Chapman Conference on Long Time-Series Observations in Coastal Ecosystems: Comparative Analyses of Phytoplankton Dynamics on Regional to Global Scales

Hotel Eden • Rovinj, Croatia
8-12 October 2007

Chapman Conference on Long Time-Series Observations in Coastal Ecosystems: Comparative Analyses of Phytoplankton Dynamics on Regional to Global Scales
Hotel Eden ● Rovinj, Croatia
8-12 October 2007

Conveners

- James E. Cloern, United States Geological Survey (U.S.)
- Nenad Smodlaka, Rudjer Boskovic Institute, Center for Marine Research (Croatia)

Program Committee

- Susan I. Blackburn, CSIRO Marine and Atmospheric Research (Australia)
- Daniel Conley, GeoBiosphere Science Center, Lund University (Sweden)
- Paul Harrison, Hong Kong University of Science and Technology (Hong Kong)
- Thomas C. Malone, OceanUS Office for Integrated and Sustained Ocean Observations (U.S.)
- Hans Paerl, Institute of Marine Sciences, University of North Carolina at Chapel Hill (U.S.)
- Trevor Platt, Bedford Institute of Oceanography (Canada)
- Ted Smayda, Graduate School of Oceanography, University of Rhode Island (U.S.)
- Victor Smetacek, Alfred Wegner Institute of Marine & Polar Research (Germany)
- Adriana Zingone, Stazione Zoologica 'A. Dohrn' (Italy)

Conference Cosponsors

- United States Geological Survey
- National Science Foundation
- Marine Biodiversity and Ecosystem Functioning, EU Network of Excellence
- Rudjer Boskovic Institute, Center for Marine Research
- Maistra, Rovinj, Croatia
- EUROCEANS EU Network of Excellence

♦ MEETING AT A GLANCE

Sunday, 7 October 2007

16:00 – 18:00 Registration and Poster Setup

18:00 – 20:00 Ice Breaker and Poster Viewing *(open to conference participants & registered guests)*

Monday, 8 October 2007

7:00 – 18:00 Registration
8:00 – 8:30 Conference Opening
8:30 – 9:00 Conference Synopsis
9:00 – 10:00 Plenary Session
10:00 – 10:30 Refreshment Break
10:30 – 12:30 Plenary Sessions
12:30 – 14:00 Lunch
14:00 – 16:00 Plenary Sessions
16:00 – 16:30 Refreshment Break
16:30 – 17:00 Plenary Session
17:00 – 18:00 Breakout Sessions

Tuesday, 9 October 2007

9:00 – 10:00 Plenary Session
10:00 – 11:00 Break out Sessions
11:00 – 11:30 Refreshment Break
11:30 – 12:30 Breakout Sessions
12:30 – 14:00 Lunch
14:00 – 15:30 Breakout Sessions
15:30 – 16:00 Refreshment Break
16:00 – 17:00 Breakout Sessions
17:00 – 18:00 Plenary Session

Wednesday, 10 October 2007

9:00 – 10:00 Plenary Session
10:00 – 10:15 Review of Afternoon Activities
10:15 – 10:30 Refreshment Break
10:30 – 12:30 Breakout Sessions
12:30 – 14:00 Lunch
14:00 Field Trip and Conference Dinner *(open to conference participants & registered guests)*

Thursday, 11 October 2007

9:00 – 10:00 Plenary Session
10:00 – 11:00 Breakout Sessions
11:00 – 11:30 Refreshment Break
11:30 – 12:30 Breakout Sessions
12:30 – 14:00 Lunch
14:00 – 15:30 Breakout Sessions
15:30 – 16:00 Refreshment Break
16:00 – 17:00 Breakout Sessions

Friday, 12 October 2007

8:30 – 10:