term temperature monitoring site deployed on Nine-Mile Reef at 18 m in 1994, the northern extent of Sodwana Bay, was complimented with two additional temperature recorders at 24 and 37 m in 2001 to study the cross-shelf dynamics of cooler water penetrating the shelf. Upwelling events occurring on the deep site were documented on the mid-shelf and shallower sites within a short period of time. These upwelling events took place throughout the year, but with a greater degree of intensity during the summer months. A further two deployments in 2001, one at Wright Canyon head at 37 m and Two-Mile Reef at 12 m, were used to study the impacts of canyon-induced upwelling on the shelf and the connectivity between the northern and southern extents of Sodwana Bay respectively. The canyon head provides a complex route for cooler water

to interact with the shelf dynamics, while a high degree of connectivity exists between the north and south of Sodwana Bay ensuring cooler water being upwelled in the north is being transported to the south. The Sodwana Bay coral communities are unique in that they have developed on a narrow shelf with the shelf break between three and seven kilometers offshore. This provides an ideal environment for Ekman veering to upwell cooler water onto the shelf, and along with canyon-induced upwelling, protect the coral reefs in the embayment from warmer temperatures which cause coral bleaching.

Oral A 9

The effect of small scale water movement on the growth rate of the brown mussel, *Perna perna*

B.P. Mostert, C.D. McQuaid, A. Elliott
Rhodes University, Grahamstown, South Africa

The effect of small scale water movement on growth rates of the brown mussel *Perna perna* was investigated during 2004 and 2006 using before/after experiments. Mussels in control and treatment patches were marked at the beginning of the experiment and then again on the application of the treatment using coloured paper triangles glued to the growing edge of the shell. No treatment was applied for the first stage of the study. Water movement around treatment mussel patches was manipulated using aluminium baffles (15 cm x 15cm in length, 7.5cm high) while control patches were left unaltered in the second stage of the study. Growth of mussels in control and treatment experiments was compared before and after the application of treatment. During the first stage of the experiment in 2004 there was no significant difference in growth rates between control and treatment patches ($F = 1.16$; $p = 0.282$) while in 2006 treatment patches had a significantly higher growth rate than control patches ($F = 7.34$; $p = 0.007$). After the application of the treatment in 2004 treatment patches had a significantly lower average growth rate than control patches ($F = 139.64$; $p < 0.05$) while the average growth rates in 2006 showed the same effect with the treatment patches now having significantly lower average growth rates than control patches ($F = 7.39$; $p = 0.007$). Given this finding it can be concluded that small scale reduction in water flow has a significant effect on growth rates of mussels.

Poster Wed 25

Amaz' Olwazi an opportunity for school science education

Thomas Mtontsi

*South African Environmental Observation Network,
Cape Town, South Africa*

For some time now, the Environmental Science Education community have been working diligently to have a stronger voice regarding improving the science literacy and environmental stewardship of this nation. This work is occurring as we recognise that we have little representation in the science community overall. Yet, little attention has focused on what it will look like when we are finally successful. In this presentation, a projection of how our school based science education can benefit from Environmental Science Education programmes challenges for more attention and support. Further, I will bring to the discussion issues that will, hopefully, lead to further discussion of where we as a community wish to go, and present some curriculum intended outcomes that will let us know when we have been successful in our endeavours. The recent oceanographic cruise to Marion Island and the Southern Ocean is just but an example of updated investigations that our school science should be supported with.

Poster Mon 10

Prediction of larval viability based on various egg and larval quality characteristics in dusky kob, *Argyrosomus japonicus*.

Maryke Musson, Niall G. Vine, Horst Kaiser
Rhodes University, Grahamstown, South Africa

Variability in egg quality of eggs available for larval rearing is a major constraint in large-scale marine finfish hatchery production. A rapid egg quality assessment is therefore an important tool for hatchery management whereby egg and larval quality can be determined by assessing various physical and chemical egg and larval characteristics. We set out to determine whether egg and larval characteristics, such as morphology, size, fertilization and hatching rate, together with larval performance in stress tests, could be indicative of larval quality and viability. Fertilized eggs and newly hatched larvae from 11 different spawning cohorts were evaluated. An egg quality ranking index (RI) was formulated incorporating egg size, shape, colour, development and oil globule number and size. Newly hatched larvae were evaluated on hatching rate, size and morphology. Replicated samples of newly hatched larvae were then exposed to four different stress tests (formalin, temperature, salinity and exposure to air), which were optimized for dusky kob. From each cohort, a minimum of five larvae were

measured daily for 30 days. After 200 degree days, larvae from cohorts with higher egg quality RI's and with better stress test survival, showed better survival and growth than those from cohorts with lower RI's and poorer stress test survival. It is thus possible to predict long-term larval viability for dusky kob using egg and larval characteristics combined with appropriate stress tests.

Oral A 6

Patterns and volumes of commercial and recreational harvest of white stumpnose in Saldanha Bay: a preliminary assessment of the fishery

Tor F. Næsje¹, Colin Attwood², Sven Kerwath³, Paul D. Cowley⁴, Felicia Keulder³, Clement Arendse²

¹ Norwegian Institute for Nature Research, Trondheim, Norway

² University of Cape Town, Cape Town, South Africa

³ Marine and Coastal Management, Cape Town, South Africa

⁴ South African Institute for Aquatic Biodiversity, Grahamstown, South Africa

The Saldanha Bay system on South Africa's west coast not only supports important recreational, artisanal and commercial fisheries, it is also an important industrial port, mariculture node and popular recreational and tourist destination. Over 100 000 people live in the area, and many are attracted by the prospects of fishing. Langebaan Lagoon, the sun-warmed, sheltered southern extension of Saldanha Bay, represents a unique marine environment along the cool-temperate, wave-exposed west coast of South Africa. A National Park was proclaimed in 1986 to protect the wetlands of Langebaan Lagoon, and included a significant (34 km²) no-take marine protected area (MPA). A five year NORAD-funded fisheries research programme commenced in 2005 to assess the state of Saldanha Bay fisheries and the adequacy of existing management procedures, including the effects of the MPA. White stumpnose *Rhabdosargus globiceps* is the most important species in both shore- and boat-based rod-and-line fisheries, constituting approximately 85 – 90 % of the catches. Although the species may live up to 20 years, the majority of the individuals caught were 4 – 6 years old, and few were older than 7 years. The species reaches 50 % maturity at age 4. Commercial harvesters were few, but accounted for approximately half the annual boat catches. The total instantaneous mortality rate was 0.51 y⁻¹, which indicates heavy exploitation. Compliance was reasonably good, in comparison to

other parts of the coast: few fishers exceeded the bag limit (1.5 %), few fish were undersize (0.8 %), and most fishers had permits. Studies of the movement of white stumpnose indicate a closed population in Saldanha Bay. Our study suggests that the MPA plays a strong conservation role, but that additional measures are required throughout the bay to protect juvenile and adult stages of fish in the face of increasing pressures.

Oral A 4

Effects of marine reserves on growth of commonly exploited and rarely exploited limpets on the southeast coast of South Africa

M.D.V. Nakin^{1,2}, C. D. McQuaid², A. J. Booth²

¹ Walter Sisulu University, Mthatha, South Africa

² Rhodes University, Grahamstown, South Africa

The effects of marine reserves on the growth of two commonly exploited (*Helcion concolor* and *Scutellastra longicosta*) and two rarely exploited limpet species (*Cellana capensis* and *Scutellastra granularis*) were investigated over 20 months at two reserve and two non-reserve sites. We wished to test the hypothesis that growth of commonly exploited species would be reduced in reserves due to higher densities and stronger intraspecific competition, with no effect for rarely exploited species. However, limpet density showed a month x reserve interaction for all species, with significantly higher densities in reserves in many, but not all of months. Growth was estimated using two techniques. Monthly data on size composition were fitted with a modified von Bertalanffy growth equation and growth rates were estimated from changes in mean cohort sizes using the MULTIFAN method. Growth was also examined over the same period using individual tagging, which gave estimates that were twice as rapid. The findings highlight the importance of biological detail. The results only partly reflect those on densities. Both *H. concolor* and *C. capensis* (sometimes mistaken for *H. concolor* and collected) showed faster growth in non-reserves, where their densities were generally lower. In accordance with the original hypothesis, there was no effect of reserve on the growth rate of *S. granularis*, but this was despite higher densities in reserves during 6 months. There was also no reserve effect for the commonly exploited *S. longicosta* although its density was higher in reserves in almost all months. As this species is territorial, intraspecific competition is minimized and its growth tends to be limited by territory size, rather than being directly affected by density. The results indicate that the effects of reserves on growth rate depend not

only on whether a species is exploited, but also on details of its biology, such as territoriality.

Poster Mon 18

Jellyfish amongst the crocodiles: a new record of *Crambionella stuhlmanni* (Scyphozoa: Rhizostomeae) from St. Lucia estuary, South Africa

Simone Neethling, Mark J. Gibbons
University of the Western Cape, Bellville, South Africa

A new record of *Crambionella stuhlmanni*, from St. Lucia estuary part of the Greater St. Lucia Wetland Park, is reported. This project describes the material using objective, quantitative morphological features not used in previous *Crambionella* diagnoses and sets the benchmark for any future study of this genus. The presence of conical projections on velar lappets, proportion of terminal club to oral arm length and absence of orbicular appendages among mouthlets were characters found to distinguish the material from two other *Crambionella* species: *C. orsini* and *C. ananndalei*. Discrepancies among previous descriptions of *C. stuhlmanni* and the material investigated imply further investigation is needed.

Oral A 13

Is there a change in the threats and status of sea turtles in countries of the western Indian Ocean since the inception of conservation in region?

Ronel Nel
Nelson Mandela Metropolitan University, Port Elizabeth, South Africa

There are eleven countries in/around the Indian Ocean seaboard of Africa, from Somalia in the north to South Africa in the south, and east to the BIOT i.e. Chagos Islands. Five species of turtle are common to these countries with nesting trends differing widely among the 74 identified nesting sites. Pertinent to the region is that it houses some of the longest running monitoring programmes in the world, with South Africa monitoring loggerhead and leatherback turtles since 1963, Seychelles monitoring hawksbills since 1973 and France/Reunion monitoring green turtles on the Scattered Islands since 1985. The populations at each of these sites have been reported as stable or increasing. Along with these monitoring programmes there has been significant effort to understand and change mortality/harvesting patterns of turtles and their eggs. Harvesting of sea turtles is now prohibited in every country in the WIO although it still takes place in 8 of the 11 nations,

with turtle meat having a market value 5 times that of beef in some places. The threats however, have also changed in the region with traditional harvesting now augmented by industrial fishing and bycatch from gill netting, trawling and longlining being the biggest threats. Furthermore, previously pristine beaches and feeding habitats are now being modified into beach developments, hotel complexes experiencing beach driving, erosion and light footprints sometimes in the name of "ecotourism". 33 of the 74 nesting sites experience moderate to heavy development pressures with 32 nesting beaches under pressure from egg or turtle harvesting, or turtles captured in nets with only 8 of these sites being communal. Some of these sites where harvesting is reported are located in protected areas. After four decades of conservation, much still remains to be done, and a comprehensive strategy is required for the migratory turtle species of the region.

Oral C 12

Ecological effects of off-road vehicle driving (for boat launching) on macroinfauna of sandy beaches of northern KwaZulu-Natal

Ronel Nel, Karien Bezuidenhout
Nelson Mandela Metropolitan University, Port Elizabeth, South Africa

The aim of this study is firstly to describe the fauna inhabiting sandy beaches in northern KwaZulu-Natal (KZN) and secondly to highlight the effects of off-road vehicle driving associated impacts on beach macrofauna. With a change of legislation boat launching was one of the only reasons left for public driving on beaches. However, since little data exist on the actual impacts on beach macrofauna, this study aimed at determining if there is suppressed species richness, abundance or biomass values in intertidal areas used for boat launching. Five launch sites were sampled as well as five non-launch sites (as control sites) where driving is restricted to routine management patrols with generally less than one vehicle pass per day. The data from this study indicated that the macrofaunal diversity (7-16 species) of KZN beaches is relatively high per given morphodynamic state as is expected for subtropical beaches, but with relatively low abundance (<2300 indiv.m⁻¹) and biomass values (<20 g.m⁻¹ shell-free dry mass). There were no significant differences between species richness and abundance between transects of impact and non-impact sites. There were, however, differences between sites, but these changes were ascribed to shifts in beach morphodynamics or other local conditions such as estuaries or rocky points. It is thus

concluded that the current restricted levels and extent of beach driving has no significant impact on beach macroinfauna of northern KZN. The expectation is that if either intensity or area of driving increases, the impacts on macrofauna could become negative and should be reassessed.

Poster Tue 5
Saving Abalone

M. Ngadlela, P. Goosen, P. Gqirana
Marine and Coastal Management, Cape Town, South Africa

The Minister of Environmental Affairs and Tourism has from the 1 February 2008 closed the wild abalone fishery to all commercial exploitation and imposed a diving ban in five areas along the SA coastline. Four areas with the best recovery potential have been identified by the scientists as focus areas for recovery. The Directorate: Compliance of MCM has put an abalone protection plan in place to ensure effective compliance which should ensure the recovery of the resource. This poster gives a synopsis of the Directorate's efforts in these areas to achieve this goal.

Poster Mon 20
Accumulation and depuration rate of Dinophysis toxins in mussels (*Choromytilus meridionalis*) and oysters (*Crassostrea gigas*) in the Southern Benguela upwelling region

J. Ntuli, G. Pitcher
Marine and Coastal Management, DEAT, Cape Town, South Africa

Harmful algal blooms are responsible for a wide variety of disturbances in the aquaculture sector, marine environment and human health. An investigation was carried out in a field survey conducted at the Southern Benguela region; this region is characterized with an intense production of harmful algal blooms. 25 bags of 15 oysters and mussels per bag were deployed on site two weeks prior to commencement of experiment, a bag of oysters and mussels were retrieved daily for toxin analysis, water samples for cell count and dinophysis cells were collected for the determination of species toxicity. Preliminary results on cell count shows a fairly appreciable amount of *Dinophysis acuminata* and the differences in species accumulation and depuration rate can at this stage be safely attributed to species physiological structure and metabolic rates. Knowledge of species will be vital in the management

of bivalve population for human consumption.

Oral A 3
Intertidal fishes of areas adjacent to the East London Marine Reserves

Nolubabalo H. Ntunzi¹, Malcolm J. Smale²
¹ *University of Fort Hare, Alice, South Africa*
² *Bayworld Centre for Research and Education, Port Elizabeth Museum, South Africa*

The intertidal fish species composition of 122 tidal pools adjacent to the three East London Marine reserves between Christmas Rock and Kei River Mouth in the Eastern Cape was assessed using rotenone sampling in January, April, July and October 2005. The tidal pools covered an area of 854.67m² with a volume of 239.38 m³. A total of 4961 fish from 19 families comprising of 52 species were sampled. The average number of fish per pool was between 3.02 m⁻² and 14.27 m⁻³ with the average biomass of between 13.96 gm⁻² and 63.75gm⁻³. Four families dominated the community; Gobiidae (35.09%), Clinidae (28.29%), Sparidae (22.79%) and Mugilidae (7.88%). Multivariate analysis using PRIMER showed that although there are some significant differences in species composition along the intertidal zone, the species composition between the sampled areas is similar. Physical factors such as weed cover, pool volume and pool substratum coupled with presence of resident species, such as *Cafrogobius caffer* and *Clinus cottoides*, were responsible for the similarity between sampled areas. Further analysis into the presence of linefish juveniles in the tidal pools revealed that these juveniles contributed 23.61% of the total catch. The analysis of recruitment patterns of *Epinephelus marginatus*, *Sparodon durbanensis*, *Diplodus sargus* and *Diplodus cervinus* into the tidal pools revealed seasonal recruitment. Multivariate analysis suggested that the species composition of these tidal pools is similar to the intertidal pools sampled elsewhere along the south coast of South Africa, which is representative of the warm temperate Agulhas biogeographic zone.

Poster Tue 19
The Cape Egg and Larval Program (C.E.L.P) data rescue project: The importance of historical data for understanding recruitment mechanisms of fish species in the southern Benguela upwelling ecosystem

Lisa J. Nupen¹, Jenny Huggett², Tracey Fairweather², Jan van der Westhuizen², Lisa Mansfield³

¹ University of Cape Town, Cape Town, South Africa

² Marine and Coastal Management, Cape Town, South Africa

³ Cape Peninsula University of Technology, Cape Town, South Africa

Current ecosystem models of the southern Benguela lack detail on lower trophic levels, particularly from earlier decades. The Cape Egg and Larval Programme (CELP) was initiated to investigate the composition, distribution and temporal variability of ichthyoplankton in the southern Benguela, thereby increasing understanding of the recruitment mechanisms of important fish species. Environmental and plankton sampling was conducted at monthly intervals from August 1977 to August 1978. EUR-OCEANS provided funding to “rescue” the CELP data from logbooks and raw data-sheets to be included in the open-access EUR-OCEANS Network of excellence (online database) and also for the curation of preserved samples. A rich dataset of widespread, monthly abundances of eggs and larvae of a comprehensive list of fish species is now available, including those of direct commercial importance as well as others of more holistic relevance in the southern Benguela ecosystem. Supplementary data includes hydrological and chlorophyll measurements in the upper 100m, larval stomach contents and length measurements. The fitting of ecosystem models to fisheries time series has highlighted the importance of plankton dynamics in understanding ecosystem dynamics. Furthermore, there is increasing application of the ecosystem approach to fisheries (EAF). Current EAF modelling initiatives include the creation of an end-to-end model of the southern Benguela marine food-web by coupling a lower trophic model with one of higher trophic levels, to explore the effects of fishing and climate change on fish communities. The CELP dataset will provide valuable information on the lower trophic levels, including the diet and early life history of fish species. The CELP dataset will also be useful in studies on long-term time series, ecosystem shifts and response to climate change.

Poster Tue 34

Home range dynamics of spotted grunter, *Pomadasys commersonnii*, in a South African intermittently open estuary

Bronwyn A. O’Connell¹, Paul D. Cowley², Amber-Robyn Childs², Tor F. Næsje³

¹ Rhodes University, Grahamstown, South Africa

² South African Institute of Aquatic Biodiversity, Grahamstown, South Africa

³ Norwegian Institute for Nature Research, Trondheim, Norway

The spotted grunter *Pomadasys commersonnii* is an important, estuarine-dependent, fishery species in southern Africa. Since estuaries are essential habitats in the life history of this species, the quantification of area use patterns and movements is important for fisheries management. This study used acoustic telemetry to investigate movements, use of habitat and home range dynamics of spotted grunter in the small intermittently open East Kleinemonde Estuary on the Eastern Cape coast of South Africa. Nine spotted grunter (range: 326-489mm TL) were surgically equipped with uniquely coded acoustic transmitters. Positional fixes were obtained by manual tracking tagged individuals on six days and six nights during five tracking sessions from March to November 2004. In addition, five stationary data-logging receivers, moored at specific locations from the mouth to the top of the estuary provided additional long-term monitoring. Kernel home ranges (95% UD) varied in size (26 296-165 321m²) but were all located in a common high use area situated between 300-1 300m from the estuary mouth, which coincided with the highest abundance of prey items. There was no significant variation in home range size [C^2 (N = 9, df = 4) = 4.18; p = 0.38] between the temporally segregated tracking sessions (over nine months). The persistence of these home range estimates were confirmed by the long-term data-logging receivers. There was no significant diel variation in home range size [F(4, 64) = 0.05, p = 0.99] or core area size [F(4, 64) = 1.40, p = 0.25]. Use of habitat and home range dynamics of spotted grunter in the East Kleinemonde Estuary were consistent over the nine month study period, and they appeared to be influenced more by biotic than abiotic factors. However, when the mouth opened at the end of the study, most tagged fish vacated their home ranges and emigrated to sea.

Oral B 8

A brief synopsis of sardine and predator movements during the annual KwaZulu-Natal sardine run

Sean O’Donoghue¹, Victor Peddemors¹, Laurent Drapeau², Phillip Whittington³, Sheldon Dudley⁴, Robert Crawford⁵

¹ University of KwaZulu-Natal, Durban, South Africa

² IRD Projects ECO-UP/ESPACE

³ East London Museum, East London, South Africa

⁴ Natal Sharks Board, Umhlanga Rocks, South Africa

⁵ Marine and Coastal Management, Cape Town, South Africa

The combined results from twenty years of sardine run aerial surveys, the predator surveys from the 2005 *R.V. Africaner* sardine run surveys and eleven years of near-shore Natal Sharks Board (NSB) field staff sightings are presented here. Sardine temporal and spatial distribution is described and compared with that of their predators and environmental conditions along the east coast of South Africa. The aerial surveys indicate that the highest sighting rates for sardines, Cape gannets and common dolphins occurred off Waterfall Bluff, Eastern Cape. Sighting rates decreased significantly for all three species north of Umtoni (about sixty kilometres south of Durban), with sardines and gannets sighted closer to shore. Results from the *R.V. Africaner* hydroacoustic surveys confirm this movement towards shore with virtually no sardine shoals recorded north of Umtoni despite substantial, concurrent purse-seine landings and nearshore sightings made by NSB field staff. Sardine distribution was significantly, inversely correlated with sea surface temperature but not with chlorophyll-a concentration. It is suggested that the presence of the persistent intrusion of warm Agulhas Current water along this stretch of coastline, via the Durban Eddy, may be an important factor in forcing the sardine run nearer to the shore. These results are presented here as a brief synopsis of the sardine run and it is intended that they will contribute towards the development of an ecological model of the sardine run using more sophisticated statistical methods.

Poster Wed 15

Biodiversity and biogeography of the ophiuroids (Brittle stars) (Echinodermata: Ophiuroidea) of South Africa

Jennifer M. Olbers¹, Charles L. Griffiths², Yves Samyn³

¹ *Ezemvelo KZN Wildlife, Durban, South Africa*

² *University of Cape Town, Cape Town, South Africa*

³ *Royal Belgian Institute of Natural Sciences, Belgium*

The most authoritative taxonomic literature on echinoderms (excluding holothuroids) in South Africa available in 2008 is still the monograph by Clark and Courtman-Stock (1976). With the exception of a few more recent publications the majority of the literature is historical being published between the 1800's and the 1970's. Since then, taxonomic revisions have been carried out and a number of new species have been described. This is indicative that a synthesis and revision of the echinoderms (excluding holothurians) of South Africa is a necessity. Revision of the classes, Crinoidea, Ophiuroidea, Echinoidea and Asteroidea

would assist in compiling new locality records, exposing whether species are still being found in the same regions as before and correcting misidentified specimens. Taxonomic revision of all the echinoderm classes is a mammoth task, and for this reason, this study will only focus on the ophiuroids (brittle stars). Thandar (1989) accounted for 124 ophiuroid (46 % endemic) species in the southern African region. In light of this and the minimal scientific research, the main objective of this study is to revise the taxonomy, distribution and diversity of the ophiuroids. This will be completed by examining existing collections in a number of national and international museums. Material will be collected (using a variety of collection methods, (i.e. SCUBA, dredging etc.) and examined from the east, south and west coasts of South Africa. The final product will be taxonomic keys for each species known to occur in South Africa, distribution of each species (including maps) and the creation of checklists with photographic references and illustrations. Clark, A.M. and Courtman-Stock, J. 1976. The echinoderms of Southern Africa. British museum of Natural History, London, 277 pp. Thandar, A.S. 1989. Zoogeography of the southern African Echinoderm fauna. South African Journal of Zoology 24: 11-18.

**Oral A 4
MPAs, Science and SANParks**

A. Oosthuizen

South African National Parks, Port Elizabeth, South Africa

SANParks as the country's premier conservation organisation has been mandated by the national government to expand South Africa's protected areas to about 8% of the country's surface area and the coastline up to about 20% by 2010. SANParks currently manages eight coastal parks, of which four terrestrial parks have adjacent MPAs. The expansion programme of SANParks proposes a further three MPAs next to existing parks. A strategic approach is needed to ensure effective management of these areas. SANParks base their 'science for management' on a Threshold of Potential Concern (TPC) approach. TPCs are upper and lower limits along a continuum of change in selected environmental indicators and are based on a combination of best scientific evidence and plausible ecological hypotheses. TPC development, monitoring and evaluation methods are discussed. SANParks approach to generating the science which TPCs are based on is two fold, for terrestrial science a large proportion is generated in-house, but for the marine environment the sci-

ence will mostly be facilitated. Facilitation of marine science in MPAs under SANParks management will be done by dedicated Science Nodes. Standardization of collection methods and baseline information toward TPCs from selected MPAs are discussed. Research is ongoing in Addo, Tsitsikamma and Table Mountain. SANParks marine monitoring systems will align with the national framework and are being developed in conjunction with SAEON.

Oral B 13

Swimming strong after stock collapse?

Carel J. Oosthuizen¹, Bruce Q. Mann², Paulette Bloomer¹

¹ University of Pretoria, Pretoria, South Africa

² Oceanographic Research Institute, Durban, South Africa

Globally it is estimated that 75 % of fish stocks are either overexploited or reached maximum exploitation. Information about species recovery after stock collapse is scarce. Here we have the opportunity to compare the level of genetic variation before and after such a stock collapse event using *Polysteganus undulosus* as an example. *Polysteganus undulosus* (known as seventy-four) is a south-east African endemic found from the Cape to Maputo. This species made up more than 50% of the commercial hook and line fishery along the KwaZulu-Natal coast between the 1960's and 1970's before the stock collapsed. Only during 1988 was the first step taken to protect this species by implementing bag limits. This was followed by a total closure (recreationally and commercially) of the fishery in 1998 in accordance with the South African Marine Living Resources Act. Within this preliminary study of intraspecific diversity, we compare samples collected from 1962/63 (before the collapse of the stock) with samples collected during 2005/06 using the mitochondrial ND2 gene. As part of a more comprehensive study, using microsatellite markers, total gene flow patterns can be estimated and contrasted with maternal gene flow based on mtDNA by increasing the sample sizes of the 2005/06 sampling season. The results obtained from this study will be integrated in conservation and management strategies.

Poster Wed 10

Adult density, shore height and upwelling intensity: Factors influencing settlement of mussels and barnacles on the west coast of South Africa

Wisaal Osman, Maya Pfaff, George Branch

University of Cape Town, Cape Town, South Africa

Community and population structure of intertidal rocky shore invertebrates are influenced by pre-settlement (larval supply and settlement) and post-settlement (competition, desiccation) factors. This study examined the effect of adult stock (mussels only) and shore height on daily settlement patterns of intertidal mussels and barnacles at two sites with contrasting upwelling strengths on the west coast of South Africa. Additionally, relationships between settlement events and phases of upwelling cycles (active upwelling, relaxation, downwelling) and swell height were explored. There was no significant relationship between mean mussel settler (<2 mm) density with recruit (2-5 mm) density and with adult (>5 mm) density. Significantly higher daily settlement rates were observed at the site with weaker upwelling, and only there, at the lower shore height. Mussel settlement was much higher than barnacle settlement, and peaks of the two taxa did not coincide in space or time. Mussel settlement events were significantly correlated with swell height and active upwelling events at both sites, with a lag of 2-3 days at the weak upwelling site. Barnacle settlement events were significantly correlated with downwelling only at the weak upwelling site. Thus the larvae of mussels and barnacles appear to have different transport mechanisms to reach the shore to settle.

Poster Wed 24

How to achieve transdisciplinary Co-operation for EAF? A South-African Case study

Paterson B.¹, Isaacs M.², Hara M.², Jarre A.¹, Moloney C.L.¹, Field J.G.¹

¹ University of Cape Town, Cape Town, South Africa

² University of the Western Cape, Bellville, South Africa

The need for transdisciplinary approaches to fisheries management is frequently stated. Collaborative projects aiming to bring together natural and social scientists, however, frequently meet with difficulties. The value of expert (or knowledge-based) systems in fostering discussion and enhancing communication has long been stressed. This paper proposes the process of developing expert systems as a way to foster transdisciplinary research for an Ecosystem Approach to Fisheries. Challenges to transdisciplinarity in general, and fisheries management in post-apartheid South Africa in particular are considered. A major obstacle for collaboration between social and natural scientists is that transdisciplinarity begins at the design-stage of a pro-

ject. Including scientists from other disciplines after completion of the conceptual phase reduces their expertise to a technical level and creates the impression that inputs are not equally valued. We describe a method of fostering collaboration and achieving active participation in the context of developing an expert system for evaluating the ecosystem performance of the South African sardine *Sardinops sagax* fishery. This software tool was developed in a consultative process with natural scientists, social scientists, resource managers and industry and follows the hierarchical tree approach recommended in the FAO guidelines for responsible fisheries. A focus group approach was chosen to elicit knowledge from natural scientists, social scientists, industry representatives and resource managers. Through this process conceptualisations of different stakeholder perspectives were developed in terms of objectives and indicators. Active participation by all focus group participants was achieved through follow up meetings that continued over a one year period. Continuous effort was made to make all participants feel that their perspectives and contributions are equally valued. This contribution summarizes the collaborative process and introduces revised hierarchies, new indicators and related data sets for the social and economic leg in support of an EAF in the South African sardine fishery.

Oral A 13

Larval fish dynamics in a shallow nearshore habitat and the implications of currents and swimming abilities on dispersal

P. Patrick¹, N.A. Strydom²

¹ Rhodes University, Grahamstown, South Africa

² South African Institute for Aquatic Biodiversity, Grahamstown, South Africa

Few nearshore larval fish studies exist to understand the links between offshore spawning and coastal nurseries in South Africa. Larval fishes were investigated in the shallow, nearshore region of the proposed Greater Addo Marine Reserve (GAMR), eastern Algoa Bay in order to provide information on the dynamics of the assemblage, specifically composition, distribution, density, and seasonality. Larvae of coastal species that produce benthic eggs dominated catches along two depth contours (~5m and ~15m) and were collected using stepped-oblique bongo net tows, twice per season for two years (March 2005 – January 2007). These larvae represented 32 families and 78 species. The Gobiidae, Cynoglossidae, Clupeidae, Engraulidae and Sparidae were the dominant fish families. Catches varied

significantly between seasons peaking in spring with a mean of 64 larvae/100m³. Preflexion stage larvae dominated catches (75%). All developmental stages of *Diplodus capensis*, *Engraulis capensis*, *Heteromycteris capensis*, *Sardinops sagax* and *Pomadourys* species were found in the study area. It appears that these species use the shallow nearshore as a nursery area. Current velocities and direction and the swimming abilities of late-stage larvae were further assessed to determine potential larval movement to and from the GAMR. Analysis of 12 months (May 2006 – May 2007) data from a bottom-moored Acoustic Doppler Current Profiler within the study area showed that offshore south eastward (39%) and onshore north westward currents (33%) dominated. The south westward current (15%) and north eastward current (12%) occurred less frequently. Current velocity decreased with depth in the nearshore, with a mean velocity of ~29 cms⁻¹ recorded at a depth of 4 m and a mean velocity of ~11 cms⁻¹ recorded at a depth of 14 m. This bottom displacement is effective in dispersing bottom eggs during the main spawning season in Algoa Bay. This has important implications in the placement of neighbouring marine protected areas. Understanding the dispersal and movement of marine fish larvae in coastal habitats requires knowledge of active swimming abilities. The study of larval fish swimming abilities is an important component in understanding larval fish dispersal patterns and recruitment success and to date, has not been studied in South Africa. The critical speed and endurance swimming of late stage larvae of two common inshore species occurring in the study area, *Diplodus capensis* and *Sarpa salpa* (Family Sparidae), were measured in a laboratory swimming chamber. The mean *U*-crit value for *D. capensis* (18.6 cms⁻¹) was similar to that of *S. salpa* (18.0 cms⁻¹), whereas mean endurance (km swum) was greater in *S. salpa* (8.4 km) than *D. capensis* (5.9 km). These swimming abilities exceed the average current velocities observed in the shallow nearshore providing larvae with the ability to greatly alter their passive dispersal trajectories and ultimately influence their distribution in the nearshore.

Oral A 8

Albatross overlap with fisheries in the Benguela upwelling system : implications for conservation and management

Samantha L. Petersen^{1,2}, Peter G. Ryan², Les G. Underhill²

¹ WWF Responsible Fisheries Programme, Cape Town, South Africa

² University of Cape Town, Cape Town, South Africa

Comparatively few studies have examined the relative importance of fisheries waste compared with natural prey in the diet of pelagic seabirds. Trawl activity on the continental shelf break off South Africa provides large quantities of high quality and predictable food in the form of offal and discards for a range of species, including non-breeding Black-browed Albatrosses *Thalassarche melanophrys* and White-capped Albatrosses *T. cauta*. As large numbers of both species are killed in collisions with trawl warp cables, mitigation measures have been introduced that include limitation of discard levels, yet little is known about the consequences of reduced food supply for scavenging birds. In this study, adult and immature albatrosses were tracked in the southern Benguela in the austral winter of 2005 and 2006, and their distribution examined in relation to fisheries, bathymetry and remotely-sensed oceanography. Kernel analysis revealed striking differences in distribution. Whilst in the south east Atlantic, White-capped Albatrosses spent most (85.0%) of their time on the Southern African trawl grounds, whereas Black-browed Albatrosses spent only 39.2% of their time in these areas, and the remainder either in deeper waters or on return oceanic foraging trips typically of 8.4 days or 2 540 km (max. 5 320 km) in duration. While foraging in South African waters, the presence of trawlers, but not longliners, was a strong predictor of both White-capped and Black-browed Albatross distribution. The limited proportion of time spent overall on the trawl grounds by Black-browed Albatrosses suggests that they are either out-competed by the larger White-capped Albatross behind vessels, or are better adapted for oceanic foraging. While on oceanic foraging trips, Black-browed Albatrosses moved predictably along the margins of warm and cold eddies, typically areas of enhanced productivity and thus high prey concentrations. This study presents evidence that Black-browed Albatrosses, in particular, forage to a large extent on natural prey, despite the high availability of discards from fishing vessels in the Benguela. Therefore, given the high incidence of albatross collisions with trawl cables, the benefit of a management decision to limit discarding as a mitigation measure is likely to far outweigh the disadvantage of reduced food in the form of fisheries waste.

Oral A 8
An Ecosystem Approach to reducing seabird by-catch in the South African demersal longline fishery

Samantha L. Petersen^{1,2}, Maria B. Honig¹, Peter G. Ryan², Les G. Underhill²

¹ WWF Responsible Fisheries Programme, Cape Town, South Africa
² University of Cape Town, Cape Town, South Africa

Although longline fishing gear is regarded as relatively selective, it is now evident that vulnerable species such as seabirds, turtles and sharks are caught incidentally. The demersal longline fishery operating in the Benguela Current Upwelling System off South Africa is no different. Endangered seabirds, endemic sharks and skates and a collapsed stock of Kingklip *Genypterus capensis* are amongst the bycatch in this fishery. Increasing line sink rates to 0.3 m/s by adding weights to longlines has been proposed to reduce seabird bycatch, but gear configurations to achieve this sink rate have not been established for the hake fishery, nor has its effect been tested on target and non-target species. For various weighting regimes (4, 6, 8 kg weights spaced at 40, 50 and 60 fathoms) no significant difference was found in the sink rate to 2 m, 5 m, 10 m and 15 m for dropper lines. However, there was a significant difference in the sink rate for the portion of the line near the weight between 4 kg, 6 kg and 8 kg weights. There was no significant difference in the catch rate of hake *Merluccius* spp. between the dropper (84.73/1000 hooks) and the weight (100.53/1000 hooks), but there was a significant increase in the catch rate of Kingklip, the three most commonly caught demersal sharks (*Squalus mitsukurii*, Catshark *Scyliorhinus capensis* and *Holohalaelurys regani*) and the most commonly caught skate (*Raja straeleni*) near weights compared to near droppers. Thus while hake catches are unlikely to be reduced by increased weighting, other vulnerable species of fish, shark and skate may be affected. Given that relatively few birds are caught in this fishery off South Africa, the increased impact on non-target fish species may outweigh the potential benefits of increased weighting on reduced seabird bycatch.

Oral A 11
Land ahoy! Different onshore transport mechanisms of intertidal mussel and barnacle larvae off the west coast of South Africa

Maya C. Pfaff¹, Vera Hoffmann¹, Wisaal Osman¹, Jennifer Fisher², John L. Largier², George M. Branch¹
¹ University of Cape Town, Cape Town, South Africa
² University of California, Davis, USA

In coastal upwelling regions, planktonic larvae of near-shore species with sessile adults need to utilize the landward currents associated with upwelling cycles to complete their life cycles and avoid being lost to sea

through the strong offshore currents. The Southern Benguela Upwelling System is characterized by seasonal pulses of upwelling-favourable winds, which lead to periodic upwelling cycles every 2-10 days during summer. Additionally, the South African shoreline features major headlands and bays, which are associated with spatial discontinuities of upwelling intensity, forming 'upwelling-centers' and 'shadows' respectively. In this highly variable system, our study focused on the relationship between upwelling dynamics and the arrival and settlement of larvae of the spatially dominant (invasive alien) intertidal mussels and barnacles. For two upwelling seasons, we monitored their daily settlement in the intertidal at two sites with contrasting upwelling intensity (Cape Columbine = upwelling-centre; Elands Bay = shadow). In addition, during a month of intense sampling, we monitored stratified larval settlement (top, mid, bottom) on moorings at three distances from shore, as well as larval availability at the shore. To quantify upwelling dynamics at each site, we recorded wind speed and direction, thermal stratification of the water column, and current speed and direction (ADCPs). Intertidal settlement was an order of magnitude higher 1) at Elands Bay than at Cape Columbine, and 2) for mussels than for barnacles. Mussel arrival and settlement events coincided with the onset of upwelling, whereas barnacles sporadically settled after down-welling. Both taxa experienced radical thinning of settler numbers as they approached the shore, with clear de-coupling between the timing of larval settlement on moorings in the very near-shore water column and on the shore. Larval transport by mechanisms other than meso-scale upwelling may thus be important for the last episode of the larval journey back to shore.

Oral PL 1

Why is the ocean so cold?

George Philander
University of Cape Town, Cape Town, South Africa

Why, in the oceans, is the layer of warm surface waters, which floats on the very deep layer of very cold water, so shallow? This feature, which permits phenomena such as El Nino in the Pacific and Atlantic, is recent in the geological records. What are the factors that determine the depth of the thermocline? Why were they different in the past when the thermocline was much deeper? How will global warming affect the oceanic thermal structure in future? This presentation will address these questions.

Poster Tue 35

Using Stable Isotope Analysis toward understanding trophic structure off the coast of South Africa and the natural variability forced by the environment

K. Pillay, S. Kaehler, L. Shannon, T. Samaai
Marine & Coastal Management, Cape Town, South Africa

The problems facing the world's marine resources are in part a failure on the side of management and governance in developing a holistic 'ecosystem' approach to fisheries management. There is an increasing trend to move from single-species, short-term management to multiple species, long-term management of ecosystems. This broad approach stems from international agreements, treaties and policies, developed under the guidance of the United Nations Law of the Sea Convention 1982 (UNCLOS), the United Nations Convention on the Environment and Development 1992 (UNCED) and the Convention on Biological Diversity 1992 (CBD). From an ecological perspective, an ecosystem approach to management translates into acknowledging, understanding and quantifying the interactions between the various components within marine ecosystems. This study focuses on the transfer of energy through marine trophic levels, on a latitudinal and bathymetric gradient, off the south and west coast of South Africa. The aim is to determine the sources of organic matter and trophic positioning of organisms to understand the linkage or coupling between the pelagic. The eventual goal is to develop an explanatory and predictive integrated ecopath/isotope mixing model, which will include all trophic levels within an ecosystem. Two important components have been identified to develop such a model which will include 1) monitoring the upper trophic levels of the pelagic ecosystem and 2) understanding the trophic linkages within the various food web components of these ecosystems. The technique of stable isotope analysis (SIA) coupled with gut content analysis will be used to understand these linkages. Carbon and nitrogen isotopes are generally used, as their signatures change predictably between predator and prey items. This facilitates the tracing of the flow of energy and nutrients through the individual food web components. To understand these trophic interactions we will be collecting various samples (muscle, bone and water) from all trophic levels on the south and west coasts of South Africa. The advantages of using SIA over stand-alone gut content analyses are that the information generated represents assimilate diets (as opposed to ingested) and that SI sig-

natures represent time-integrated long-term feeding behaviours (as opposed to a once-off snapshot in time). SIA may also distinguish between different geographic origins of the diets thus facilitating an interpretation of feeding grounds and possible feeding migrations (e.g. large geographic scale as well as smaller scale inshore-offshore migrations).

Oral C 6

Mechanisms of phytoplankton bloom formation in embayments of eastern boundary upwelling systems

Grant C. Pitcher¹, Andre du Randt¹, F.G. Figueiras², B.M. Hickey³, M.T. Moita⁴

¹ Marine and Coastal Management, Cape Town, South Africa

² Instituto de Investigacions, (CSIC), Vigo, Spain

³ University of Washington, Seattle, USA

⁴ Instituto de Investigacao das Pescas e do Mar (IPIMAR), Lisbon, Portugal

In upwelling systems phytoplankton biomass and productivity are determined by the dynamics of the surface boundary layer which is in turn significantly modified by the interaction of varying wind-forcing cycles with changes in coastline configuration and orientation. The resulting complex time and space dependent patterns of active and passive upwelling circulations favour different algal groups and dramatically influence shelf productivity. Embayments may offer the required balance between advective dispersion and enrichment favouring bloom development. The influences of variable coastal geomorphology on phytoplankton biomass and productivity in the Benguela, California and Iberia upwelling systems therefore considered through their influence on water stratification and retention. Included are the influences of a spectrum of coastline configurations, including headlands, capes, peninsulas, Rias, bays and estuaries, representing systems of increasing isolation from the open coast and consequent increasing retention times.

Oral B 6

Modelling the impacts on top predators of an expanding Krill fishery

Éva Plagányi

University of Cape Town, Cape Town, South Africa

Quantitative population dynamics models are required to contribute to understanding of Antarctic marine ecosystem structure and functioning as well as to provide tactical management advice pertaining to important

harvested resources such as krill (*Euphausia superba*). Given likely increases in the harvest of krill, CCAMLR (Commission for the Conservation of Antarctic Marine Living Resources) has requested scientific advice regarding the subdivision of the precautionary catch limit for krill among 15 small-scale management units (SSMUs) in the Scotia Sea. The primary concern pertains to the potential impact of fishing on land-based predators such as penguins and seals. A Spatial Multi-species Operating Model (SMOM) of krill-predator-fishery dynamics is being used to test decision rules for adjusting fishing activities based on field data in the future. This talk summarises the development of a multi-species model as well as recent work that has focused on validating and tuning SMOM using a set of reference observations on penguin, seal, whale and fish populations. Preliminary simulations will also be shown that investigate the role of environmental factors in quantifying the impact of krill fishing in the vicinity of krill-dependent seal and penguin colonies in the Antarctic Peninsula region.

Oral PL 16

Skunks of the sea?- The composition and function of pygmy sperm whale “ink”

Stephanie Plön¹, Christopher Marshall², David Raubenheimer³, David Greenwood³, Stuart Parsons³

¹ Port Elizabeth Museum, Port Elizabeth, South Africa

² Texas A & M University, Galveston, USA

³ University of Auckland, Auckland, New Zealand

Pygmy sperm whales (*Kogia breviceps*) have a unique behaviour of squirting “ink”, which has earned them the Japanese name of “skunk of the sea”. Circumstantial evidence suggests this occurs when animals are distressed. We have initiated this project to test the hypothesis that, by analogy with cephalopods, this behaviour serves either as a predator defense mechanism or aids in hunting. We have taken an integrative approach with the following objectives: 1) describe the anatomy and histology of the rectal sac in which the “ink” is stored, 2) to examine the chemical composition of the “ink” by means of mass spectrometry, and 3) to determine the behaviour of potential predators towards the “ink”. Preliminary results indicate that the “ink”, which consists of liquid faeces, is stored in a dilation of the lower colon. This structure is present in male, female, adult and sub-adult animals, as well as foetuses, but is unique to the family Kogiidae. No ink gland is present. The histological examination shows the presence of a normal glandular epithelium, but a lack of Goblet cells in the upper colon relative to the jejunum.

Melanocytes are found throughout the colon. The ink-like substance has a characteristic odour and a dark reddish-brown colour unlike the faeces of other odontocetes. The largest amount recorded from a single animal is nine litres of fluid. Examination of foetal animals indicated that these already have a substance similar to the "ink" present in the rectal sac. Mass-spectroscopy analysis shows that this substance, a type of melanin, is similar in biochemical composition to that found in post-natal specimens. Dopa is also present as a key small molecule, a precursor in melanin production, which may serve to stun the olfactory sense of potential predators.

Oral PL 4

Does iron fertilization in the Southern Ocean enhance export - Crozet, a natural example

Raymond T Pollard¹, Mike I Lucas², CROZEX Team^{1,2}

¹ *National Oceanography Centre Southampton, UK*

² *University of Cape Town, Cape Town, South Africa*

Purposeful iron addition experiments have established that the addition of iron to high nutrient low chlorophyll (HNLC) waters enhances phytoplankton growth and hence carbon uptake. Much harder is to quantify whether that carbon is exported by sinking material to depths where it cannot be returned to the atmosphere by deep mixing in the following winter. In austral summer 2004/5 RRS Discovery carried out a multidisciplinary survey of the huge (size of KwaZulu Natal) phytoplankton bloom that occurs annually to the north of the Crozet Islands; also of a control HNLC area south of Crozet. Our hypotheses, that the bloom was fertilized by iron from Crozet, and that carbon export to the bottom would be enhanced, both proved correct. Elevated dissolved iron was found near the islands, which was delivered during the winter, primarily by horizontal advection, to an area of weak circulation in the Polar Frontal Zone. As stratification developed, light limitation was lifted and the bloom developed. Silicate quickly became limiting in the bloom, whose community structure changed from diatom domination to *Phaeocystis*. While chlorophyll levels in the HNLC region never rose higher than 0.6 mg/m³, silicate did slowly reduce to limiting levels and there was a short but substantial late export event. Measurements in the bloom of primary productivity, DIC draw-down, shallow export, annually integrated deep-water POC flux and core-top organic carbon accumulation were all enhanced 2- to 4-fold over the HNLC region. The carbon sequestration efficiency (ratio of carbon

exported to iron delivered) was in line with most recent estimates but significantly lower than that reported from a similar natural bloom south of Kerguelen Island.

Poster Tue 28

Circulation constrains a naturally iron-fertilized bloom round the Crozet Islands

R T Pollard¹, J T Allen¹, J F Read¹, H J Venables²

¹ *National Oceanography Centre Southampton, Southampton, SO14 3ZH, UK.*

² *British Antarctic Survey, Cambridge, CB3 0ET, UK.*

This poster introduces the Crozet experiment and summarizes the circulation which controls the spatial structure of the long-lasting bloom which develops annually north of the Crozet Plateau in the Southwest Indian sector of the Southern Ocean. Two multidisciplinary CROZEX (CROZet circulation, iron fertilization and EXport production experiment) cruises on RRS Discovery examined the causes and consequences of this bloom from November 2004 to January 2005, funded by the NERC NOC Core Strategic Project BICEP (Biophysical Interactions and their Controls on Export Production). The circulation, both large scale and mesoscale, is determined from a combination of hydrography, surface drifters, deep floats and absolute surface geostrophic velocities derived from altimetric and gravity satellite missions. The bloom is bounded in the north and west by the SubAntarctic Front, off which eddies of HNLC (high nutrient low chlorophyll) water break into the bloom area. The bloom develops round the edge of the Plateau and particularly to the north (downstream) of the two main Crozet Islands (Possession and Ile de l'Est), thus indicating the likely sources of iron. East of these islands there is usually no bloom, probably because the northward flow there has not been in contact with the bottom. We shall show that there is rarely southward flow from the islands, yet significant export flux (of detrital material out of the surface ocean) did occur in January at control sites south of the islands.

Oral A 9

Does Larviphagy affect the connectivity of mussel populations?

F. Porri, T. Jordaan, C.D McQuaid

Rhodes University, Grahamstown, South Africa

Intertidal population dynamics are driven by a complex series of processes, including larval supply and the

possibility of larval predation by benthic animals such as filter-feeders. We hypothesised that larviphagy could play a major role in the reproductive connectivity of mussel populations by removing larvae as they attempt to settle in the adult habitat. We tested hypotheses that consumption of mussel larvae by adults removes a significant proportion of potential settlers and is influenced by settlement intensity and tidal state. Predation of mussel larvae by adult mussels was investigated on incoming and ebbing tides during four spring tides by analysing the gut contents of adult *Perna perna* and *Mytilus galloprovincialis* collected from the low mussel zone. Consumption rates were compared to estimates of successful settler densities on natural beds. The results showed that mortality of competent larvae through adult ingestion reaches up to 77% of potential settlers. Rates of larval consumption were highest during months of intense settlement, suggesting that mussels feed opportunistically, filtering a relatively fixed volume of water and removing particles, including larvae, in proportion to their densities in the water. Rates of larviphagy were also higher during receding than incoming tides. We suggest that this is due to changes in larval density or, more probably, in adult filtration efficiency that are related to the state of the tide. Despite significant effects of both tidal state and settlement intensity on rates of larval ingestion, neither had a significant effect on the proportion of potential settlers removed. During settlement more than half of all potential settlers are lost through larviphagy, with potentially serious consequences for population maintenance. The results highlight the paradoxical nature of the evolution of settlement mechanisms in mussels, which must balance the advantages of settlement in habitats favourable to adults against the consumption of larvae by adults.

Oral B 11
Abiotic Correlates of Shallow Subtidal Reef Community Structure in KwaZulu-Natal

S. Porter¹, K. Sink², G. Branch¹
¹ *University of Cape Town, Cape Town, South Africa*
² *South African National Biodiversity Institute, Cape Town, South Africa*

The biodiversity of shallow subtidal reefs in KwaZulu-Natal and the abiotic variables that may underlie their community structure are poorly known. This study was aimed at identifying the potential factors that may determine community structure of reefs in water less than 10m deep. Shallow subtidal reef community structure at 30 sites along the KwaZulu-Natal coast was

quantified and correlated with abiotic variables derived either in-situ or with remote sensing satellite image data. At a regional scale, turbidity, temperature, depth, reef heterogeneity and sand inundation were synergistically found to account for most of the biological differences between sites. However, at a within-region scale, sand inundation and heterogeneity gave the highest correlation in Maputaland whereas turbidity, temperature and depth gave the highest correlation in Natal. A number of very different community types and regionally distinguishing and characteristic species have been identified which reflect the degree to which abiotic variables differ at biogeographic and local scales. The same approach is to be used for a larger analysis of 54 shallow reefs spanning five countries in the western Indian Ocean. In addition, as turbidity was found to be important, the trophic role of rivers in KwaZulu-Natal and the function they may play in structuring communities apart from reducing light penetration is also being investigated using stable carbon, nitrogen and sulfur isotopes.

Oral C 9
South African Life Sciences Learners can benefit from Current Scientific Research

Jone Porter
NPC Sea World Education Centre, SAAMBR, Durban, South Africa

A new South African Life Sciences (Biology) Curriculum has been rolled out for Grades 10 to 12 between 2006 and 2008. The main themes for each Grade should have three results: use of scientific methodology, core knowledge and the understanding of relationships between science, society and environmental issues. The third aim is the most unfamiliar to science teachers and the most obvious area that scientific institutions can assist with. The Sea World Education Centre runs teachers' workshops and learners' courses for these grades and has selected relevant curriculum themes associated with marine biology. In each of these courses current scientific research examples are used to explain concepts. More importantly, discussion around some of the social issues leads to information on conservation actions that each participant can undertake. It is essential for research findings to be made available for the average Southern African educator in a form that is easy for the general public to understand. The recommendations of scientific research projects should also include conservation actions that are relatively easy to follow.

Poster Tue 20

Investigating the utility of the Continuous Underway Fish Egg Sampler for collecting high resolution data on the abundance and distribution of zooplankton.

Michelle Potgieter, Cornelia Nieuwenhuys, Carl van der Lingen

Marine and Coastal Management, Cape Town, South Africa

Data on the abundance and distribution of zooplankton off South Africa's coast are customarily collected using a vertically-hauled bongo net at stations positioned 10 nautical miles apart along transects sampled during research surveys. The Continuous Underway Fish Egg Sampler (CUFES) is routinely used during these surveys to collect eggs of pelagic fish from just below the sea surface, and because it samples continuously whilst the ship is underway instead of only at stations, it is able to sample at a fine-scale spatial resolution. The CUFES also collects zooplankton, and this presentation reports on investigations into the utility of the CUFES for collecting high resolution data on the abundance and distribution of zooplankton. Firstly, we processed CUFES samples collected over the Agulhas Bank during surveys conducted in autumn and summer of 2005, and identified, enumerated, and measured the zooplankton in each sample. We then compared diel and seasonal differences in near-surface zooplankton concentrations for 13 zooplankton groups, and found that night-time concentrations were typically higher than day-time concentrations, this difference being attributed to diel vertical migration. Near-surface zooplankton concentrations were higher during the winter survey than the summer survey, and small scale variability in the distribution of the various plankton groups was observed in both surveys, indicating the CUFES is able to capture such variability. Secondly, we compared CUFES-derived estimates of near-surface zooplankton concentration with depth-integrated concentration from vertical bongo net samples that were collected concurrently with the CUFES samples using regression analysis. Significant relationships were derived for only 3 of the 13 zooplankton taxa assessed, indicating that near-surface concentration (an estimate of relative abundance) for most zooplankton taxa is not a good predictor of absolute, depth-integrated zooplankton concentration. However, the comparative data-set is small (n=15), and the addition of further data may result in more significant relationships.

Oral A 8

Using baseline biological and ecological information to design a traffic light precautionary management framework for leerfish *Lichia amia* (Linnaeus 1758) in southern Angola

W.M. Potts^{1,2}, W.H.H. Sauer¹, A-R. Childs², A.D.C. Duarte³

¹ Rhodes University, Grahamstown, South Africa

² South African Institute of Aquatic Biodiversity, Grahamstown, South Africa

³ Instituto de Desenvolvimento da Pesca Artesanal, Luanda, Angola

The coastline of southern Angola is sparsely populated and, largely because of a protracted civil war, has very lightly exploited inshore fish stocks. This has provided the almost unprecedented opportunity to determine pre-fishing state reference points and to implement management strategies at the early stages of exploitation. The leerfish *Lichia amia* is distributed from the Mediterranean Sea, along the west coast of Africa to the southern and eastern coasts of South Africa. Despite its importance in recreational catches in South Africa and Angola, there is little information on the biology of this species. The leerfish forms one of the three most dominant recreational shore-fishery species in southern Angola, and a biological study on the species was conducted in that region between May 2005 and December 2006. The mean length of captured fish was 767mm fork length (FL) and 6.8kg, and the catch per unit effort was 0.13 fish angler⁻¹ h⁻¹ and 0.79kg angler⁻¹ h⁻¹. The growth of the leerfish population (in mm) was described by: $L_t = 1137(1 - e^{0.22(t + 1.58)})$, and its total mortality was estimated to be 0.41 (±0.05). Female mortality (0.40 ± 0.06) was lower than that for males (0.44 ± 0.14), and the length and age-at-50% maturity was 623mm FL and 2.4 years respectively. Female fish with ripe ovaries were found between June and November. The male:female ratio was 1:1.9. Leerfish fed exclusively on fish, mainly sardinella *Sardinella aurita* (62% frequency of occurrence). Based on this biological information, a theoretical traffic light precautionary management framework is constructed for the species. Appropriate management regulations and potential future threats to the species are discussed.

Oral B 8

Do fish predators prefer their sardines fresh or frozen? Evidence from trends in shore angling catches on the KwaZulu-Natal coast

Pierre Pradervand¹, Sean Fennessy¹, Paul de Bruyn²

¹ *Oceanographic Research Institute, Durban, South Africa*

² *AZTI Tecnalia / Unidad de Investigación Marina, Pasaia (Gipuzkoa)*

The proliferation of predatory fishes on the KwaZulu-Natal coast during the sardine run, and the simultaneous increase in numbers of anglers which pursue them, have been reported for many years. However, while increased abundances of larger predators such as dolphins and sharks have been more formally investigated, reports on the seasonal influx of predatory teleosts are mostly anecdotal, and some have entered the realm of urban legend. This study investigates the linkage between the KwaZulu-Natal sardine run and the abundance of selected teleosts and anglers along the KwaZulu-Natal coast. This was achieved by analysing species-specific catch data and angler effort data (rods per kilometre of coastline) stored on the National Marine Linefish System, using a General Linear Model (GLM). Proxies for sardine abundance/presence were obtained from beach-seine landings and aerial observations of sardine shoals. The species-specific catch and effort data were then analysed using the GLM model to determine whether the presence of the sardine run in a particular year had a significant effect on the catch rates of several selected teleost species. As expected, the model indicated that the total number of rods per kilometre (fishing effort) increased significantly during the sardine run. The GLM analysis also demonstrated that the CPUE of certain teleost species (shad *Pomatomus saltatrix*, blacktip kingfish *Caranx sem*, garrick *Lichia amia*, king mackerel *Scomberomorus commerson*, dusky kob *Argyrosomus japonicus*, queen mackerel *Scomberomorus plurilineatus*) increased significantly during the sardine run. Assuming CPUE is an index of target species' abundance, this analysis would indicate that the anecdotal observations of increased predatory teleost activity during the sardine run are more than just fishermen's tales.

Oral A 7

Ecosystem considerations for the management of the South African hake resource : Modelling approaches

Rebecca A. Rademeyer, Charles T.T. Edwards, Éva E. Plagányi, Doug S. Butterworth
University of Cape Town, Cape Town, South Africa

The pressures for an Ecosystem Approach to Fisheries are increasing world-wide. In South Africa, the management of the hake resource (*Merluccius paradoxus*

and *M. capensis*), one of the major fishery in the country, is currently based on single-species approaches. The potential impacts of inter-species interactions and ecosystem effects on this resource have been recognised for some time and there are currently several modelling projects which are underway to address some of these issues. A model of the two hake species is under construction using the software GADGET (Globally Applicable Area-Disaggregated General Ecosystem Toolbox) that takes account of cannibalism and inter-species (hake-on-hake) predation. At the next stage, the impact of other important predators, such as seals, will also be included. In another project, a spatially-disaggregated simulation model has been developed to investigate the potential impacts of Marine Protected Areas for the hake trawl fishery. Work is underway to include ecosystem effects of trawling by using available data on trawling intensity. Taking account of these ecosystem effects, taking due account of uncertainty in both data inputs and current understanding of interactions, will eventually result in improved and more robust fisheries management recommendations.

Oral C 13

Managing mangrove resources using matrix modelling

Anusha Rajkaran, Janine B. Adams
Nelson Mandela Metropolitan University, Port Elizabeth, South Africa

South Africa is home to 0.01% of Africa's mangrove forests. It is the southern limit of mangrove distribution in Africa stretching from Kosi Bay (Kwa-Zulu Natal) in the north to Nahoon (Eastern Cape) in the south. Mangrove forests are important areas of habitat for nurseries and areas of refuge for invertebrates and fish thus playing an important role in sustaining biodiversity in coastal areas. Management of mangrove forests in South Africa is required due to harvesting pressures in both Kwa-Zulu Natal and the Eastern Cape. Matrix models have been used in the past to predict the response of plant populations to harvesting or other pressures. Growth rate data, in terms of height and diameter at breast height (DBH), were measured in the Mngazana Estuary in the Eastern Cape for *Rhizophora mucronata*, *Bruguiera gymnorrhiza* and *Avicennia marina*. Preliminary results showed that survival rates from one size class to another were higher in the smaller size classes but this was coupled with high mortality rates. Seedlings and saplings of *Rhizophora mucronata* grew faster than *Bruguiera gymnorrhiza*.

Current growth rates (4.1 to 5.8 cm yr⁻¹) for a range of size classes were used in matrix models to determine how long it would take *Rhizophora* and *Bruguiera* individuals to reach a height greater than 3 m. These growth rates are much slower than that recorded in other mangroves forests for *Bruguiera gymnorrhiza* (Pacific Islands – 21.6 cm.yr⁻¹) and *Rhizophora apiculata* (Pak Phanang Estuary, Thailand 32.9 cm yr⁻¹). Once a population model has been constructed a number of harvesting scenarios will be tested to determine optimal mangrove harvesting rates at Mngazana Estuary.

Poster Wed 2

Inter-annual variability of the Cold ridge and atmospheric driving forces

Aluwani E. Ramulifho

Marine and Coastal Management, Cape Town, South Africa

The cold ridge can be defined as an episodic extended sloping tongue of cold water off the Tsitsikamma coast in the Agulhas bank. This feature owes its existence to primary and secondary production as it enhances more nutrient rich water into the surface. The predictability and the mechanism leading to its development is yet to be understood, however Roberts (2005) indicated that its existence and periodicity is a function of wind forcing. Analysis of the sea surface temperature data collected from Tsitsikamma and Knysna indicates that there is seasonality in the variation of cold and warm episodes of the water column. The wind stress analysis over the area shows an inter-annual relation with the temperature analysis and these can also be said about the CAP index. The large scale global climatic perturbation, the SOI time series also relates to the local sea level pressure (SLP) analysis with high peak values of SLP found during the 97/98 summer season of the El Nino event. The variation observed in the SST data, wind analysis and the sea level pressure altogether are important tools to understand for predicting the occurrence of the cold ridge.

Oral C 5

New species of Myxozoa (Myxosporea: Bivalvulida) from the south coast of Africa

Cecile C. Reed¹, L. Basson², L.L. Van As²

¹ *University of Cape Town, Cape Town, South Africa*

² *University of the Free State, Bloemfontein, South Africa*

Current records of marine myxozoans from the coast of Africa are limited to descriptions of 52 species from mostly Senegal, with a few from Tunisia and southern Africa. Several surveys along the Cape south coast of South Africa between 1998 and 2002 revealed the presence of a myriad of different myxozoan species from a single locality near the southern most tip of Africa. Three species from the genus *Ceratomyxa* (Thélohan, 1892) were recorded from the gall-bladders of *Amblyrhynchotes honckenii* (Bloch, 1795), *Clinus cottoides* (Valenciennes, 1836) and *C. superciliosus* (Linnaeus, 1758). Two species from the genus *Myxidium* (Bütschli, 1882) were recorded from the gall-bladders of *Chorisochismus dentex* (Bloch, 1795) and *Diplodus sargus capensis* (Smith, 1844), respectively. One species from the genus *Sphaeromyxa* (Thélohan, 1892) was recorded from the gall-bladder of *Pavoclinus graminis* (Gilchrist and Thompson, 1908). Representatives of the genera *Chloromyxum* (Mingazzini, 1890), and *Sphaerospora* Thélohan, 1892 were also recorded, respectively, from two individual surf zone fishes, *Torpedo fuscumaculata* (Peters, 1855) and *Lightognathus lithognathus* (Cuvier, 1830). This study has laid the foundation for future research on life-cycles, pathology and phylogeographical relationships amongst southern African myxozoans.

Oral B 6

Krill trophodynamics at the Subtropical Convergence, Indian Ocean

Nicole B. Richoux, P. William Froneman

Rhodes University, Grahamstown, South Africa

The Subtropical Convergence (STC), a frontal region which represents the northern border of the Southern Ocean, is characterized by elevated biological activity. As such, the STC is thought to play an important role in the ocean carbon cycle, and it may act as a biogeographical barrier to plankton. Stable isotope signatures ($\delta^{13}\text{C}$, $\delta^{15}\text{N}$) were used to assess regional differences in the trophodynamics of euphausiid (krill) communities between 41° and 42° south, where the cool nutrient-rich subantarctic waters meet the warm nutrient-poor subtropical waters. Significantly enriched values of $\delta^{15}\text{N}$ were noted in populations of 7 euphausiid species inhabiting the warm northern waters (maximum surface temperature 21°C), compared with the same species living in the cool southern waters (minimum surface temperature 11°C). Specimens col-

lected from the area of greatest transition between the two water bodies had isotopic signatures midway between those in the warm and cool regions. Similar patterns of $\delta^{15}\text{N}$ in particulate samples collected throughout the region suggested that the marked changes in euphausiid $\delta^{15}\text{N}$ values across the frontal region may be driven by variations within the phytoplankton communities. Signatures of $\delta^{13}\text{C}$ within the different euphausiid groups, however, did not exhibit a distinctive north to south pattern. Positive linear relationships were found between enrichment of $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ with body size, indicating an additional important factor influencing euphausiid trophodynamics.

Oral B 9

Oceanography of the Transkei shelf and its relevance to the Natal sardine run

Roberts, M. J., van der Lingen, C., Coetzee, J. C., van den Berg, M.

Marine and Coastal Management, Cape Town, South Africa

The existence and annual strength of the Natal Sardine run has long been a conundrum to fishermen and scientists alike particularly that sardines need to migrate along the narrow Transkei shelf against the powerful, warm, Agulhas Current. However, data collected during several recent research cruises, augmented with ADCP current meter moorings, shows that northward flowing coastal counter currents with cooler water exist between the eastern Agulhas Bank and the Natal Bight. Three ADCP moorings set across the shelf off Port Alfred indicate that a northerly counter current regularly exists along the coast between Algoa Bay and East London with speeds of 30–40 cm s^{-1} . This north-easterly current is formed within the large upwelling cell which is driven by the divergence of the Agulhas Current. Coastal water temperatures in this cell are commonly between 14 and 18°C and chlorophyll a levels high. The cell shows no seasonality. Ship-borne ADCP survey data collected on three cruises also shows the existence of a small, semi-permanent, cyclonic cell immediately west of the Waterfall Bluff–Port St Johns bight, resulting in a northward flowing 30–40 cm s^{-1} coastal current between Morgon Bay and Port Grosvenor. Similarly, this is associated with shelf edge upwelling with surface temperatures of 15–19°C. Although not well documented, ship borne ADCP survey data, current mooring data and SST satellite data, all confirm the existence of a nearly permanent cyclonic eddy off the Durban Bluff region. This is a lee trapped eddy and exists as a result of the fast flowing Agulhas

Current passing a subsurface bight in the shelf edge bathymetry off Durban. Consequently, a strong northward coastal current is usually observed between Park Rynie on the southern KZN shelf and Balito Bay north of Durban. Together, these cyclonic eddies and their concomitant northerly counter currents - if active simultaneously - provide most of the means for sardines to move against the Agulhas Current. However, ADCP mooring data collected across the shelf at Port Edward indicate that northward flowing coastal currents here are much less frequent (average once a month for a few days) and only exist when transient cyclonic eddies formed in the boundary of the Agulhas Current or a Natal Pulse pass. The dynamics on this section of the shelf, therefore, would appear to be the “weak point in the conveyer” and may well influence the ability and timing of the sardines to reach the south coast of KZN and the Natal Bight.

Poster Tue 36

MERIS Ocean Colour Satellite Validation in high biomass Southern Benguela Waters

Lisl Robertson¹, Stewart Bernard², Grant Pitcher³, Trevor Probyn³, Andre du Randt³, Alex Fawcett¹

¹ *University of Cape Town, Cape Town, South Africa*

² *CSIR, Stellenbosch, South Africa*

³ *Marine and Coastal Management, Cape Town, South Africa*

The high biomass Case 1 waters of the Southern Benguela present some unique challenges for the validation of ocean colour satellite data. Optically complex algal blooms are frequently associated with high spatial variability, which together with regional atmospheric characteristics (e.g. dust off the adjacent semi-desert) make validation activities both demanding and essential if satellite data are to be used operationally for the detection and monitoring of Harmful Algal Blooms. These often result in severe impacts on the local marine ecosystems and communities as well as commercial marine concerns. Radiometric data from an automated bio-optical mooring will be presented in the context of satellite validation exercises, supplemented by radiometric and geophysical data from field campaigns undertaken in the region. A preliminary comparison of MERIS, MODIS and GlobColour products will be shown.

Poster Wed 13

The influence of juvenile conspecifics and microbial film on the settlement of mussel larvae: Preliminary results from a field study

J. Robey, K. Faulkner, C.E.O. von der Meden, F. Porri, C.D. McQuaid
Rhodes University, Grahamstown, 6140, South Africa

Settlement of intertidal marine invertebrates with a pelagic larval stage may be affected by various cues on potential settlement substrata, including the presence of a microbial film and of conspecifics. To examine the impact of these two possible settlement cues on competent mussel larvae, a field study was undertaken at Brenton-on-Sea, on the south coast of South Africa. Six treatments (n = 10 for each) were deployed among low shore mussel beds, using plastic scouring pads as artificial settlement substrata. The experiment had two phases. In phase one, four treatments were developed over six days on the shore to allow larval settlement and biofilm development. The four treatments were pads containing: 1) mussel settlers only; 2) biofilm only; 3) and 4) settlers plus biofilm developed under shaded and unshaded conditions. The last two treatments tested the effects of shading by mesh used to exclude settlers from treatment 2). For treatment 1), pads were collected on day five, settlers were removed from them and transplanted into clean pads kept in aerated aquaria. On day six the remaining pads were collected. All pads from phase one were then stained for 24h with the vital stain calcein in aerated aquaria. For phase two, these treatments plus two additional treatments were placed on the shore. The 2 additional treatments were: clean pads that had been soaked in calcein and clean pads that had not. These tested for the effects of calcein on pads. After 24h all treatments were removed. The numbers of unstained larvae and of larvae stained with calcein in each treatment were compared to determine the effects of conspecifics and biofilm on mussel settlement using 1-way Anova. Preliminary results illustrate the role of attraction of biofilm and of conspecifics in settlement of a gregarious filter-feeder.

Oral B 10

Red Sea Water in the greater Agulhas Current system

Raymond Roman, Johann R. E. Lutjeharms
University of Cape Town, Cape Town, South Africa

Despite its small formation volume, Red Sea Interme-

diate Water (RSIW) has been observed as far south as the Agulhas retroflexion where it is involved in inter-ocean exchange. Previous investigations of this water mass focussed mainly on quantifying its contribution in the Indian Ocean by combining all hydrographic data available and thus showing its main spreading path. RSIW formation however varies considerably seasonally and variable input into the Agulhas Current system cannot be established by combining all data. Using a multi-parameter water mass analysis 36 hydrographic sections was analysed to quantify RSIW variability. Results indicate considerable variability in the source regions of the Agulhas Current, especially at the southern tip of Madagascar. This variability is also observed in the Agulhas Current proper as far south as the retroflexion. Differences in the transport and maximum contribution along the Agulhas Current were in some cases more than 100%. It was thus concluded that the transport of RSIW along the Agulhas Current is highly variable making any estimates of transport for more than a singular hydrographic section impossible.

Oral A 10

Testing a rapid method of kelp biomass estimation.

Rothman M.D.^{1,2}, Anderson R.J.¹, Boothroyd C.J.T.¹, Kemp F.A.¹, Bolton J.J.²

¹ *Marine and Coastal Management, Cape Town, South Africa*

² *University of Cape Town, Cape Town, South Africa*

Due to a rapidly expanding abalone farming industry in South Africa, using kelp as feed, the demand for harvested *Ecklonia maxima* has increased drastically in the Western Cape, making kelp the most harvested seaweed in South Africa (5300 tons fresh in 2007). A quick method was tested for estimating biomass from measurements of the density of kelp heads at the surface. Two snorkel divers work along a transect, at 4 m intervals, from the seaward edge of the kelp bed towards the shore. The number of kelp heads in 1 m² quadrats, at the surface, are counted. The surface-reaching plants are followed down to the substratum and then cut, just above the holdfast, and brought to shore and weighed. A significant correlation was established between the number of heads at the surface and the kelp biomass at the surface ($r^2 = 0.5973$; $p = 0.0007$). We then tested this 'surface method' by comparing it to data gathered from the traditional destructive 'bottom sampling method'. The 'bottom sampling method' involves a diver using SCUBA, also working along a transect as explained above, cut all the kelp in a 1 m² quadrat who pass it to snorkelers on the surface

who then swims it to shore for weighing. A significant correlation was established between the number of heads at the surface and the total kelp biomass, although the predictive value is quite lower ($r^2 = 0.4611$; $p = 0.0107$). The 'surface method' provides a quick estimate of *E. maxima* biomass, using less man-power and man-hours, which can be an effective tool for managing the kelp resources of South Africa especially when considering that kelp harvesters only harvest surface reaching kelp.

Oral B 10

Warming in the Agulhas current system since the 80's

Mathieu Rouault¹, Pierrick Penven², Benjamin Pohl³

¹ University of Cape Town, Cape Town, South Africa

² IRD and LPO, Brest, France

³ CRC, University of Dijon, France

Since the 80's the sea surface temperature of the Agulhas Current system have increased significantly. The warming is due to an intensification of the Agulhas Current system in response to an increase in wind stress curl in the South Indian Ocean. The intensification causes an augmentation in the fluxes of salt and heat into the Atlantic Ocean and of the transfer of energy from the ocean to the atmosphere. We have used most observation available since the 60's and a model that is reproducing the interannual variability of the Agulhas Current system and adjacent upwelling system reasonably well. The increase in wind stress is due to the shift in westerly wind in the South Indian Ocean reported by many authors, some having proposed that the recent shift was anthropogenic. Further shift in westerly winds is a scenario proposed by IPCC. During the same period the sea surface temperature of the upwelling systems of the west and south coast of South Africa has decreased. The west coast is part of the Benguela upwelling system. The south coast upwelling is not as intense due to weaker wind but a dynamic upwelling exists between the Agulhas current and the coast. At about 25 °S near the coast the colder water has encroached upon the Agulhas current at the location of the Port Alfred dynamic upwelling cell, which is consistent with an intensification of the Agulhas current along the continental shelf.

Poster Tue 25

The Extension of PIRATA in the Tropical South East Atlantic: A successful One-Year Experiment

Mathieu Rouault¹, Jacques Servain², Chris Reason¹,

Bernard Bourlès², Marjolaine Rouault³, Nicolas Fauchereau¹

¹ University of Cape Town, Cape Town, South Africa

² IRD, France

³ CSIR, University of Dijon, France

PIRATA (Brazil, France, USA) has deployed and maintained since 1997 an array of 12 ATLAS buoys with the objective of monitoring, describing and understanding the evolution of sea surface temperature, upper ocean thermal and saline structure, net heat budget, air-sea fluxes of momentum, latent and sensible heat and fresh water in the tropical Atlantic. The oceanic and meteorological observations are transmitted to shore via satellite and are available in real-time on the Internet. They are communicated to the Global Telecommunication System and readily available for ocean and weather prediction models. THE BCLME PIRATA ATLAS BUOY KIZOMBA was deployed at about 6°S - 8°E at 4100 m depth (5° 58.6 S ; 7° 59.5 E) during the AMMA-EGEE 5 cruise on the 27 of June 2006 at 6 S 8 E and recovered a year later in perfect condition. The mooring is fitted with a current meter, 4 temperature/conductivity sensors deployed at 1, 20, 40, 120 meter depth, 5 temperature sensors to be deployed at 60, 80, 100, 140, 180 meter depth and 2 temperature/pressure sensors to be deployed at 300 and 500 as well as anemometer, air temperature and humidity probe, short wave solar radiation probe and rain gauge. An extension of PIRATA in the South East Atlantic has application to marine ecosystem processes, fisheries-environment interaction, climate variability and forecasting. Besides gaining information on the physics of the seasonal cycle of sea surface temperature, ocean surface heat content and other key parameters, ATLAS moorings can be used to monitor Benguela Niños or other oceanic events detrimental to society as they approach the region.

Poster Wed 21

Prey Switching and Sex differences in the diet of Bottlenose dolphins (*Tursiops aduncus*) incidentally caught in the shark nets in KwaZulu-Natal.

Maryanne Roux¹, S. Plön², G. Kerley¹

¹ Nelson Mandela Metropolitan University, Port Elizabeth, South Africa

² Port Elizabeth Museum and Oceanarium/Bayworld, Port Elizabeth, South Africa

Bottlenose dolphins are the best known delphinids because they are the most commonly and successfully kept in captivity. There are two *Tursiops* species along

Africa

Corals in South Africa are found primarily in the Delagoa Bioregion in the IsiMangaliso Wetland Park (GSLWP). Biodiversity surveys have provided information on the coral communities and their susceptibility to damage, needed for development of a zonation plan for their sustainable use. There are 18 coral communities on the reefs, in a gradient from north to south. Recommendations were made to modify current sanctuary zonation to meet the GSLWP biodiversity target of 40% for the protection of representative communities. Usage zones were categorised from diver training areas to those suitable only for advanced and experienced divers, with appropriate diving limits. The data have been incorporated with geophysical and socio-economic information in an interactive database for conservation planning and development of the GSLWP. Monitoring has yielded valuable information on coral community dynamics and climate-related bleaching. Sea temperatures have attained the bleaching threshold, leading us to hypothesise the probable future of these coral communities in the face of climate change. This may initially encourage hard coral growth but will adversely affect the reefs in the long-term. Diminishing recruitment success has emerged as a further silent climate-related effect. The combined results, together with further initiatives, will contribute to ecosystem models that will facilitate development of conservation and management strategies for the reefs, including risk assessment.

Poster Tue 13

Effects of technological creep on the perceived pup trends of the Cape Fur Seal (*Arctocephalus pusillus pusillus*)

Mduduzi Seakamela^{1, 2}, Steve Kirkman^{1, 2}, Herman Oosthuizen¹, Mike Meyer¹, Deon Kotze¹, Les Underhill²

¹ Marine and Coastal Management, Cape Town, South Africa

² University of Cape Town, Cape Town, South Africa

In recent times, and especially with the advent of ecosystem-based management approaches, much recognition has been given to the importance of long term monitoring of animal populations. Besides monitoring of the conservation status of these populations, resulting time series of information potentially provide indicators of ecosystem changes in response to management or other effects (e.g. pollution, global climate change). A potential pitfall with such long term moni-

toring programmes are effects of technological creep, i.e. effects of technological/methodological improvements in monitoring techniques on perceived numerical trends. A case in point is the time series of annual pup censuses of the Cape Fur Seal throughout its range in southern Africa, which are used to indicate total pup production and estimate population size. Since the initiation of this time series in the early 1970s, there have been modifications in censusing equipment (including aircraft type, mode of photography) and counting techniques (manual vs digital counting). In this study, an experimental approach is used to contrast different modes of censusing and counting, with the ultimate view of being able to calibrate for any significant differences which may affect the interpretation of the time series. Comparisons such as these are critical for long term monitoring of animal populations, as the time series depend on continuity to be effective.

Poster Tue 14

Nanomolar ammonia distribution in the Benguela, Natal Bight and Tanzanian ecosystems

H. Sessions, R. Barlow, T. Lamont

Marine and Coastal Management, Cape Town, South Africa

Ammonia is a biologically essential nutrient in the marine environment and plays an important role in the regenerated nitrogen cycle. Previous ammonia studies used spectrophotometric techniques for analysis, but these methods have limits of detection to concentrations $>1 \text{ mmole m}^{-3}$. However, ammonia is usually distributed in very low concentrations of $<1 \text{ mmole m}^{-3}$. A sensitive fluorometric method was therefore adapted and applied to measure ammonia in the nanomolar range. Investigations in the southern Benguela ecosystem, the Natal Bight, and the coastal waters around Pemba and Zanzibar islands in Tanzania revealed that ammonia distribution was very variable. A transect in the southern Benguela in January 2008 showed that ammonia ranged from $<50 \text{ nmoles m}^{-3}$ up to $700 \text{ nmoles m}^{-3}$, with the elevated levels being observed at depth (40 m) in the vicinity of 32°S . On the Natal Bight in September 2007, ammonia concentrations were $<50\text{-}300 \text{ nmoles m}^{-3}$ and the high levels were recorded at depth (20-40 m) in the southern sector of the bight coinciding with elevated phytoplankton biomass. In the Tanzanian ecosystem in October 2007, ammonia concentrations were $<50\text{-}300 \text{ nmoles m}^{-3}$ in the upper 100m, with sub-surface maxima being observed at depths of 50-90 m. At one station where sampling was conducted to 700 m, ammonia levels of $600 \text{ nmoles m}^{-3}$

were recorded at a depth of 650 m.

Oral A 5

Understanding the behaviour of ecological indicators using food web models fitted to time series of abundance and catch data

L.J. Shannon¹, M. Coll^{2,3}, S. Neira⁴

¹ Marine and Coastal Management, Cape Town, South Africa

² Dalhousie University, Nova Scotia, Canada

³ Institute of Marine Science (ICM-CSIC), Barcelona, Spain

⁴ University of Cape Town, Cape Town, South Africa

Previously, standardized snap-shot models of the Southern Benguela (1980-1989), Southern Humboldt (1992) and Southern Catalan Sea (1994) ecosystems were examined and found to facilitate assessment of ecosystem characteristics related to the gradient in exploitation status of the ecosystems; highest level of exploitation in the south Catalan Sea (North-western Mediterranean), high in the Southern Humboldt and lower in the Southern Benguela. Subsequently, these models were calibrated and fitted using available catch, fishing effort/mortality and abundance data series and incorporated environmental and internal drivers. This study furthers the previous comparative analyses by comparing changes in ecosystem structure using a selection of ecosystem indicators from the calibrated models and assessing how these indicators change over time in these three contrasting ecosystems. Indicators examined include community turnover rates (production/biomass), trophic level of landings and the community, biodiversity indicators, ratios of predatory/forage fish and pelagic/demersal fish biomass, catch ratios, and network analysis indicators. Using the set of model-derived indicators, the three ecosystems were ranked in terms of exploitation level. This ranking was performed using the values of these indicators in recent years (ecosystem state) as well as their trends over time (ecosystem trend). The non-parametric Kruskal-Wallis and Median tests were used to test for significance of the difference between indicators from the three ecosystems in the last 5 years of the simulation to compare present ecosystem states. We compared the slope of the lineal trend and its significance between ecosystems using the generalized least squares regression taking auto-correlation into consideration to analyse ecosystem trends.

Poster Wed 12

Epibiosis on the rocky shore – interactions between

mussels and barnacles

J.N. Sheppard, C.D. McQuaid, F. Porri
Rhodes University, Grahamstown, South Africa

The effect of the epibiotic barnacle *Chthamalus dentatus* on the biology of the mussels *Perna perna* and *Mytilus galloprovincialis*, and the nature of the relationship between them was investigated along the south-east coast of South Africa. Growth rates and condition index of *P. perna* were calculated seasonally over a range of levels of barnacle infestation. Mussel growth was significantly negatively affected by the presence of epibionts, with the effect depending on cover of epibionts, and was significantly lower during winter than summer (ANCOVA, season $p = 0.0001$, cover $p = 0.0011$). Correlation analysis of mussel condition and level of infestation showed a negative, but non-significant relationship ($r = -0.1677$). Condition index was also calculated for barnacles, and was found to be significantly greater for epibiotic barnacles than for those settled on bare rock (1-way ANOVA, $p = 0.0164$). Heat shock proteins (Hsps) form part of the biochemical stress response. An analysis of Hsp70 expression in mussels with and without epibionts, using western blotting gave inconclusive results as methodological problems resulted in low sample sizes. The preliminary results showed that *M. galloprovincialis* generally had a higher frequency of expression. Thus, biochemically, the indigenous *P. perna* exhibited a weaker stress response than the invasive species, which is confined to the mid to high shore through competition with the indigenous *P. perna*. Nevertheless, neither mussel species exhibited a clear link between stress protein production and the presence of epibionts. Overall, mussels are negatively affected by the association with epibiotic barnacles, the degree of harm being determined by the number of epibionts present on an individual and the mussel's existing level of stress, which are set by its location within its biogeographic range and position on the shore.

Oral B 3

A "Down Under" Approach to Determining Environmental Flow Needs of Estuaries

John Sherwood¹, Adam Pope¹, Lance Lloyd², Chris Gippel², Marcus Cooling², Jeremy Hindell², Brett Anderson²

¹ Deakin University, Victoria, Australia

² Lloyd Environmental, Victoria, Australia

Environmental flow requirements of rivers have been

the subject of much research. In Victoria (Australia) a standard methodology (the FLOWS Method) has been developed to establish water needs of the freshwater reaches of rivers. Until recently it was assumed that these flows would also meet the needs of estuaries. A growing body of research has questioned this assumption. In 2005 the Victorian State Government funded a project to develop an estuaries methodology. It is currently being trialled on the Werribee and Gellibrand estuaries. This presentation will discuss the nature of estuary water needs and outline the approach being trialled.

Oral C 6 Comparative aspects of the North and South Atlantic upwelling regimes

F.A. Shillington¹, E.D. Barton², M. Ostrowski³
¹ *University of Cape Town, Cape Town, South Africa*
² *Instituto de Investigaciones Marinas, Vigo, Spain*
³ *Institute of Marine Research, Bergen, Norway*

The Iberian and Benguela regions represent the meridional extremes of the upwelling ecosystems of the Atlantic Ocean. Both North and South Atlantic systems are characterized by local wind-driven upwelling, strong alongshore advection, a poleward undercurrent, and high productivity of plankton and pelagic fish. Their boundary currents and biological system in each case extend beyond the continental shelf, and both regions are subject to remote physical forcing by large scale tele-connections. Here some basic physical characteristics of both systems are examined and compared, including the wind stress field and variability, the strength of stratification, the pycnocline depth, the upwelling response time, the mixed layer depth, the relative importance of mixing and Ekman transport. Both systems exhibit heterogeneous structure in the form of eddies, fronts, upwelling filaments and river plumes so that differences within systems may be as great as those between systems. Common features include the upwelling coastal jet and its development into persistent and repeatable filaments extending offshore far beyond the shelf edge. Another is the intermittent interruption of summer upwelling by downwelling episodes and shelf poleward flows with similar consequences in terms of Harmful Algal Blooms in both regions. Over the slope, a possibly permanent subsurface poleward current that surfaces in winter may play an important role in the reproduction and retention of important fish species. We explore these common characteristics, and also significant differences, on the basis of historical data and recent surveys off Iberia,

NW Africa, Namibia and South Africa.

Oral C 4 Ecophysiological Studies Of a New Aquaculture Crop, *Ulva capensis* (Chlorophyta)

Diina Shuuluka¹, John J. Bolton¹, Robert J. Anderson², Michael S. Stekoll³
¹ *University of Cape Town, Cape Town, South Africa*
² *Marine and Coastal Management, Cape Town, South Africa*
³ *University of Alaska, Juneau, U.S.A.*

Ulva capensis is one of the *Ulva* species used as both bio-filter and feed in land-based mariculture of abalone in South Africa. Investigations addressing physiological and ecological processes of South African *Ulva* species are important in the improvement of isolation and cultivation techniques. Culture experiments were performed to investigate the growth of *U. capensis* under varying conditions of irradiance (0, 40, 80, 120 and 160 $\mu\text{mol m}^{-2} \text{s}^{-1}$), temperature (5, 10, 15, 20 and 30 °C) and nutrient concentrations [Nitrogen sources (NH_4^+ and NO_3^-) and Phosphorus]. The photosynthetic performance of this alga was also investigated by analyzing the relationship between photosynthesis rate and photon irradiance at 15 °C. Growth rate was strongly influenced by both irradiance and temperature. There was no growth at 0 $\mu\text{mol m}^{-2} \text{s}^{-1}$ after 14 days, but when exposed to 80 $\mu\text{mol m}^{-2} \text{s}^{-1}$ growth resumed. Although growth occurred at other irradiances, there was no significant difference in growth at 80 - 160 $\mu\text{mol m}^{-2} \text{s}^{-1}$. The highest growth was recorded at 15 and 20 °C, while 5 °C resulted in the slowest growth. At 30 °C, growth declined after 7 days and tissue damage became evident. *U. capensis* has a broad tolerance to PO_4^{3-} , with growth occurring at concentrations up to 220 μM . The best growth was recorded in a range of 26 - 50 $\mu\text{M PO}_4^{3-}$. There was no significant difference in growth at lower concentrations of both N-sources. Increased concentrations of NO_3^- resulted in higher growth rates whereas reduction in growth was recorded when NH_4^+ concentrations were increased. The light saturating irradiance (I_k) and the maximal photosynthetic rate (P_{max}) occurred at 145 and 240 $\mu\text{mol m}^{-2} \text{s}^{-1}$ respectively. These results will be useful for the improvement of cultivation conditions of this species in abalone farms.

Oral B 13

Apparent western North American origin of *Boccardia proboscidea* pests on the cultured abalone, *Haliotis midae*, in South Africa

Carol Simon^{1,2}, Daniel J. Thornhill³, Kenneth M. Halanych³

¹ Rhodes University, Grahamstown, South Africa

² Stellenbosch University, Stellenbosch, South Africa

³ Auburn University, USA

South African cultured abalone, *Haliotis midae*, are infested by the non-indigenous polychaete, *Boccardia proboscidea*. This species occurs naturally along the west coast of North America and Japan, but has been introduced in Hawaii, Australia and New Zealand where it infests cultured oysters and abalone. It is hypothesised that the South African worms were inadvertently transported to South Africa on *Haliotis rufescens* imported from California in the late 1980's. To test this hypothesis, populations from six abalone farms of the west, south and east coasts of South Africa were compared with populations from California (Alamitos Bay and La Jolla), Washington (False Bay Harbour) and British Columbia (Vancouver). Sequence data of 16S and Cytochrome b (cyt b) genes demonstrated that the South African worms potentially originated on the west coast of America: single identical haplotypes for each gene were found among South African and American populations, with additional haplotypes for cyt b present in the samples from the southwest coast of South Africa. These data suggest that a) the populations on the southwest coast are the oldest, b) that worms were spread among farms primarily through the movement of abalone, and c) either several inoculation events occurred, or the source population originated outside of North America. Hypotheses describing potential vectors will be presented.

Oral C 11

Predator-prey interaction on squid spawning sites by top predators

Larvika Singh^{1,2}, William Froneman¹, Malcolm J. Smale²

¹ Rhodes University, Grahamstown, South Africa

² Bayworld Centre for Research and Education @ P.E. Museum, Port Elizabeth, South Africa

The loliginid squid (*Loligo vulgaris reynaudii*) is a coastal species that spawns sporadically throughout most of the year, although spawning peaks in spring/summer. During October/November paired male and

female chokka *Loligo vulgaris reynaudii* aggregate along the coast of the Eastern Cape, especially in St Francis Bay and its vicinity, to spawn. Video and underwater acoustic telemetry data indicate that the aggregation of the squid attracts a large suite of predators including skates, sharks, rays and teleosts to the spawning ground. In order to determine the importance of squid in the diets of the predators, stomach contents and stable isotope (¹³C and ¹⁵N) of selected predators and squid were conducted. Results from gut content analyses indicate a poor representation of both squid eggs and adults in the diet of the selected predators. This is confirmed by preliminary stable isotope results, showing a low contribution of both squid and eggs to the diet of selected predators. The nature of the association between the top predators and the squid spawning areas are discussed.

Poster Tue 37

The bigger picture – SONAR improves our knowledge of fish behaviour and provides for a comparative estimation method.

Sithole, B.

Marine and Coastal Management, Cape Town, South Africa

Small pelagics are of major importance to fisheries worldwide. Changes in pelagic fish populations would therefore impact significantly on commercial fisheries throughout the world. For this reason it is essential to control the exploitation of pelagic fish. Off South Africa, acoustic surveys employing echo sounders were introduced in 1984 to estimate fish biomass. There are, however, still inherent problems with this assessment method which are not easy to resolve. These include blind zones near the sea surface, fish avoidance to approaching vessels and a low sampling volume due to a narrow vertical beam. Horizontally guided Sound Navigation and Radar (SONAR) have some advantages over echo sounders using vertical beams; they can observe shallow schools, ensonify a broad area, and can observe movement of fish. There have been several attempts to utilize fisheries SONARs for scientific purposes but these SONARs have several restrictions which make quantitative surveying impossible at this stage. These restrictions include Target Strength (TS) variation by fish aspect, reverberation by ship's wakes and refraction of sound rays. In this project SONAR is used to investigate vessel avoidance by pelagic fish and to calculate a comparative biomass estimates. The results indicated that there was indeed lateral vessel avoidance by the fish during the survey. Fish avoided

the approaching vessel by simultaneously swimming towards deeper waters or to the sides of the vessel. The biomass estimates were, however, much lower compared to that measured by the conventional echo sounder. This may be due to necessary assumptions made regarding the density of schools detected by the SONAR or to the method used to estimate SONAR school volume. Both limitations of the method as well as insights regarding fish behaviour are discussed.

Poster Mon 21

Lysosomal membrane destabilization in the feral oyster *Striostrea margaritacea*, exposed to metals on the South African South Coast.

Michelle Slabber, Reinette Snyman, James Odendaal
Cape Peninsula University of Technology, Cape Town, South Africa

The causes, monitoring and control of marine pollution, particularly metals, have become an important research topic worldwide. Oysters are often used as models in metal pollution research because they accumulate metals to high concentrations in their bodies. They are particularly effective models in biomarker studies of metal exposure. One such biomarker response is lysosomal membrane destabilization, which is measured by means of the neutral red retention time bioassay. Along the South African South Coast there are various possible sources of metal pollution, however, no information is available about the degree of metal bioaccumulation in the feral oyster (*Striostrea margaritacea*) along this coast, or about the degree of toxicity of these metals to the oysters. The aims of the present study are therefore to determine the degree of metal contamination along this coastline, as well as metal accumulation in *S. margaritacea*, from selected polluted (Wilderness, Witsand) and unpolluted (Goukamma MPA) sites. Furthermore, toxicity of accumulated metals will be determined using a biomarker (lysosomal membrane destabilization) as tool. Oysters and water and sediment samples will be collected seasonally from each site. After testing the biomarker response in the laboratory, the water and sediment samples and the oyster specimens (bodies and shells) will be analysed for various metals. A preliminary screening has already revealed high amounts of Zinc, Copper, Iron and Aluminium in oysters from the polluted sites. The final metal and biomarker results for autumn and winter will be discussed in this presentation. Results of this study may possibly be used to introduce a more advanced monitoring program using bivalves as models.

Oral B 7

Survival and autumnal north-eastward migration of formerly captive and wild ragged-tooth sharks (*Carcharias taurus*)

M.J. Smale¹, M.R. Farquhar², M. Meyer³, A.J. Booth⁴

¹ *Port Elizabeth Museum @ Bayworld, Port Elizabeth, South Africa*

² *Two Oceans Aquarium, Cape Town, South Africa*

³ *Marine and Coastal Management, Cape Town, South Africa*

⁴ *Rhodes University, Grahamstown, South Africa*

Three raggedtooth sharks (*Carcharias taurus*) held at Two Oceans Aquarium in Cape Town for several years were subsequently released back to the wild in an ongoing study from 2004. To test the hypothesis that they would survive in the wild and behave in a similar way to wild conspecifics, we equipped the sharks with Pop-up Archival Tags and ultrasonic coded tags to investigate their post-release behaviour. Both aquarium-released and wild-caught sharks (also equipped with identical tags) displayed north-eastward movements. Data from the PAT tags indicated that the individuals swam between the surface and mid-shelf waters to depths of approximately 100 m. The temperature range through which they travelled (approximately 10 - 22° C) indicates a wide temperature tolerance. We plot the likely tracks of the sharks to illustrate behaviour that may be described as station keeping and migration during autumn. The depth ranges recorded in this study support information on habitat choice found in earlier studies of this species. Furthermore, this study illustrates that sharks survive release and behave in ways similar to wild conspecifics, although some caveats are provided to the release of sharks to the wild.

Oral C 5

Blood protozoans of South African marine fishes

Nico J. Smit

University of Johannesburg, Johannesburg, South Africa

Between 1918 and 1932, H.B. Fantham published a series of research papers on the protozoans of South African marine fishes, the first such records for this region. Fantham reported various blood infections in these vertebrates, but named only 4 species, including one type of haemogregarine (*Haemogregarina fragilis* Fantham, 1930) and 3 forms of trypanosome (*Trypanosoma capigobii* Fantham, 1919, *T. nudigobii*

Fantham, 1919 and *T. blenniellini* Fantham, 1930), all from intertidal fishes. Unfortunately, when Fantham left South Africa in the 1930s, research on fish blood protozoans in the region ceased. However, interest in the research field was revived in 1999 by Smit and Davies who recorded *Haemogregarina bigemina* Laveran and Mesnil, 1901 in the blood of the intertidal fishes *Clinus superciliosus* and *Clinus cottoides*. Since their 1999 publication, these authors and their co-workers have described further new species of intertidal (*Haemogregarina koppiensis* Smit and Davies, 2001 and *Haemogregarina curvata* Hayes, Smit, Seddon, Wertheim and Davies, 2006) and offshore (*Desseria zeii* Smit and Davies, 2006) fish haemogregarines. They have also reported a *Desseria* sp. in mullets, revised the taxonomic status of *H. fragilis* (now *H. bigemina*) and elucidated the life cycle of *H. bigemina* and *H. curvata*. Recent work on trypanosomes includes the description of a new species infecting elasmobranchs (*Trypanosoma haploblephari* Yeld and Smit, 2006), as well as the development of the intertidal species, *T. nudigobii*, in its leech vector. This paper reviews the current status of the systematics and biodiversity of South African marine fish blood protozoans and highlights possible areas for future research in this intriguing field of parasitology.

Oral A 6

Biology and stock assessment of the coastal fish *Lichia amia* (Teleost: Carangidae) off the South African coast

D. Smith, B.Q. Mann, R.P. van der Elst
Oceanographic Research Institute, Durban, South Africa

The limited range of garrick/leervis *Lichia amia*, its popularity as a gamefish to all sectors of the recreational fishery and the degradation of many estuaries which function as nurseries for this species, has aroused concern about the stock status of this species. In addition, other than a preliminary investigation conducted by ORI in 1992 into the age, growth and stock status of *L. amia*, relatively little research has been undertaken on this important recreational species. Considering the value of *L. amia* and the need to provide a scientific basis for its management, a comprehensive stock assessment was required. This study therefore investigated the biology and stock status of *L. amia* off the South African coast compiled as a detailed species profile. Through ad hoc biological sampling undertaken from 1978-2007 and validation of growth by means of OTC marking and mark-recapture data,

the growth of the *L. amia* population was best described as: $L_t = 1220mmFL(1 - e^{-0.192/yr[r-1.111years]})$. The mark-recapture data was further utilized in illustrating the movement behaviour of *L. amia*. Trends in catches were determined from the analysis of catch and effort data from the National Marine Linefish System (NMLS) database. This showed a decreasing trend in the CPUE of *L. amia* along the KZN coast over time for all sectors of the KZN recreational linefishery investigated. The growth parameter estimates were used in undertaking a stock assessment of *L. amia* to determine the best management options for this species.

Poster Mon 11

3-dimensional computational assessment of the fluid flow around coasting mature male *Prionace glauca* (Linnaeus, 1758) with respect to functional biology

Tamsin H.E. Smith, Gary S. Caldwell
Newcastle University, Newcastle Upon Tyne, UK.

Morphological adaptations that enhance swimming efficiency in fish have evolved over millions of years driven by the requirement to combine hydrodynamic efficiency with functional biology. Body induced vortices and the flow regime surrounding mature male blue sharks, *Prionace glauca*, are investigated in relation to the functional biology of the animal. Morphology was described using measurements from 5 North Atlantic specimens and the flow around these specimens was investigated using 3-dimensional computational fluid dynamics software (*Fluent*TM). A k-epsilon turbulent model was used to represent the ocean flow regime and a number of different models represented the shark morphology (in order to reduce error induced by software limitations). Compared to control models (horizontal cylinders) the *P. glauca* body morphology increased the flow velocity on the body surface. The region around the gill slits showed a maximum relative velocity magnitude (increasing oxygen uptake efficiency) and the area of the lateral line adjacent to the dorsal fin showed the minimum. The effect of the dorsal fin on the flow regime was investigated using dorsal section models with and without the dorsal fin attached (and similar, half cylinder controls). The vorticity magnitude seemed to be enhanced by dorsal fin-body interactions along the adjacent section of lateral line. The results suggest that *P. glauca* body morphology acts to channel vortices along the lateral line, at a reduced relative velocity magnitude. This may allow for a greater abundance of superficial neuromasts and facilitate body-induced flow cancellation by the otovolateral nucleus, thereby enhancing the sensitivity of

the lateral line in the low frequency range and enabling *P. glauca* to locate ambient water currents, such as the Gulf Stream, during migrations.

Oral B 3

A review of the use of microalgae in estuarine freshwater reserve determinations

G.C. Snow, J.B. Adams

Nelson Mandela Metropolitan University, Port Elizabeth, South Africa

The increasing demands for freshwater as well as its eutrophication are major concerns with regards to estuarine health, environmental resource management and human health. The correct management of water is necessary to ensure that it is utilised in a sustainable manner and the amount of water necessary for an estuary to retain an acceptable ecological status is known as the Estuarine Ecological Reserve. The reserve assessment method is designed to evaluate ecosystem requirements by employing groups of specialists from different disciplines. This includes hydrologists, sedimentologists, water chemists and biologists. Microalgal research can be divided into two main focus areas; phytoplankton and benthic microalgae (microphytobenthos; MPB). The basic aims underlying the research were to identify factors that determine the spatial patterns of microalgal biomass (phytoplankton and MPB) in South African estuaries; to determine how MPB biomass is related to sediment carbohydrates and sediment stability; and to determine how microalgae can be used to determine the freshwater inflow requirements of estuaries. Results from the study highlight differences in phytoplankton communities in permanently open estuaries in relation to river flow, the importance of organic matter as a long-term source of mineral nutrients in temporarily open/closed estuaries and the close association between MPB biomass and the organic content in fine particle sediment. In addition, there were a number of recommendations to improve the data requirements on microalgae for the Intermediate Determination of Resource Directed Measures (RDM).

Oral A 7

What is the potential for the constraints associated with ECOPATH to improve estimates of biomass and productivity in the southern Benguela?

S. Somhlaba^{1,2}, D.S. Butterworth², É.E. Plaganyi²

¹ Marine and Coast Management, Cape Town, South Africa

² University of Cape Town, Cape Town, South Africa

The popular ecosystem modeling package ECOPATH provides a mathematical basis for specifying the predator-prey-associated constraints on all the species in an ecosystem. We investigated whether the ecotrophic and food conversion constraints associated with the set of linear equations that comprise ECOPATH are capable of improving knowledge about estimates of biomass and productivity available from other sources such as surveys. We used Markov Chain Monte Carlo methodology as it is more efficient than ECOPATH's built in simple random-number-based integration package ECORANGER. In the initial analyses, uncertainties about point estimates for each biomass (*B*) and production:biomass (*P/B*) ratio were assumed to be uniform distributed over ± 20 , ± 40 and ± 60 of the original estimates. The preliminary results show the extent to which the constraints imposed by ECOPATH equations update the prior distribution. For both *B* and (*P/B*) suggest that there is a general reduction in uncertainty as measured by standard deviation. The reduction is appreciably larger when the input uncertainties are either ± 40 or ± 60 . However, the improvements were not large, being typically less than 20% for most individual groups, except for ± 60 cases. For the production:biomass ratios (*P/B*), the reduction in the extent of uncertainty are somewhat large. The decrease in uncertainty for planktonic groups averages more than 30% in most cases and the overall gain is higher when the uncertainties are increased from ± 40 and ± 60 . The analysis is currently being refined using updated inputs as well as specific estimates of uncertainty for parameters for each species/species group. This will assist in quantifying the extent to which the ECOPATH predator-prey constraints have potential to improve single-species abundance and productivity estimates, and hence to benefit single-species-based management advice. Preliminary results suggested that these constraints do not preclude a fairly wide range of possible values for such quantities in the region.

Poster Mon 4

Culturing of *Hypnea rosea* as a food source for commercially grown abalone, *Haliotis midae*, on the Eastern Cape coast

M.J. Sonnekus, D.R. du Preez, A.E. Cloete

Nelson Mandela Metropolitan University, Port Elizabeth, South Africa

The feasibility of using *Hypnea rosea* Papenfuss as a mariculture species was investigated at Marine Grow-

ers (Pty.) Ltd, a commercial abalone farm located outside Port Elizabeth. The rate of nutrient uptake, specific growth rate (S.G.R) and yield were investigated. An uptake preference for $\text{NH}_4^+\text{-N}$ was evident. As *H. rosea* become nutrient depleted with time, the slopes of the NH_4^+ removal curves reflected a more rapid uptake of $\text{NH}_4^+\text{-N}$, increasing from $10.17 \pm 1.35 \mu\text{M N g}^{-1}$ dry mass h^{-1} at Day 0 to $23.84 \pm 0.39 \mu\text{M N g}^{-1}$ dry mass h^{-1} at Day 4 (mean \pm SD). This increase was found to be significant ($d.f. = 10; p < 0.05$). Nutrients were taken up in both light and dark conditions at the same rate and followed Michaelis-Menten kinetics. V_{max} values for dark/light $\text{NH}_4^+\text{-N}$ uptake were 117.46 ± 30.18 and 67.42 ± 37.29 for the dark and light treatments, respectively (mean \pm SD) this difference was not significant as determined by a Student's t-test ($t = -1.807; d.f. = 4; p = 0.145$). The differences between dark and light uptake rates for $\text{NO}_3^-\text{-N}$ and phosphate were not significant [$(t = -1.856; d.f. = 22; p > 0.05)$ and $(t = -0.899; d.f. = 22; p > 0.05)$ respectively]. S.G.R was dependent on stocking density, with a maximum growth rate of 0.052 ± 0.011 doublings day^{-1} at a stocking density of 1 kg m^{-2} . The highest yield ($47.657 \pm 8.187 \text{ g m}^{-2} \text{ day}^{-1}$) was obtained at a density of 3 kg m^{-2} . The results of the study indicate that *Hypnea rosea* is suitable for mariculture.

Oral C 6

Comparing estimates of zooplankton abundance from CUFES samples with those from a vertical bongo net

S. Sono¹, C. L. Moloney¹, C. D. van der Lingen²
¹ University of Cape Town, Cape Town, South Africa
² Marine and Coastal Management, Cape Town, South Africa

Accuracy of using CUFES (continuous underway fish egg sampler) as an alternative method to vertical bongo nets for sampling zooplankton abundance and distribution were examined. Analyses were based on 14 taxonomic groups representing a wide variety of organism sizes. Samples were collected in March 2004 in the southern Benguela, South Africa. In total, 64 CUFES samples were collected while the ship was underway and 32 CUFES and vertical bongo net on-station samples along four inshore-offshore transects. The frequencies of obtaining the taxa using CUFES and vertical bongo net samples were the same for small copepods, amphipods adults and juveniles, *Nannocalanus*. Volumetric abundance estimates of nine taxonomic groups from on-station CUFES (ln no.m^{-3}) were significantly correlated with volumetric abundance esti-

mates from vertical bongo net samples (ln no.m^{-2}), these groups were mostly small zooplankton and crustacean eggs, showing the usefulness of CUFES for sampling small zooplankton. There were considerable differences between night and day catches with higher correlations for *Metridia* adults and juveniles, small copepods, *Cladocera*, *Oithona* and *Centropages* adults at night than during the day, suggesting that these taxa undergo diel vertical migration. Relative abundance plots indicate that small copepods were relatively the most abundant taxonomic group sampled by vertical bongo nets while crustacean eggs were relatively the most abundant taxonomic group sampled with CUFES. We did not find good evidence of improved precision by using underway CUFES sampling compared with on-station samples. Generally, there was greater proportion of a large zooplankton in vertical bongo net samples than in CUFES samples.

Oral B 5

Carnivorous macrozooplankton community structure in the region of the Subtropical Convergence in the Indian sector of the Southern Ocean during late austral summer (April) 2007

J.A. Sterley, P.W. Froneman
 Rhodes University, Grahamstown, South Africa

Carnivorous macrozooplankton community structure in the vicinity of the Subtropical Convergence (STC) within the Indian sector of the Southern Ocean was investigated during austral autumn (April 2007). Total average abundance ($3.89 \pm 5.46 \text{ ind.}100\text{m}^{-3}$) and biomass ($0.14 \pm 0.27 \text{ mg Dwt.}100\text{m}^{-3}$) south of the front was significantly ($p < 0.001$) higher than the total average abundance ($1.33 \pm 1.81 \text{ ind.}100\text{m}^{-3}$) and biomass ($0.03 \pm 0.05 \text{ mg Dwt.}100\text{m}^{-3}$) values north of the front. There were no significant correlations between selected physico-chemical (temperature and salinity) and biological (mesozooplankton abundance and biomass) variables and the total abundance and biomass of the carnivorous macrozooplankton. There was no evidence of enhanced biomass and abundance values at stations occupied in the immediate vicinity of the frontal system. South of the front, the total carnivorous macrozooplankton abundance and biomass was dominated by euphausiids (50.78% and 56.10% respectively) and amphipods (26.86% and 31.42% respectively). North of the front, the total carnivorous macrozooplankton abundance was dominated by euphausiids (43.08%) and chaetognaths (39.02%) while biomass was dominated by the euphausiids (47.63%) and the amphipods (45.62%). Numerical analysis identified two major

groups of zooplankton which coincided with the water masses north and south of the STC. Differences between the groups were mainly attributed to changes in the abundance of species rather than the presence or absence of individual species.

Poster Mon 15

Composition, abundance and distribution of larval fishes in the Nxaxo-Ngqusi estuary complex

N.A. Strydom¹, R.J. Wasserman², T.H. Wooldridge²
¹ South African Institute for Aquatic Biodiversity, Grahamstown, South Africa
² Nelson Mandela Metropolitan University, Port Elizabeth, South Africa

The larval fish assemblage was investigated in the permanently open Nxaxo-Ngqusi Estuary complex, in the subtropical / warm temperate biogeographic boundary region of South Africa. Larvae and early juvenile fishes were collected by means of both boat-based plankton tows and seine net hauls in summer and winter of 2007 and the work is ongoing in 2008. Within the Nxaxo Estuary salinity ranged from 17.5‰ to 37.0‰, temperature ranged from 16.3°C to 29.9°C, pH ranged from 8.2 to 10.9 and transparency ranged from 90cm to 185cm. Within the Ngqusi Estuary salinity ranged from 17.0‰ to 37.7‰, temperature ranged from 18.09 °C to 27.4 °C, pH ranged from 8.17 to 10.6 and transparency ranged from 50cm to 130cm. In total 16041 fishes were collected representing 15 families and 29 species. In both estuaries the Clupeidae and Gobiidae were the dominant fish families and the dominant species was the estuary-resident *Gilchristella aestuaria* (Clupeidae). Estuary resident larvae were the dominant group in the system. Fish densities ranged from 8-6063 individuals per 100m³ in summer and ranged from 0-1432 individuals per 100m³ in winter in the Nxaxo estuary. Fish densities ranged from 42-10002 individuals per 100m³ in summer and ranged from 9-932 individuals per 100m³ in winter in the Ngqusi estuary. Species diversity also varied seasonally. The estuary complex was found to support a mix of both temperate and tropical species. Salinity zones played a significant role in terms of species distribution. Salinity, temperature and turbidity were identified as important variables governing larval and early juvenile fish composition, abundance and distribution.

Oral C 7

Lateral carbon export from the southern Benguela upwelling system

Neil C. Swart¹, Lihini I. Aluwihare², Peter J.S. Franks², Howard N. Waldron¹
¹ University of Cape Town, Cape Town, South Africa
² Scripps Institution of Oceanography, University of California San Diego, USA.

The Benguela upwelling system has the highest productivity of any Eastern Boundary Current, and dynamic interaction with the Agulhas Current. This suggests that the Benguela could be an intense site of lateral carbon export from the shelf to the deep ocean. To explore this flux we have taken a multivariable approach, with comprehensive measurements of POC, PON, and stable isotopes of carbon and nitrogen. We also report, to the best of our knowledge, the first reliable measurements of DOC and DON in the southern Benguela. A turbidity proxy for POC is developed, and strong evidence is presented for quasi-permanent POC loaded bottom nepheloid layers (BNLs) over the southern Benguela shelf. A four-year time series of BNL turbidity shows periodic pulses of POC which traverse the shelf, and enter the deep ocean. We present recording current meter records, which confirm a prominent cross shelf component of flow in the BNL, which could have been responsible for the advection of POC. Furthermore, the role of semi-diurnal internal tides is highlighted as a mechanism controlling the turbulence regimes of the southern Benguela shelf and slope. Using the turbidity time series we develop a power model which quantifies the observed cross shelf fluxes of POC. Integrating over appropriate scales, we derive a POC export for the southern Benguela system, which is less than 1% of primary production (PP), confirming the proposition that the majority of PP is consumed on the shelf. However, the measured DOC gradient between the Benguela edge and the open ocean suggests the DOC flux would be an order of magnitude greater than the POC flux. Nonetheless, the total lateral organic carbon flux from the southern Benguela to the deep ocean remains a small fraction of total primary production. These results imply that the biological pump mechanism in such systems cannot modulate atmospheric CO₂ concentrations on timescales of human relevance.

Oral C 3

South Africa's National Programme of Action to Protect the Coastal Marine Environment from Land-based Activities

S Taljaard¹, L van Niekerk¹, A K Theron¹, P D Morant¹, Y Peterson², F Albertus-Stanley²

¹ CSIR, Stellenbosch, South Africa

² Marine & Coastal Management, Cape Town, South Africa

South Africa is a signatory to the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA) where, in 1995, 108 governments expressed their commitment to prevent the degradation of marine and coastal environments from land-based impacts and threats. One of the requirements calls on governments to develop and implement National Programmes of Action (NPA). The Department of Environmental Affairs and Tourism, Branch: Marine and Coastal Management has been appointed as the Lead Agent for the development of South Africa's NPA. A National Advisory Forum was established in April 2007 to assist the Department in the NPA process. This paper discusses South Africa's response to the call to develop and implement such an NPA. The process aims at highlighting and coordinating existing relevant national, provincial and local initiatives, identifies shortcomings and proposes future actions and prioritisation. The NPA addresses the following key components: a) *Environmental Situation Assessment* that provides an overview of the characteristics of South Africa's coastal marine environment, major land-based activities (direct causes) contributing to problems and a short review on the state of the coastal marine environment; b) *Vision and Resource Objectives for the Coastal Marine Environment* that considers legislation and actions related to the establishment of a vision and resource objectives for South Africa's coastal marine environment; c) *Management Programmes for Land-based Activities* that considers management programmes for major land-based activities (including legal frameworks) to prevent detrimental affects on the coastal marine environment; d) *Programme Support Elements* that highlights support elements that can be utilised in the effective implementation of an NPA, e.g. institutional structures; and *Monitoring and evaluation* programmes to continuously assess and report on results and achievements of the NPA.

Poster Tue 10

Parasites of the bluntnose klipfish, *Clinus cottoides*

L. Tang, C.C. Reed

University of Cape Town, Cape Town, South Africa

Despite their use as effective tools to explore the origins, distribution and maintenance of biodiversity, parasites have received little attention from the broader community of zoologists. As a result, the relationships between the parasites, hosts, and their ecosystems are poorly understood. In this study, *Clinus cottoides* was collected from most of its geographical range (west to southeast coast of South Africa) to investigate parasite diversity and infection levels. The skin, gills, internal organs, and blood were examined. The following parasites were found: 1) trichodinids on the gills, 2) myxozoans in the gall bladder, and 3) gnathiids on the skin. This study is likely to be the first documentation of trichodinids and myxozoans in *C. cottoides*. These results will lay the foundation for a future study determining whether the parasite community of *C. cottoides* exhibits a biogeographical pattern and whether the phylogeography of the myxozoans reflects that of its host.

Oral B 2

The influence of mouth dynamics on the avifauna of four intermittently open estuaries in the Eastern Cape, South Africa

Anja Terörde, Jane Turpie

University of Cape Town, Cape Town, South Africa

The main objective of this study was to describe the poorly studied avifauna of intermittently open estuaries (IOEs) and its response to changes in mouth conditions and to provide information for management decisions. The study area consisted of four IOEs of varying sizes within a 40 km stretch of coastline in the warm temperate region of South Africa. Between December 2005 and November 2006 58 waterbird counts were conducted under closed and 52 under open estuary mouth conditions. The specific objectives were to describe changes in abundance, diversity and community composition with changes in estuary mouth conditions and to compare estuaries of varying sizes. Waterbird densities varied from 0.46 individuals per hectare to 4.24 individuals per hectare. Abundance increased significantly when the estuary mouth was open at the largest estuary. It decreased significantly at the estuary with the largest floodplain habitat due to loss of wading habitat. There was no significant change in overall abundance at the smaller two estuaries. Diversity increased significantly on three out of four estuaries under open condition. Species composition changed significantly from a closed to open mouth phase on all

four estuaries. Each estuary had a significantly distinct bird community composition. The avifauna of each estuary responded differently in terms of changes in feed guild composition when the mouth opened. This study showed that under open estuary mouth conditions waterbird diversity is higher but species composition is significantly different from closed mouth conditions. Abundance is affected immediately after breaching. If the open mouth periods should increase then the characteristic IOE avifauna may be lost and replaced by a community resembling that of permanently open systems. This must be considered when making management decisions that affect mouth conditions.

Oral C 7

Particulate organic carbon export from the North and South Atlantic gyres : the ^{234}Th / ^{238}U disequilibrium approach

Sandy Thomalla¹, Robert Turnewitsch², Mike Lucas¹, Alex Poulton³

¹ University of Cape Town, Cape Town, South Africa

² The Scottish Association of Marine Science, Oban, Scotland

³ The National Oceanography Centre, Southampton, UK

Subtropical ocean gyres are characterized by low carbon export from the surface into the deep ocean. However, due to their large areas even relatively low export could be significant for the global carbon cycle. Radioactive disequilibria between the radionuclide ^{234}Th (half-life 24.1d) and its parent ^{238}U were used to measure carbon export from surface waters of the North and South Atlantic subtropical gyres. Samples were collected between $\sim 50^\circ\text{S}$ and $\sim 50^\circ\text{N}$ as part of the Atlantic Meridional Transect (AMT) programme during April/May 2004 (AMT 14). Application of a steady state model to the ^{234}Th data revealed particle export from the surface (^{234}Th deficit) and, in one instance, some evidence for shallow particle remineralisation at depth (^{234}Th excess). Export fluxes of POC were calculated from water column ^{234}Th / ^{238}U disequilibria and the POC to ^{234}Th ratios on large rapidly sinking particles ($>50\mu\text{m}$). The lowest ^{234}Th derived POC export fluxes were found in the oligotrophic gyres and ranged from 0 in the northern to $6 \text{ mmol C m}^{-2}\text{d}^{-1}$ in the southern oligotrophic gyre indicating a tightly coupled food web. Enhanced POC export was associated with the equatorial region ($25 \text{ mmol C m}^{-2}\text{d}^{-1}$) and the upwelling region north of the equator ($15 \text{ mmol C m}^{-2}\text{d}^{-1}$). POC export in the temperate regions ranged from $7 \text{ mmol C m}^{-2}\text{d}^{-1}$ to a maximum of $41 \text{ mmol C m}^{-2}\text{d}^{-1}$.

High fluxes at the poleward edges of the oligotrophic gyres probably result from episodic nutrient loading processes associated with submesoscale features. Results from this study suggest that although carbon export in the oligotrophic centres of the gyres may be low, carbon sequestration in the temperate fringes of the gyres as well as in the equatorial and upwelling regions can be substantial, but that spatio-temporal variability in these areas of the world's oceans may be considerable.

Oral B 1

The combined effects of salinity and temperature on postembryonic growth, survival and fecundity of the amphipod, *Melita zeylanica* Stebbing (Gammaridae)

Thwala N. N., Wooldridge T. H.

Nelson Mandela Metropolitan University, Port Elizabeth, South Africa

The epibenthic amphipod *Melita zeylanica* is relatively common in the upper reaches of the temporarily open/closed Mngazi estuary. The boundary between the river and estuary is highly variable, extending much further upstream under closed mouth conditions (by approx. 1 km or 20 % of the length of the open estuary). Numerous estuarine species colonize these upper reaches when the mouth closes, some migrating downstream (e.g. mysids) when riverine conditions again return. Other species such as *M. zeylanica* persist under riverine conditions in the upper estuary, at least temporarily. In order to determine the influence of temperature and salinity combinations on *M. zeylanica*, we tested survival, postembryonic growth and fecundity in the laboratory. Juveniles, male and female amphipods were exposed to experimental regimes of combinations of three temperatures (19, 24 and 29°C) and a range of salinities (0 to 63 psu, interval 7). A 100% mortality of juveniles occurred within 1-6 days at salinity values of 0, 49, 56 and 63 psu. At the same salinities (0, 49, 56, 63 psu), adults survived slightly longer than juveniles and survival was highest at the 24°C; and lowest at 29°C. There was no significant difference in survival between adult males and females. In general male and female amphipods remained in precopula for 1-3 days. Mean offspring number, number of broods produced and inter-brood interval were significantly affected by both temperature and salinity. Growth parameters determined (head length and number of antennal segments), reflected that growth was continuous under laboratory conditions although reduced/restricted at high salinity values. Although

adults probably survive and attempt to breed under riverine conditions in the upper estuary under closed mouth conditions, recruitment ceases when the upper estuary becomes fresh. Survival of the population in the upper Mngazi estuary will therefore also depend on the duration of an open mouth.

Poster Tue 1
Total Lipid Content of Hake Eggs

M. Tsanwani, R. Barlow, H. Sessions
Marine & Coastal Management, Cape Town, South Africa

Lipid content of fish vary considerably and strongly depending on the ingested food. A positive relationship exists between recruitment success and the total lipid content. In this study, the total lipid content was studied in the eggs of the shallow water hake *M. Capensis* and the deep water hake *M. Paradoxus*. The egg samples were collected during the 1st leg of the West Coast Hake Survey from the 7th to the 18th of January 2008. Female hakes of different length and weight were selected. This investigation revealed that there was no difference in the total lipid content per unit dry mass between the two species. The total lipid content of *M. Capensis* and *M. Paradoxus* range between 0.1 gg⁻¹ and 0.28 gg⁻¹ with the mean level in both species being 0.20 gg⁻¹. However, differences were observed in the total lipid content per egg between the two species. The results indicated that the content per egg for *M. Capensis* varied between 6.8 and 12.1 µg egg⁻¹, for *M. Paradoxus* the lipid content ranged from 2.4 µg egg⁻¹ to 8.9 µg egg⁻¹. Therefore it appears that *M. Capensis* has nearly twice as much lipid per egg compared to *M. Paradoxus*.

Poster Wed 18
An estimated growth curve of the South African loggerhead turtles

Tucek, J. B., Nel, R.
Nelson Mandela Metropolitan University, Port Elizabeth, South Africa

Sea turtles are endangered species, because they are over-harvested on land and killed in modern and traditional fishing gears. They are very slow growing, late maturing reptiles and studies on age and growth have resultantly been difficult. Moreover, growth information is missing for the first decade for most species/populations because turtles go through a pelagic phase, known as the “lost years”. Information is only avail-

able when they return again as sub-adults to the coast. However, for effective conservation management the natural mean age at maturity and growth rate are essential parameters. This project aims to establish an estimate for individual growth rate and age at first maturity for South African loggerheads, which previously was estimated to be 12 – 20 years (by Hughes). This project is revisiting the available size-age information by pooling various data sets collected over the last 40 years. This includes data from hatchlings and juveniles raised in captivity combined with size data of hatchlings and adult females collected in the wild. A von Bertalanffy growth curve, along with notching experiments were used to estimate the overall growth rate of individuals in KwaZulu-Natal. It was found, that the gain in straight carapace length (SCL) in hatchlings is slightly higher, than in juveniles (> 1.5 years). The growth in adult females slows down almost to a stop after reaching sexual maturity, indicated by the first nesting. It is also clear, that the growth rate of sea turtles is affected by a range of external factors, like water temperature, tank size (in captivity) and food quantity/quality. Current estimates indicate that hatchlings (mean SCL 44,7 mm) in KZN need about 20 years to achieve maturity (SCL 80-90 cm), which is about 10-13 years younger than current age estimates for east Australian loggerheads. Both studies are still ongoing.

Oral B 2
Ecological-economic modelling for estuarine management: A case study of the East Kleinemonde estuary

Jane K. Turpie, Barry M. Clark
University of Cape Town & Anchor Environmental Consultants, Cape Town, South Africa

Managing estuaries requires making decisions about freshwater inflow requirements, artificial breaching and human use. These decisions are currently made using expert opinion in which assumptions are not made explicit. An ecological-economic model was built of the East Kleinemonde estuary, an intermittently open estuary in the Eastern Cape, in order to test the feasibility of producing a useful tool for management. The model was built in STELLA, using a daily time step, and using inputs on freshwater inflows and measured tide and wave height. The model simulated breaching behaviour of the estuary through freshwater and marine effects on estuary water volume and berm growth. These effects were calibrated using long-term daily records of mouth condition. Salinity, nutrients, macroalgae, invertebrates, fish and birds were modelled based on data

collected during 2005-6. Total economic value of the estuary was based on research conducted in 2007. Outputs of the model include measures used in the assessment of estuary health as designed for the Resource Directed Measures methodology which is used to determine the freshwater reserve. A management module allows artificial manipulation of the mouth. Modelled flow scenarios were run to simulate the natural condition and two alternative development scenarios and the outputs were compared with expert scores provided during the RDM study of the East Kleinemonde estuary. The model produced similar results, and would lead to healthy debate where the results differ from expected. It has the added advantage that it can reduce to cost of running additional scenarios. It is anticipated that transfer to other intermittently-open systems would be relatively easy, but more complex systems will require the use of better hydrodynamic and water quality models.

Oral A 13
Comparing the spatial and temporal distribution of pelagic fish species with environmental parameters

N. Twatwa, S. Somhlaba, J. C. Coetzee
Marine and Coastal Management, Cape Town, South Africa

It has been hypothesized that the environment influences, both the abundance and spatial distribution patterns of small pelagic fish species. We investigated possible relationships between anchovy, sardine and round herring densities and environmental variables in the southern Benguela region to validate this hypothesis. Biomass estimates of these three pelagic species off the coast of South Africa have been obtained annually by means of hydro-acoustic research surveys since 1984. Estimates of abundance obtained from these surveys are an essential part of the management of the South African pelagic resources. We used information collected over a four year period (2000-2003) in November/December during which the adult spawning stock is estimated to quantify fish density, together with physical and biological variables routinely collected during these surveys. Physical variables included in our data set were limited to sea surface temperature (SST), fish mean depth and oxygen, while our biological variables consisted of zooplankton and phytoplankton biomass. Relationships between fish density and each environmental variable were quantified using a multivariate modeling approach. This approach employs a combination of generalized additive models (GAM) and general linear models (GLM).

Additionally, results of the GAM were incorporated into the GLM to further parameterize the defined shapes. Results showed that physical variables (SST & fish mean depth) explained the major part of the variability in pelagic fish densities while biological variables were less important.

Oral B 1
Variability in the recruitment of zooplankton and nekton into a temporarily open/closed Eastern Cape estuary, during 3 different hydrological mouth phases

G. P. Tweddle, W. P. Froneman
Rhodes University, Grahamstown, South Africa

The recruitment of macrozooplankton and nekton into the temporarily open/closed Mpekweni Estuary was investigated during three hydrological phases; freshwater dominated breaching event, tidally dominated breached phase and overtopping events. Macrozooplankton and ichthyofauna were collected using a funnel trap that was placed either on the berm of the sand bar or in the channel at the mouth of the estuary. Results of the study indicated that maximum recruitment of both macrozooplankton (mainly decapods) and nekton (marine breeding species with an obligate estuarine phase) occurred during the freshwater dominated breach phase. The observed pattern appeared to be associated with olfactory cues (mainly variability in salinity) within the marine environment. The reduced recruitment of macrozooplankton and nekton into the estuary during the tidally dominated breached phase and during overtopping appeared to be the result of the absence of olfactory cues within the marine environment. The key feature of the recruitment during these two phases was the extreme diel variability in species composition, abundance and biomass. The observed pattern appears to reflect the patchy dynamics of macrozooplankton and nekton in the marine environment adjacent to the estuary.

Poster Mon 3
The efficacy of orally administered praziquantel in treating *Diplectanum oliveri* infections in cultured Silver Kob (*Argyrosomus inodorus*)

Van Der Bank M.G.¹, Christison K.C.^{1,2}
¹ *University of the Western Cape, Bellville, South Africa*
² *Marine and Coastal Management, Cape Town, South Africa*

Aquaculture is a rapidly growing industry filled with untapped potential. South African finfish farmers are now realizing the potential of farming with *Argyrosomus inodorus* Griffiths and Heemstra, 1995 (Silver Kob) and *Argyrosomus japonicus* Temminck and Schlegel, 1843 (Dusky Kob) as a transition was made from a research and development to a commercial scale production phase. *Diplectanum oliveri* Williams, 1989 is a monogenean parasite frequently found on the gills of cultured and wild Silver Kob and Dusky Kob and has the potential to cause major losses in fish stocks. In the present study the efficacy of praziquantel in treating *D. oliveri* infections in cultured *A. inodorus* was examined. Oral medicated pellet feed at dosages of 40 mg / kg BW and 200 mg / kg BW for both three days and six days was tested as well as possible effects of the drug on fish haematology as indicated by haematocrit and haemoglobin concentration. Results indicated that a longer exposure time was more effective in removing *D. oliveri* when compared to a short exposure time however this requires a critical dose of 200 mg praziquantel / kg fish BW. Furthermore, praziquantel lowered food palatability but appeared to have had an insignificant effect on fish haematology.

Oral B 8

Overview of the sardine run and biological characteristics of sardine engaged in the KwaZulu-Natal sardine run

Carl D. van der Lingen^{1,2}, Marc Hendricks¹, M. Deon Durholtz¹ Cynthia N. Mtengwane¹

¹ Marine and Coastal Management, Cape Town, South Africa

² University of Cape Town, Cape Town, South Africa

The eastward movement of sardine (*Sardinops sagax*) from the Agulhas Bank up to Durban and beyond in winter each year is known as the KwaZulu-Natal sardine run. The arrival of sardine shoals in KwaZulu-Natal waters, followed as they are by substantial numbers of seabird, marine mammal and fish predators, results in a natural spectacle that has recently become the focus of rapidly-developing film and tourist industries, and the run also supports a beach-seine fishery that catches several hundreds of tons of sardine annually. Whereas anecdotal information on the sardine run going as far back as the 1930s has been gleaned from local newspapers, quantitative data on the sardine run has been collected since 1951, albeit somewhat sporadically. We collated information on the biological characteristics of sardine engaged in the run, including data on length frequency distributions and length/

weight relationships; sexual maturity, sex ratios and gonad maturity state; diet; and age and growth; in order to characterize sardine runners, and to provide data that may be useful for testing hypotheses regarding the cause/s of the sardine run. We present time-series of these biological characteristics, where possible, and conduct a detailed comparison of the characteristics of runners with those of sardine from South Africa's west and south coasts for 2004 and 2005. Sardine runners are typically medium-sized (15-19 cm CL), in relatively poor condition, are sexually mature with equal sex ratios and mostly in a pre-spawning mode, are primarily zooplanktivorous, and are predominantly 1-3 years old.

Oral C 4

The effects of hand vs machine grading on the growth and survivorship of grow-out abalone

E. van der Merwe¹, G.W. Maneveldt¹, J. Venter²

¹ University of the Western Cape, Bellville, South Africa

² Jacobsbaai Sea Products, Jacobsbaai, South Africa

Research has shown that larger abalone are generally competitively superior to smaller ones and so size-grading, in order to minimize intraspecific grazing competition, is regularly practised. As the grading process is on-going and labour intensive, it is considered a costly farming activity. Currently farmers use mainly hand-grading and/or machine-grading to size-sort their abalone. It has been suggested that machine-graded animals are more stressed by the grading process than hand-graded animals and that there are higher counts of mortalities from the former process. Of concern also is the use of carbon dioxide as an anaesthetic. Till now, nothing has been known of the effects of grading on the recovery and survivorship of abalone. The aim of this study was to determine the recovery response and survival rate of grow-out abalone (*Haliotis midae* Linnaeus) undergoing machine-grading versus hand-grading, with and without the application of carbon dioxide as an anaesthetic. Abalone growth was monitored on a commercial abalone farm over a period of 4 months and consisted of 3 treatments with 4 replicates (n = 100 abalone per replicate). The treatments were: Treatment 1 (machine-graded with carbon dioxide); Treatment 2 (hand-graded with carbon dioxide); and Treatment 3 (hand-graded without carbon dioxide). The data show that there are no significant differences between the machine- or hand-graded treatments when an anaesthetic is used. However, the use, or lack of use of an anaesthetic appears to be critical;

Oral C 5

Haematological examination as a tool to determine the efficacy of oral praziquantel in individually pit-tagged *Seriola lalandii* (Yellowtail Kingfish) infested with *Zeuxapta seriolae* (Monogenea: Heteraxinidae)

David B. Vaughan¹, Kevin W. Christison², Anna Mouton³

¹ Two Oceans Aquarium, Cape Town, South Africa

² Marine and Coastal Management, Cape Town, South Africa

³ Amanzi Biosecurity, Hermanus, South Africa

Zeuxapta seriolae (Monogenea: Heteraxinidae) is an economically important parasite of yellowtail kingfish (*Seriola lalandii*) in aquaculture world-wide. This sanguiferous parasite attaches to the gill lamellae of its hosts and has been associated with anaemia and the mortality of both *Seriola lalandii* and *S. dumerili* in Japan, Australia, New Zealand, the Mediterranean, and now South Africa. Recently, individual *S. lalandii* of an experimental shoal, with a confirmed heavy infestation of *Z. seriolae* were individually pit-tagged at the Two Oceans Aquarium to test the efficacy of an orally administered praziquantel treatment regime as a quarantine measure. All fish were anaesthetised using a concentration of 0.150mℓ/ℓ 2-Phenoxyethanol to facilitate their safe handling and blood extraction both pre and post-treatment. Each individual fish from the experimental group was scanned for identification at each procedure to gather both individual as well as group data. Blood was extracted from the caudal blood vessel and analysed for haematocrit, haemoglobin concentration, and erythrocyte count. Individual fish had a mean mass of 2.16kg, and were given praziquantel at a calculated mean dosage of 283mg/kg using 500mg gelatin capsules disguised in pieces of either fresh Pilchard or Maasbanker and fed to the group according to an integrated pest management strategy specific to *Z. seriolae*. Praziquantel was given for the first 3 consecutive days, and thereafter on days 8, 9, 10, 11, 12, 13, 14, 15 and 16. A modified filter trap was placed into the pump filter basket during the experiment and checked for the presence or absence of dislodged parasites every hour for 8 hours for the first 3 consecutive days, and thereafter, every 24 hours. Parasites were recovered between 3 and 26 hours into the treatment only. Routine haematology revealed a statistically significant improvement in blood parameters after the successful completion of this treatment. These data suggest that orally administered praziquantel fed at strategic intervals within the integrated parasite management strategy was

effective in significantly reducing the mean intensity of *Zeuxapta seriola* in a captive population of yellowtail kingfish and thus has application potential not only in parasite management in public aquaria but also in mariculture facilities. Furthermore routine haematology can be used as a non invasive tool to quantify efficacy of treatments against blood feeding parasites.

Oral C 6

Equilibrium dynamics of the northern and southern Benguela systems

J.A. Veitch¹, P. Penven², F.A. Shillington¹

¹ University of Cape Town, Cape Town, South Africa

² IRD-URO97 ECO-UP, Plouzane, France

The Benguela system is one of the four major eastern boundary current (EBC) systems of the worlds oceans. It is unique among EBC systems in that, not only its equatorward, but also its poleward boundary is marked by a warm water regime. The Regional Ocean Modelling System (ROMS), forced with climatological QuikSCAT winds, is used in this study to improve the understanding of the equilibrium dynamics of the BCS. The BCS can be divided into northern and southern regimes, based on distinct dynamic as well as topographical differences. Topographically, the division between the northern and southern regimes coincides with an abrupt narrowing of the continental shelf at ~28°S. The dynamic manifestation of the divide is associated with an upwelling-favourable wind stress maximum, a deep-reaching cyclonic feature, an along-shore offshore transport maximum and a stratification discontinuity on the shelf (i.e. more stratified in the south). A modeling experiment in which the coastline and continental shelf have been straightened suggests that the wind is a primary forcing mechanism for this divide. Characteristic of the northern Benguela system is a deep poleward current that is most intense between ~10-400 m and tends to follow the orientation of the shelf-edge. This poleward current advects water of tropical Atlantic origin into the northern Benguela system. A topographical control exists in the southern Benguela system such that the position of the upwelling front and the path of the Benguela Current closely follow the orientation of the shelf-edge. The distinct northern and southern areas of the Benguela provide a good platform for a comparative study of disparate upwelling regimes within one system and one model simulation.

Oral C 9

The St Lucia - Mfolozi System link: Importance of

the Mfolozi estuary for juvenile marine fish when the St Lucia system is closed

L. Vivier, D.P. Cyrus

University of Zululand, Kwadlangezwa, South Africa

The Mfolozi estuary, located adjacent to the St Lucia estuarine system, historically served as an important water source to maintain lake levels in St Lucia, but due to increased siltation following establishment of sugar cane farming in the Mfolozi flood plain after the 1950's, the Mfolozi mouth was kept separate from that of the St Lucia System. A regional drought caused the St Lucia mouth to remain closed from June 2002 to present, coinciding with very low lake levels and hypersaline conditions, except for a five month period during 2007 when the St Lucia mouth was open. A study was initiated in 2007 on the biota of the Mfolozi system coinciding with a study on the effects of the drought on Lake St Lucia. The fish community of Mfolozi system was sampled at six sites in March and August 2007 using seine and gill nets. A total of 49 fish species were recorded. The highest species number was recorded at the mouth, decreasing towards the fresher upper reaches. The fish community was dominated by large numbers of small juveniles of *Leiognathus equula*, the ambassids *Ambassis dussumieri* and *A. natalensis*, and the mullets *Valamugil cunnesius* and *V. seheli*, confirming the importance of the Mfolozi estuary as nursery for juvenile marine fish. The fish densities were higher than expected for a small system given the very low benthic densities recorded. The importance of the Mfolozi estuary as an important regional alternate refuge for juvenile marine fish during periods when the St Lucia system is closed, is reviewed and discussed, with particular reference to future management options for St Lucia.

Oral B 13

A comparative phylogeography of three southern African clinid fishes

S. von der Heyden¹, G. Bernardi², R.C.K. Bowie³

¹ *University of Stellenbosch, Stellenbosch, South Africa*

² *University of California, Santa Cruz, USA*

³ *University of California, Berkeley, USA*

Southern Africa is the meeting point of two great and dynamic oceanic currents, with the associated coastline comprising a number of highly variable bioregions that affect the distribution and abundance of marine species. Here we examine the population genetic structure of three live-bearing clinid fishes, *Clinus cottoides*, *Clinus*

superciliosus sensu stricto and *Muraenoclinus dorsalis*. These fish have quite remarkably different environmental requirements. By sequencing the 5' section of the mtDNA control region, as well as the second intron of the S7 ribosomal gene, we investigate the population structure and demographic history of the three clinid species in South Africa. Results show that genetic structure is variable and probably related to shore-zonation and habitat requirement of each of the species. This is mirrored by coalescent analyses of migration and gene flow patterns. By utilising mismatch analyses, we will investigate the population demographic histories of these clinids, from which we can begin to understand southern Africa's dynamic oceanic past.

Oral A 9

The effect of coastline topography on mussel distribution across life-history stages: larval settlement and beyond

C.E.O. von der Meden¹, F. Porri¹, J. Erlandsson², C.D. McQuaid¹

¹ *Rhodes University, Grahamstown, South Africa*

² *University of Stockholm, Stockholm, Sweden*

For sessile intertidal invertebrates with a pelagic life stage, coastline topography influences both the pre- and post-settlement environments. Very broadly this occurs through topographic effects on a combination of nearshore oceanographic dynamics including physico-chemical factors, larval transport mechanisms and levels of wave exposure. Recent work has shown that embayed shores, in particular, can be zones of retention with higher settlement and recruitment rates, as well as being areas of greater adult abundance. This study describes the adult distribution of two mussel species, *Mytilus galloprovincialis* and *Perna perna*, along a single coastline encompassing multiple bays (11 sites) and open coast shores (11 sites). In conjunction with the adult distribution, patterns of settlement and recruitment (summer and winter) and post-settlement mortality (summer) are examined in order to understand better topographic effects on early life stages. 'Snap-shot' levels of summer and winter wave exposure were determined simultaneously over a sub-set of sites and related to adult cover. Mean adult cover of both species was found to be significantly greater in bays than on the open coast. This distribution was well explained by significantly higher mean settlement and recruitment rates of each species within bays mainly during summer months. Preliminary post-settlement mortality results did not identify any topographic pattern; however these data are limited by frequently low settle-

ment. As expected, bay sites had lower wave forces and water flux values than open coast sites, particularly in winter when these differences were statistically significant. Thus, adult distribution was well explained by topographic effects on wave exposure, and higher settlement and recruitment rates. These results clearly indicate a broadly pervasive influence of topography on mussel populations from settlement into adult stages.

Oral PL 8
African countries join hands in marine management programme

David Vousden
ASCLME, Grahamstown, South Africa

A major programme for improving the management of the marine ecosystems of the western Indian Ocean was initiated in January, when the representatives of nine countries (Comoros, Kenya, Mauritius, Mozambique, Seychelles, Somalia, South Africa, and the United Republic of Tanzania) met in Durban for the Inception Workshop of the Agulhas Somali Currents Large Marine Ecosystem (ASCLME) project. The Global Environment Facility (GEF) funds the ASCLME project, which forms part of a multi-project, multi-agency programme that aims to assist the countries of the western Indian Ocean region to introduce cooperative and adaptive management of the Agulhas and Somali Current Large Marine Ecosystems. The ASCLME project is centred on the two large marine ecosystems (LMEs) of the Western Indian Ocean region. These are the Somali Current LME in the north and the Agulhas Current LME in the south. An estimated 56 million people, living in the nine countries of the region, are dependent on the resources of the two LMEs. The next five years will see researchers embarking on a series of well-coordinated oceanographic research cruises in an attempt to gather information about the oceanography and living marine resources of the two LMEs. The coastal resources and their critical link to the well-being of coastal communities will also come under intense scrutiny. Scientific findings will lay the groundwork for the nine countries of the region to develop a strategy for collectively managing the resources on which their people and economies depend.

Oral C 10
A shallow-water retractable autonomous buoy - concept, developments and progress

Carl K. Wainman, Brian Sherriff, Mike E Gardener
The Institute for Maritime Technology, Simon's Town,

Cape Town, South Africa

Underwater buoyed technologies have experienced minimal innovations in the past few decades, due mainly to the difficulties in overcoming the harsh environmental conditions under which the platforms are expected to operate. Technological advancements have focused instead on materials, sensors and data communications. A novel yet conceptually simple underwater retractable autonomous buoy platform is currently under development at The Institute for Maritime Technology. The so called WRAP buoy was developed from diving and underwater gear recovery principles by balancing the interplay between a simple coiled spring 'motor' and the buoyancy force offered by air. This shallow-water buoyancy adjusted platform is able to repetitively transport data from the seafloor to the sea surface, triggered by a time interval or data anomaly. When fitted with suitable payload sensors, limited water column profile measurements will also become possible. Once at the sea surface, data is transmitted back to a shore base via existing data communications technology, thereafter the buoy mechanically retracts or spools itself back to its seafloor docking station to repeat the cycle, with minimal electrical power requirements and without the need for a permanent tether or surface buoy. The intention is to provide a platform for industry standard 'off-the-shelf' sensors for applications that include seafloor and water-column monitoring, research and surveillance. Early mechanical results from the concept model have proved encouraging, especially the buoys ability to 'ride' short period waves. Currently work is underway to refine the recoil mechanism of the docking station and develop the air control system in the docking station and profiling buoy. A design patent is pending.

Oral C 10
A prominent colour front in False Bay, South Africa: cross-frontal structure, composition and origin

Waldron H.N.¹, Wainman C.K.², Waldron M.E.¹, Whittle C.¹, G.B. Brundrit.¹

¹ *University of Cape Town, Cape Town, South Africa*

² *Institute for Maritime Technology, Simon's Town, South Africa*

Colour fronts are a frequent occurrence in False Bay, South Africa and their occurrence has been the subject of previous study and anecdotal conjecture. The opportunity arose to make a cross-frontal study of this feature in November 2005. Photographs were taken

and, subsequently, satellite imagery was obtained. Measurements were made of temperature, salinity, turbidity, dissolved oxygen, suspended solids, plant nutrients and chlorophyll-a. Cross-frontal comparisons were also made on particulate material using a scanning electron microscope (SEM) and elemental dispersive x-ray (EDX) analysis. Frontal waters were milky white-green in colour, in stark contrast to the adjacent clearer, green-blue waters. The milky white-green water (MW-GW) was found to be warmer, [apparently] less saline, more turbid, richer in nitrate and silicate and had a higher chlorophyll-a concentration. The dissolved oxygen signal was less pronounced, both water types being supersaturated. Paradoxically, in spite of the higher turbidity in the MW-GW, both water types had similar weights of suspended solids, although the MW-GW material was found to be more abundant and fragmentary when compared with its green-blue water (G-BW) counterpart. The MW-GW was rich in calcium whereas the G-BW was silicon enriched. The central findings of this study are that the strong southerly, onshore wind conditions prior to MW-GW formation introduced calcium-rich, fine particulates into the waters of the surf-zone. The sources of these particulates are thought to be the sea bed sediments and the sea/land interface. The particulates are close to neutral buoyancy enabling the MW-GW to persist over the time-scale of days. A mechanism reinforced by the warming of this water in the nearshore zone. The water was then advected by wind-forcing and subsequently, its own inertia around the north-west corner of False Bay, at which stage it was easily observed and sampled. It is suggested that the eventual collapse of the front was due to the slowing down of inertial movement in combination with the passive sinking of fine particulates and evaporative cooling resulting in downward convection.

Oral A 3

Post-settlement movement behaviour of blacktail (*Diplodus sargus capensis*), zebra (*Diplodus cervinus hottentotus*) and white musselcracker (*Sparodon durbanensis*) along the South African coast

Peter Watt-Pringle¹, Paul D. Cowley², Colin G. Attwood³

¹ Rhodes University, Grahamstown, South Africa

² South African Institute for Aquatic Biodiversity, Grahamstown, South Africa

³ University of Cape Town, Cape Town, South Africa

Post-settlement movement behaviour of three Sparid fishes was investigated to gain a clearer understanding

of this aspect of their ecology and management in South African marine shore fisheries. Juvenile movements were investigated in rocky intertidal nursery habitats. Individuals, marked with visible implant fluorescent elastomer (VIFE), were re-sighted on snorkel gear over a period of six months. Zebra and white musselcracker displayed strong site-fidelity, with few movements to adjacent gullies. Blacktail, however, were only regularly re-sighted during the first two months, probably due to an ontogenetic shift to adjacent sub-tidal areas. Movements of recaptured sub-adults and adults were analysed using data from the Oceanographic Research Institute's national voluntary tagging programme (NVTP), and the De Hoop (DH) and Tsitsikamma National Park (TNP) research tagging programmes. Recaptured blacktail, zebra and sub-adult white musselcracker displayed little movement. Data from the TNP, with high spatial resolution, suggested that they occupied small home ranges, with the majority of recaptured blacktail (67%) and sub-adult white musselcracker (92%) caught less than 100 m from their tagging locality, and zebra recaptures mostly at their tagging site. Observed movements of adult white musselcracker increased with age (size), were generally eastwards, and included considerable displacements of up to ~850 km. These, and adult aggregation in spring months, suggests an annual migration linked to the reproductive cycle. Fish from different regions migrate eastwards to different spawning areas. The observed movement patterns should maximise transport of eggs and larvae to nursery areas on the southern and eastern Cape coasts. The findings of this study highlight the conservation value of no-take MPAs for populations of these species. Adult white musselcracker undertake large movements and additional management options for protecting spawning aggregations of this species should be evaluated.

Oral A 10

The use of resident and transplanted brown mussels (*Perna perna*) to assess metal exposure and effects along the subtropical east-coast of South Africa.

V. Wepener, K. A. Mills, K. Schüring, S. Schweintek
University of Johannesburg, Johannesburg, South Africa

Many of the water bodies in South Africa are either enriched or polluted by metals. Although the freshwater monitoring framework has been well developed in South Africa, monitoring of metal exposure and effects in the marine ecosystem has received less attention. In this study the marine bivalve, *Perna perna*, was used as

indicator organism to assess metal exposure and biological effects at three sites along the east coast of KZN. Mussels from an uncontaminated area (Umhlali Beach) were transplanted to the study sites i.e. Richards Bay Harbour, Thukela Estuary and the Mvoti Estuary. The transplanted mussels and resident mussel populations were sampled following 28 days of exposure and returned to the laboratory for further analysis. Metal concentrations in soft tissues were analysed using standard ICP-MS procedures. Biological effects were evaluated using biomarkers of exposure (metallothionein-MT) and effect (cellular energy allocation-CEA). The concentrations of Al, Cd, Cr, Cu, Fe, Mn, Pb and Zn increased in the transplanted mussels when compared to the original control concentrations. The concentrations in the transplanted mussels approximated those measured in the resident mussels, clearly indicating the measure of metal regulation taking place. The biomarker results revealed that transplanted mussels showed induction in MT levels in response to metal exposure, whereas the MT levels in resident populations were very similar to the levels recorded in control mussels. The CEA biomarker is similar to the Scope for Growth biomarker and also provides information on the energy reserves available for growth and reproduction. Although the metal concentrations at both Richards bay Harbour and Thukela Estuary may be considered to be elevated when compared to other polluted marine systems, the biomarker responses indicate a measure of adaptation to these conditions. These results underline the importance of not relying on body burdens alone to assess the metal pollution status of marine environments.

Oral B 6

The effect of research disturbance on the behavioural responses and breeding success of Grey-headed Albatrosses at Marion Island

Mariëtte Wheeler, Marienne S. de Villiers, Res Altwegg
University of Cape Town, Cape Town, South Africa

At sub-Antarctic Marion Island, Grey-headed Albatrosses (*Thalassarche chrysostoma*) on Grey-headed Ridge have been afforded the highest level of protection. However, research disturbance may influence the behaviour and breeding success of the birds. Several sections of the colony (1-9) with varying levels of chronic disturbance were defined. Nests in section 2 was monthly monitored for a long-term study. Section 3 was entered monthly for the collection of cephalopod beaks. In 2004/5 individual nests in other sections were

marked out and monitored twice. In 2005/06 and 2006/07, all sections were monitored remotely through fixed-point photography. In 2004/5, behavioural responses of birds in section 2 were recorded during research activities, and birds in section 4 served as a control. Control birds were less likely to be responsive ($p < 0.001$) than birds in section 2. Chicks in section 2 were more likely to stand ($p < 0.001$), more likely to be responsive ($p < 0.001$) and less likely to perform comfort behaviours ($p < 0.001$) when researchers were present. The proportion of responsive chicks was highest at subsections where researchers worked, and remained high while researchers were on the ridge, but returned to pre-disturbance levels shortly after researchers left the ridge. Breeding success was recorded as the percentage of identified nests that were still active. Average breeding success for all studied sections in February was 62.46%, 51.33% and 71.84% over the three consecutive years. Level of disturbance did not influence breeding success. Sections of different sizes did not differ significantly in breeding success in 2004/5 or 2005/6, but the largest section had significantly lower breeding success in 2006/7. In 2006/07, most breeding failures occurred during incubation but in 2005/6, most failures occurred during brooding and guarding. Although research disturbance influenced the short-term behaviour of Grey-headed Albatrosses, it did not influence breeding success. Fixed-point photography is recommended as a non-intrusive monitoring method.

Oral PL 2

A multidisciplinary study of a small, intermittently open South African estuary, with particular emphasis on the influence of mouth state on the ecology of the system

Alan K. Whitfield¹, Janine B. Adams², Guy C. Bate³, Karen Bezuidenhout², Tom G. Bornman², Paul D. Cowley¹, William Froneman⁴, Phumelelo T. Gama², Nicola C. James¹, Bernard Mackenzie¹, Tarin Riddin², Gavin C. Snow², Nadine A. Strydom¹, Susan S. Taljaard⁵, Anja I. Terörde⁶, Andre K. Theron⁵, Jane K. Turpie⁶, Lara van Niekerk⁵, Paul D. Vorwerk⁴, Tris H. Wooldridge²

¹ SAIAB, Grahamstown, South Africa

² Nelson Mandela Metropolitan University, Port Elizabeth, South Africa

³ Diatom & Environmental Management cc, Howick, South Africa

⁴ Rhodes University, Grahamstown, South Africa

⁵ CSIR, Stellenbosch, South Africa

⁶ University of Cape Town, Cape Town, South Africa

In 2005/06 a diverse research programme that included studies on the hydrodynamics, sediment dynamics, macro-nutrients, microalgae, macrophytes, zoobenthos, hyperbenthos, zooplankton, fishes and birds of the intermittently open East Kleinemonde Estuary was conducted. Particular attention was given to the responses of the different ecosystem components to the opening and closing of the estuary mouth and how this is driven by both riverine and marine events. Using a complimentary dataset of daily estuary mouth conditions spanning a 14-year period, five distinct phases of the estuary were identified, including closed (average = 74% of the time), outflow (<1%), tidal (9%), semi-closed (<1%) and overwash (16%). The open mouth phase is critical for the movements of a number of estuary-associated fishes (e.g. *Rhabdosargus holubi*) and invertebrates (e.g. *Scylla serrata*) between the estuary and sea. The timing of this open phase has a direct influence on the ability of certain estuary-associated fishes (e.g. *Lithognathus lithognathus*) and invertebrates (e.g. *Palaemon peringueyi*) to successfully recruit into the system, with a spring opening (October/November) being regarded as optimal for most species. The type of mouth breaching event and outflow phase is also important in terms of the subsequent salinity regime once the berm barrier forms. A deep mouth breaching following a large river flood tends to result in major tidal inputs of marine water prior to mouth closure. Conversely, a shallow mouth breaching with reduced tidal exchange during the open phase often leads to a much lower salinity regime at the time of mouth closure. The biota, especially the submerged macrophytes, respond very differently to the above two scenarios, with *Ruppia cirrhosa* benefiting from the former and *Potamogeton pectinatus* from the latter.

Oral A 6

Indirect age validation of Cape hake *Merluccius capensis* in the northern Benguela using otoliths collected from Namibian seal scat samples

Margit R. Wilhelm¹, Jean Paul Roux^{1,2}, M. Deon Durholtz³

¹ University of Cape Town, Cape Town, South Africa

² Ministry of Fisheries and Marine Resources, Lüderitz, Namibia

³ Marine and Coastal Management, Cape Town, South Africa

This paper attempts to indirectly validate (corroborate) the annuli on otoliths of the Cape hake *M. capensis* caught off Namibia using the strong 1998-spawned cohort. Otoliths of young (0- to 2-year old)

M. capensis were obtained from seal scat samples, which were collected at monthly intervals from several seal colonies in Namibia. Otoliths of older hake (2+ years old) were collected from the same strong cohort caught during annual summer surveys, 2000-2005. Samples were chosen from these progressive length frequency data using FISAT Battacharya's method. The otoliths were analysed for 1) the seasonal formation of hyaline bands and 2) diameter measurements (tip-to-tip in mm, OD) of each hyaline band. Mean fish lengths (FL) at each hyaline band were calculated from OD-FL conversions and were compared to actual measured mean lengths at age of survey samples and to modes in the length frequency distributions. Fitted ogives on % complete bands against collection date and against OD showed that the first hyaline band was formed in the middle of April 1999 (late summer / autumn) at 6.1 mm OD and the second in the middle of August 1999 (winter) at 7.7 mm OD. These ODs translate to about 11 and 15 cm FL respectively. The latter corresponds to the cohort followed through the survey length frequency distributions. This showed that the first true annulus is usually the second visible hyaline band formed in winter at about 8 mm OD.

Poster Tue 6

The South African Traditional Linefishery in the 21st Century: An Update

Wilke C.G, S. Kerwath

Marine and Coastal Management, Cape Town, South Africa

The South African linefishery is a truly national fishery actively practiced along the full extent of the South African coastline. It is a multi-user, multi-species fishery targeting approximately 200 species of which 50 contribute significantly to commercial catches. The origin of the fishery can be traced back to the 18th century. The current boat based component is comprised of three broad user groups, a well established commercial and recreational component and as well as a growing group of small scale or subsistence fishermen, a sector that has yet to be fully established within the policy framework. The targeted species, many of which are endemic to the region, represent a variety of life histories and movement patterns (nomadic, resident and migratory). Stock assessments conducted since the mid 1990s have revealed that most commercially exploited species have been depleted to dangerously low levels, which led the Minister of Environmental Affairs and Tourism to declare a state of emergency for the resource in December 2000 followed by a drastic re-

duction in commercial effort and strict limitations of recreational catches. Spatial, temporal and cultural fragmentation of user groups, lack of continuity in management and not at least lack of a comprehensive overview of the vast amount of existing information on patterns and trends in fishery and the target species continue to hamper efforts towards rebuilding and sustainable management of linefish stocks. The National Marine Linefish System (NMLS) established in 1985 collates commercial and recreational catch data submitted by the participants as well as information on fish biology and size composition collected by scientific observers. Here, we use a time series of commercial catch data extracted from the National Marine Line Fish System, in conjunction with length frequency data to provide an overview of the trends in the fishery in the 21st century.

Oral C 9

A practical diet for the South African marine finfish industry : towards better water quality and feed conversion

Woolley L.D., Jones C.L.W., Britz P.J.
Rhodes University, Grahamstown, South Africa

Two kob species (*Argyrosomus japonicus* and *A. inodoros*) are in the early stages of commercial development in South Africa. The dusky kob (*A. japonicus*) is a good candidate for aquaculture due to its fast growth, market acceptability and acceptance of pelleted feeds. At present there is no locally produced pelleted feed specifically formulated for marine finfish species. Developing finfish operations rely on expensive imported feeds and locally produced trout feeds which have not performed well. The overall aim of this project was to develop a marine finfish diet, specifically formulated for dusky kob. A specific objective was the minimization of pollution from feed waste and excess nitrogen excretion which is critical in closed recirculation systems and open-sea cages. We achieved a highly water stable pellet by adapting the existing feed pelletising technology used in local abalone (*Haliotis midae*) farming industry. In order to reduce ammonia excretion by the fish we tested iso-energetic diets with varying protein: energy concentrations. After 12 weeks the fish fed the diets containing the higher protein and lipid concentrations grew significantly more (Kruskal-Wallis: $H_{(6, 21)}=15.37$, $p=0.01$), with the diets containing 46% crude protein resulting in a combined mean weight gain of 125.7% whilst those containing 42% crude protein only realised a growth of 92.6%. The fish fed the imported diet grew significantly less than

those fed all the test diets (ANOVA: $F_{(6,14)}=7.31$, $p=0.001$). By addressing the nonprotein energy to protein levels in diets, in order to spare protein, optimal growth is maintained and the amount of nitrogenous wastes excreted by the fish is reduced. These results will be discussed.

This work was funded by THRIP, Marifeed (Pty) Ltd and Aquafarm (Pty) Ltd and fish were made available by Espadon Marine (Pty) Ltd and I&J (Pty) Ltd.

Oral C 4

What effect does settled sludge have on dissolved ammonia concentrations in raceways used to grow abalone *Haliotis midae* fed a formulated diet?

Rowan D. Yearsley, Clifford L.W. Jones, Peter J. Britz
Rhodes University, Grahamstown, South Africa.

Abalone *Haliotis midae* growth and survival can be affected by dissolved nitrogenous waste, particularly under farm conditions where they are stocked at high densities and fed a high protein (26-35 %) formulated diet. It is farm practice to remove the sludge that accumulates in the bottom of raceways. However, the contribution that sludge makes towards dissolved ammonia in the raceways was unknown. The objective was to determine the effect that sludge had on the concentration of dissolved ammonia in raceways when using a formulated diet. Abalones in 10 farm raceways were fed a formulated feed for 24 days, during which time sludge was allowed to accumulate. Sludge was then removed from five raceways. Total ammonia-nitrogen (TAN) production and toxic, free ammonia-nitrogen (FAN) were recorded in raceways from which sludge was removed and compared to those in which sludge remained. This was done prior to the removal of the sludge and again 26, 44 and 50-hours later. A control treatment, which included raceways with neither abalone nor sludge, was also included. TAN production and FAN were negligible in the control at all times. Prior to the removal of the sludge there was no difference in TAN production and FAN between the test treatments ($p>0.05$). After 50-hours, mean TAN production (\pm standard deviation) was on average 42% higher in raceways from which sludge was not removed compared to cleaned raceways. The FAN concentrations were correspondingly higher in raceways with sludge present ($2.3\pm 0.3\mu\text{L}^{-1}$) compared to cleaned raceways ($1.9\pm 0.1\mu\text{L}^{-1}$). While this is below known lethal FAN concentrations for *H. midae* it is uncertain whether FAN in this concentration range negatively

affects growth. Until this has been established, the removal of sludge from raceways is recommended since this will significantly reduce the level of dissolved ammonia. Funded by: Frontier Program, Marine and Coastal Management (DEAT).

Poster Tue 11

Protozoan blood parasites from three endemic catshark species from the west and south coasts of South Africa

Eleanor M. Yeld¹, Nico J. Smit², Charles L. Griffiths¹

¹ University of Cape Town, Cape Town, South Africa

² University of Johannesburg, Auckland Park, South Africa

The current study focuses on three endemic catshark species: the dark shyshark, *Haploblepharus pictus*, the puffadder shyshark, *H. edwardsii* and the pyjama shark, *Poroderma africanum*. These sharks are found from Namibia to Agulhas (*H. pictus*), Cape Point to Northern Natal (*H. edwardsii*) and St Helena Bay to Natal (*P. africanum*). Sharks were collected by SCUBA divers and rod and line fishing from four sites spanning Lambert's Bay to De Hoop Nature Reserve. Parasites from the skin, gills, body cavity, stomach and intestine were counted, removed, and fixed as appropriate. A total of 155 sharks were examined. The sharks were found to host representatives of a large variety of different parasitic taxa i.e. Crustacea, Trematoda, Nematoda, Hirudinea, Cestoda and Protozoa, including a number of species new to science. A trypanosome new to science was observed in the blood of all sharks examined. This trypanosome species, *Trypanosoma haploblephari* sp. nov., is characterised by its large size, particularly its width, the shape and orientation of the cell nucleus, standard morphometric indices, and its geographic location. *Trypanosoma haploblephari* is the first species of elasmobranch trypanosome to be described from southern Africa and represents the first description of a blood parasite from South African sharks. Additionally, two potentially new species of intraerythrocytic apicomplexan haemogregarine were found in the blood of all sharks examined. These are characterised by their large size, the shape and orientation of the cell nucleus, standard morphometric indices, and staining properties. No haemogregarine species have yet been described from South African elasmobranchs. There is a notable paucity of research into marine protozoan blood parasites in elasmobranch host species in South Africa.

Oral A 5

Assessing spatial patterns in the size structure and sources of fish mortality for the fish communities in the southern Benguela ecosystem based on an IBM model: a comparison across three periods

Dawit Yemane¹, Yunne-J. Shin², John G. Field³

¹ Marine and Coastal Management, Cape Town, South Africa

² IRD, Sete, France

³ University of Cape Town, Cape Town, South Africa

Recent international agreement to implement an ecosystem approach to fisheries creates the need to measure and ultimately regulate impacts on the structure and function of ecosystems. To this end various indices of the status of ecosystems have been proposed; these are categorized into groups such as: size-based indicators, species-based indicators, tropho-dynamic indicators, etc. Size-based indicators include: mean size, mean maximum size, attributes of the size-spectra, and each of the indicators can be calculated at different levels of the ecological hierarchy (population, community, and ecosystem). A study, using the mass balance approach, compared the structure and function of the Benguela ecosystem between two periods (1980s and 1990s) while another study cross compared output of the mass balance based model to the output of the Individual Based Model OSMOSE and found reasonable agreement in the findings. Comparison of the ecosystem structure (in terms of size composition) across the three periods (1980s, 1990s, 2000s) has not been done previously. Furthermore there has been substantial change in the distribution pattern of some of the modeled species during the 2000s. This is presumed to be reflected in the size structure and spatial distribution of mortality from different sources. This study compares patterns in the distribution of the slopes of the size spectra among the three periods for the southern Benguela using the IBM OSMOSE output. Similarly we assessed the spatial distribution of different sources of mortality, viz. predation and fishing. The combined results provide insight into the structure of the ecosystems across the three periods and help characterize the three periods in terms of size composition and relative distribution of different sources of fish mortality.

Participants at SAMSS 2008

Janine Adams	adams@nmmu.ac.za
Fathima Ahmed	Ahmedf1@ukzn.ac.za
Derek Airey	Derek.Airey@sappi.com
Louise Allan	louise.allan@gmail.com
Brian Allanson	estuary@mweb.co.za
Shan Ambrose	g05a2095@campus.ru.ac.za
Darrell Anders	danders@deat.gov.za
Robert Anderson	Robert.Anderson@uct.ac.za
Margaret Angula	margaret.angula@uct.ac.za
Isabelle Ansorge	Isabelle.Ansorge@uct.ac.za
Hugo Arancibia	harancib@udec.cl
Dale Arendse	dalearendse@deat.gov.za
Bronwyn Arendze-Bailey	bronwyn.arendze@uct.ac.za
Lara Atkinson	Lara.Atkinson@uct.ac.za
Colin Attwood	colin.attwood@uct.ac.za
Lutz Auerswald	lauerswa@deat.gov.za
Johann Augustyn	augustyn@deat.gov.za
Santosh Bachoo	bachoos@kznwildlife.com
Bjorn Backeberg	bjorn.backeberg@nersc.no
Sean Bailey	sean@saeon.ac.za
Sarah Baker	bksar002@uct.ac.za
Ashok Bali	abali@deat.gov.za
Ray Barlow	rgbarlow@deat.gov.za
Janine Basson	janinebasson@googlemail.com
Rhett Bennett	g01b3014@campus.ru.ac.za
Anthony Bernard	ant@saeon.ac.za
Kim Bernard	kim@saeon.ac.za
Andrea Bernatzeder	g05b4903@campus.ru.ac.za
Peter Best	pbest@iziko.org.za
Karien Bezuidenhout	Karien.Bezuidenhout@nmmu.ac.za
Aiden Biccard	aiden.biccard@gmail.com
William Billany	willbillany@gmail.com
Bronwen Blake	bronwen.blake@uct.ac.za
Laura Blamey	laura.blamey@uct.ac.za
Ross Blamey	ross.blamey@uct.ac.za
Samantha Bodill	g05b1053@campus.ru.ac.za
Silke Bollmohr	BollmohrS@dwaf.gov.za
Taryn Boom	taryn.boom@uct.ac.za
Chris Boothroyd	Chris.Boothroyd@uct.ac.za
Thomas Bornman	t.bornman@ru.ac.za
Marie Botha	s204009316@nmmu.ac.za
Suzanne Botha	suzanne.botha@uct.ac.za
George Branch	George.Branch@uct.ac.za
Anabela Brandão	Anabela.Brandao@uct.ac.za
Faye Brinkman	fayebr@mfmr.gov.na
Peter Britz	p.britz@ru.ac.za
Geoff Brundrit	oceangeoff@iafrica.com
Natalie Burls	natalie.burls@uct.ac.za
Doug Butterworth	doug.butterworth@uct.ac.za

Fernando Caniua	tavarescaniua@yahoo.com.br
Simone Carolesson	csimone@deat.gov.za
Nicola Carrasco	203507654@ukzn.ac.za
Anton Cartwright	Anton@econologic.co.za
Fabienne Cazassus	fcazassus@yahoo.fr
Riaan Cedras	2320648@uwc.ac.za
Russell Chalmers	r.chalmers@itsnet.co.za
Nicolette Chang	nicolette.chang@uct.ac.za
Amber-Robyn Childs	amber.childs@ru.ac.za
Kevin Christison	kchris@deat.gov.za
Clinton Chrystal	chrystal@ukzn.ac.za
Gerhard Cilliers	cilliersg@dwaf.gov.za
Barry Clark	barry.clark@uct.ac.za
Dylan Clarke	dclarke@deat.gov.za
Hayley Clements	clmhay001@uct.ac.za
Jeremy Cliff	dudley@shark.co.za
Andy Cockcroft	cockcrof@deat.gov.za
Janet Coetzee	jcoetzee@deat.gov.za
Maryke Coetzee	mlcoetzee23@yahoo.com
Victoria Cole	V.Cole@ru.ac.za
Darryl Colenbrander	dcolenbrander@ori.org.za
Charine Collins	cllcha009@uct.ac.za
Jocelyn Collins	jcollins@uwc.ac.za
Rachel Cooper	s205022685@nmmu.ac.za
Paul Cowley	p.cowley@ru.ac.za
Vernon Coyne	vernon.coyne@uct.ac.za
Digby Cyrus	dcyrus@pan.uzulu.ac.za
Mark Cyrus	cyrmar001@uct.ac.za
Charlene Da Silva	cdasilva@deat.gov.za
Luzuko Dali	luzuko@saeon.ac.za
Ryan Daly	g07d6341@campus.ru.ac.za
Stephanie De Beer	s2050111128@nmmu.ac.za
Paula de Coito	paula.decoito@uct.ac.za
Wesley De Klerk	s205054102@nmmu.ac.za
Marianne de Villiers	marianne.devilliers@uct.ac.za
Pierre de Villiers	estuaries@capenature.co.za
Marlee de Vries	2234552@uwc.ac.za
Nicolette Demetriades	nicolette@mer.co.za
Shaun Deyzel	shaun@saeon.ac.za
Matthew Dicken	raggedtoothshark@bayworld.co.za
Lucky Dlamini	dlmluc005@uct.ac.za
Thembinkosi Dlaza	thembinkosi.dlaza@uct.ac.za
Bruce Donovan	Bruce.donovan@gmail.com
Mbulelo Dopolo	Mdopolo@deat.gov.za
Sandrina Dos Santos	sandrina@tuks.co.za
Nicola Downey	nikkid1@gmail.com
Andre du Randt	andre@deat.gov.za
Sheldon Dudley	dudley@shark.co.za
Fiona Duncan	fiona.duncan@gmail.com
Jonathan Durgadoo	jdurgadoo@gmail.com
Deon Durholtz	durholtz@deat.gov.za

Rosemary Eager	9512477@uwc.ac.za
Christopher Ealand	Christopher.Ealand@uct.ac.za
Russel Egypt	rhe@imt.co.za
Bruce Ellender	g06e3146@campus.ru.ac.za
Simon Elwen	simon.elwen@gmail.com
Jessica Escobar- Porras	g06e6254@campus.ru.ac.za
Adrian Evans	AdrianGareth.Evans@nmmu.ac.za
Lucinda Fairhurst	lfairhurst@deat.gov.za
Tracey Fairweather	tracey@deat.gov.za
Daniel Farrell	freedanfarrell@hotmail.com
Katelyn Faulkner	g05f0694@campus.ru.ac.za
Sean Fennessy	seanf@ori.org.za
John Field	jpgfielduct@gmail.com
Camilla Floros	cfloros@ori.org.za
Bradley Flynn	2317181@uwc.ac.za
Anthony Forbes	nicolette@mer.co.za
William Froneman	W.froneman@ru.ac.za
Irene Garcia Fernandez	irenegafe@hotmail.com
Cornelia Garner	s172013570@nmmu.ac.za
Zoe Gebhardt	gbhzoe001@uct.ac.za
Yonela Geja	ygeja@deat.gov.za
Caren George	carengео@gmail.com
Michael-John Gibberd	mjgibberd@yahoo.co.uk
Mark Gibbons	mgibbons@uwc.ac.za
Sanette Gildenhuys	sgi@imt.co.za
Nhlanhla Ginindza	Nginindza@deat.gov.za
Jean Githaiga-Mwicingi	jmwicingi@deat.gov.za
Mark Goodman	mgoodman@deat.gov.za
Pedro Goosen	pgoosen@deat.gov.za
Nuette Gordon	nuette.gordon@nmmu.ac.za
Wayne Goschen	wayne@saeon.ac.za
Albrecht Götz	albrecht@saeon.ac.za
Natasha Govender	tasha.govender@gmail.com
Rodney Govinden	rodgovin@yahoo.com
Pinky Gqirana	pgqirana@deat.gov.za
Tanith Grant	t.grant@ru.ac.za
Alistair Green	g02g0416@campus.ru.ac.za
Charles Griffiths	charles.griffiths@uct.ac.za
Marten Grundlingh	mgrundli@csir.co.za
Lisa Guastella	lisa@zes.co.za
Mthuthuzeli Gulekana	mgulekan@deat.gov.za
Thokozani Gumede	gumedet@kznmwildlife.com
Kerry Hadfield	aquarium@uj.ac.za
Issufo Halo	issufo.halo@uct.ac.za
Shannon Hampton	shannon.hampton@uct.ac.za
Lisa Hancke	lisa@oceanafrika.com
David Harding	David.Harding@uct.ac.za
Nazeera Hargey	nhargey@deat.gov.za
Amy Harington	a_widget@hotmail.com
Autumn-Lynn Harrison	harrison@biology.ucsc.edu
Neil Hart	neil.hart@uct.ac.za

Tanya Haupt	tanya.haupt@uct.ac.za
Rebecca Helm	mgibbons@uwc.ac.za
Martin Hendricks	mhendricks@uwc.ac.za
Juliet Hermes	Juliet@saeon.ac.za
Elodie Heyns	g04h5615@campus.ru.ac.za
Barbara Hoareau	b.hoareau@scmrt-mpa.sc
Greg Hofmeyr	greg@bayworld.co.za
Susan Holloway	susan.holloway@uct.ac.za
Maria Honig	mhonig@wwf.org.za
Deon Horstman	horstman@deat.gov.za
Rael Horwitz	rael.horwitz@uct.ac.za
Bernadette Hubbard	bhubbart@deat.gov.za
Robert Huddy	Robert.huddy@uct.ac.za
Jenny Huggett	jhuggett@deat.gov.za
Nigel Hussey	nigehuss72@aol.com
Kenneth Hutchings	ken.hutchings@uct.ac.za
Larry Hutchings	lhutchin@deat.gov.za
Hassan Ismail	heishmail@deat.gov.za
Kim Jacobs	kjacobs@deat.gov.za
Lee-Ann Jacobs	lee-ann@oceanafrica.com
Nolusindiso Jafta	203050150@nmmu.ac.za
Nicola James	nikkij@saeon.ac.za
Marike Janse van Rensburg	marike.jansevanrensburg@uct.ac.za
Liesl Janson	ljanson@deat.gov.za
Astrid Jarre	astrid.jarre@uct.ac.za
Clifford Jones	c.jones@ru.ac.za
Tembisa Jordaan	tembisajordaan@gmail.com
Cornelia Joubert	cornia.joubert@nmmu.ac.za
Warren Joubert	wjoubert@csir.co.za
Lineekela Kandjengo	lineekela.kandjengo@uct.ac.za
Ignatius Kauvee	ikauvee@unam.na
Erika Kean	erikakean@yahoo.com
Derek Kemp	derek.kemp@uct.a.za
Justin Kemp	groovypalm@gmail.com
Sven Kerwath	SKerwath@deat.gov.za
Felicia Keulder	fkeulder@deat.gov.za
Jimmy Khanyile	jkhanyile@deat.gov.za
Carola Kirchner	ckirchner@mfmr.gov.na
Steve Kirkman	stephen.kirkman@uct.ac.za
Horst Kleinschmidt	hkleinschmidt@feike.co.za
Alison Kock	alison@saveourseas.com
Sophie Kohler	kohler84@gmail.com
Roberto Komeno	robertojeanluc@yahoo.fr
Daisy Kotsedi	s203044134@nmmu.ac.za
Pieter G H Kotze	dkotze@deat.gov.za
Francis Kuriah	kuriahfrancis@yahoo.com
Hiroyuki Kurota	kurota@affrc.go.jp
Erwann Lagabrielle	erwann.lagabrielle@gmail.com
Megan Laird	mail.meganl@gmail.com
Stephen Lamberth	lamberth@deat.gov.za
Tarron Lamont	tlamont@deat.gov.za

Avelino Langa	avelinolanga@yahoo.com.br
Louise Lange	louiselange@yahoo.com
Cloverley Lawrence	lawrencec@sanbi.org
Robynne Lawrie	rlawrie@ukzn.ac.za
Renee Le Roux	renee@nrf.ac.za
Rob Leslie	rwleslie@deat.gov.za
Tamsyn-Claire Livingstone	livingst@kznwildlife.com
Amanda Lombard	gemsbok@mweb.co.za
Mike Lucas	milucas@egs.uct.ac.za
Johann Lutjeharms	Johann.Lutjeharms@uct.ac.za
Brett Macey	bmacey@deat.gov.za
Angus Mackenzie	Amacken@deat.gov.za
Liwalam Madikiza	lmadikiz@deat.gov.za
Seshnee Maduray	smaduray@deat.gov.za
Ali Mafimbo	ali.mafimbo@uct.ac.za
Samuel Mafwila	smafwila@gmail.com
Genevieve Maharaj	gmaharaj@deat.gov.za
Prideel Majiedt	majiedt@sanbi.org
Pierre Malan	oceantek@mweb.co.za
Gavin Maneveldt	gmaneveldt@uwc.ac.za
Chumani Mangcu	cmangu@deat.gov.za
Bruce Mann	bruce@ori.org.za
Judy Mann-Lang	jmamm@saambr.org.za
Majuto Manyilizu	clmmaj001@uct.ac.za
Benita Maritz	bem@imt.co.za
Rodrigo Martins	rodrigo.plei@gmail.com
Ntuthuko Masikane	Ntuthuko@saeon.ac.za
Andrew Mather	mathera@durban.gov.za
Phaphedi Matsapola	pem@imt.co.za
Conrad Matthee	cam@Sun.ac.za
Cherize Mattheus	s205001581@nmmu.ac.za
Frank Mazibuko	fmazibuko@nrf.ac.za
Sekiwe Mbande	smbande@deat.gov.za
Steven McCue	smccue@deat.gov.za
Ann McLachlan	ann_5@telkomsa.net
Christopher McQuaid	C.McQuaid@ru.ac.za
Angela Mead	angela.mead@uct.ac.za
Mike Meyer	mmeyer@deat.gov.za
Nelson Miranda	204507499@ukzn.ac.za
Qayiso Mketsu	qmketsu@deat.gov.za
Mbali Mkhize	mkhizem@kznwildlife.com
Mpho Mmonwa	g07m6344@campus.ru.ac.za
Coleen Moloney	Coleen.Moloney@uct.ac.za
Phanor Montoya-Maya	p.montoyamaya@ru.ac.za
Tamaryn Morris	tammy@oceanafrika.com
Bruce Mostert	G04m2634@campus.ru.ac.za
Thomas Mtontsi	thomas@saeon.co.za
Craig Mulqueeny	craigm@kznwildlife.com
Vikash Munbodhe	vmunbodhe@mail.gov.mu
John Mungai	john.mungai@uct.ac.za
Tor F Naesje	tor.naesje@nina.no

Vincent Nakin	mnakin@wsu.ac.za
Simone Neethling	2413432@uwc.ac.za
Sergio Neira	sergo.neiraalarcon@uct.ac.za
Ronel Nel	Ronel.Nel@nmmu.ac.za
Mashudu Nemutandani	
Mqondisi Ngadlela	mngadlela@deat.gov.za
Khulekani Ngcobo	kng@imt.co.za
Ratsimanarisoa Njaka	njakaa@hotmail.com
Joyce Ntuli	ntulic@deat.gov.za
Nolubabalo Ntunzi	nolubabalontunzi@yahoo.com
Lisa Nupen	LisaNupen@gmail.com
Bronwyn O'Connell	brooco@gmail.com
Sean O'Donoghue	200202089@ukzn.ac.za
Jennifer Olbers	olbersj@kznwildlife.com
Sadasing Oocheetshing	osadasing@moi.intnet.mu
Ané Oosthuizen	a.oosthuizen@ru.ac.za
Carel Oosthuizen	co@tuks.co.za
Herman Oosthuizen	oosthuiz@deat.gov.za
Wisaal Osman	iamwisaal@yahoo.com
Angus Paterson	angus@saeon.ac.za
Barbara Paterson	Barbara@paterson.alt.na
Paula Patrick	paula.patrick@gmail.com
Ingrid Peters	ipeters@iziko.org.za
Samantha Petersen	spetersen@wwf.org.za
Frank Pey	pyxfra001@yahoo.co.uk
Maya Pfaff	maya.pfaff@gmail.com
George Philander	gphlder@princeton.edu
Stan Pillar	scpillar@deat.gov.za
Deena Pillay	Deena.Pillay@uct.ac.za
Keshnee Pillay	kepillay@deat.gov.za
Pavs Pillay	pavs.pillay@uct.ac.za
Grant Pitcher	gpitcher@deat.gov.za
Éva Plagányi-Lloyd	Eva.Plaganyi-lloyd@uct.ac.za
Stephanie Plön	Stephanie@bayworld.co.za
Andrea Plos	Andrea.Plos@uct.ac.za
Raymond Pollard	raymond.pollard@gmail.com
Nitesh Poon	9606447@ukzn.ac.za
Francesca Porri	f.porri@ru.ac.za
Jone Porter	jporter@seaworld.org.za
Sean Porter	caranx@polka.co.za
Michelle Potgieter	mpotgieter@deat.gov.za
Warren Potts	w.potts@ru.ac.za
Penny Price	penny@saeon.ac.za
Kim Prochazka	kimpro@deat.gov.za
Fouad Abdou Rabi	fouad.abdourabi@yahoo.fr
Rebecca Rademeyer	Rebecca.Rademeyer@uct.ac.za
Stephanie Rainier	srainier@mweb.co.za
Anusha Rajkaran	Anusha.Rajkaran@nmmu.ac.za
Elijah Ramulifho	elijahr@deat.gov.za
Cecile Reed	Cecile.Reed@uct.ac.za
Nicole Richoux	N.Richoux@ru.ac.za

Michael Roberts	squid@metroweb.co.za
Lisl Robertson	lisl.robertson@uct.ac.za
James Robey	g08r5620@campus.ru.ac.za
Tamara Robinson	trobins@botzoo.uct.ac.za
Raymond Roman	Raymond.Roman@uct.ac.za
Mark Rothman	mark.rothman@uct.ac.za
Mathieu Rouault	Mathieu.Rouault@uct.ac.za
Maryanne Roux	s204008956@nmmu.ac.za
Toufiek Samaai	Tsamaai@deat.gov.za
Warwick Sauer	w.sauer@ru.ac.za
Ursula Scharler	scharler@ukzn.ac.za
Michael Schleyer	schleyer@ori.org.za
Gerhard Scholtz	kgws@imt.co.za
Oliver Schultz	scholi005@uct.ac.za
Mdudzi Seakamela	smseakamela@deat.gov.za
Heather Sessions	heather@deat.gov.za
Lynne Shannon	lshannon@deat.gov.za
Jill Sheppard	g04s2451@campus.ru.ac.za
John Sherwood	jsher@deakin.edu.au
Frank Shillington	frank.shillington@uct.ac.za
Diina Shuuluka	shldii001@uct.ac.za
Carol Simon	csimon@sun.ac.za
Larvika Singh	larks13@gmail.com
Sarika Singh	sasingh@deat.gov.za
Bonisiwe Sithole	bsithole@deat.gov.za
Michelle Slabber	kittycash@mighty.co.za
Malcolm Smale	msmale@bayworld.co.za
Albertus Smit	smitaj@ukzn.ac.za
Nicholas Smit	nicos@uj.ac.za
Alan Smith	asconsulting@telkomsa.net
Daniel Smith	dsmith@ori.org.za
Gilly Smith	Gilly.Smith@uct.ac.za
Kyle Smith	kyles@sanparks.org
Marie Smith	smith_chiq@yahoo.com
Michael Smith	smtmic028@uct.ac.za
Tamsin Smith	t.h.e.smith@ncl.ac.uk
Gavin Snow	190152310@nmmu.ac.za
Yolanda Snyders	ysnyders@deat.gov.za
Sobahle Somhlaba	ssomhlaba@deat.gov.za
Martinus Sonnekus	tsonnekus@gmail.com
Sandisiwe Sono	sandisiwe.sono@uct.ac.za
Conrad Sparks	sparksc@cput.ac.za
Jessica Sterley	g03s0290@campus.ru.ac.za
Lieze Swart	LSwart@deat.gov.za
Neil Swart	neil.swart@uct.ac.za
Neville Sweijd	nsweijd@csir.co.za
Thivhakoni Swethane	aswethane@deat.gov.za
Susan Taljaard	STaljaard@CSIR.co.za
Laura Tang	puravidalaurat@gmail.com
Bronwyn Tarr	fishiggle@gmail.com
Rob Tarr	rtarr@deat.gov.za

Anja Terörde	anjater@yahoo.de
Sandy Thomalla	sandy_thomalla@yahoo.com
Meredith Thornton	thornton@iziko.org.za
Nompumelelo Thwala	npumisz@yahoo.co.uk
Mutshutshu Tsanwani	mtsanwani@deat.gov.za
Jenny Tuček	jtucek@freenet.de
Jane Turpie	jane.turpie@uct.ac.za
Nandipha Twatwa	Natwatwa@deat.gov.za
Gavin Tweddle	g.tweddle@ru.ac.za
Ulrich van Bloemestein	uvanbloemestein@uwc.ac.za
Megan van der Bank	2401402@uwc.ac.za
Carl van der Lingen	vdlingen@deat.gov.za
Elizabeth van der Merwe	2538521@uwc.ac.za
Johan van der Molen	jvdmolen@csir.co.za
Lara van Niekerk	lvnieker@csir.co.za
David Vaughan	dvaughan@aquarium.co.za
Jennifer Veitch	veitch@ocean.uct.ac.za
Kanyisile Vena	kvena@deat.gov.za
Ilke Vermeulen	g08v6668@campus.ru.ac.za
Niall Vine	n.vine@ru.ac.za
Carmen Visser	sancor@deat.gov.za
Leon Vivier	lvivier@pan.uzulu.ac.za
Sophie von der Heyden	svdh@Sun.ac.za
Charles von der Meden	g04v5287@campus.ru.ac.za
David Vousden	d.vousden@ru.ac.za
Carl Wainman	ckw@imt.co.za
Howard Waldron	howard.waldron@uct.ac.za
Ryan Wasserman	s207073904@nmmu.ac.za
Peter Watt-Pringle	g99w1018@campus.ru.ac.za
Julia Wentworth	s205032494@nmmu.ac.za
Victor Wepener	victorw@uj.ac.za
Grea Wessels	grea.wessels@gmail.com
Mariëtte Wheeler	mariettewheeler@yahoo.com
Alan Whitfield	a.whitfield@ru.ac.za
Margit Wilhelm	margit.wilhelm@uct.ac.za
Chris Wilke	cwilke@deat.gov.za
Gwyneth Wilson	gwynwilson3@hotmail.com
Lindsey Woolley	lindseyw@vodamail.co.za
Eleanor Yeld	Eleanor.Yeld@uct.ac.za
Dawit Yemane	DawitYemane@gmail.com

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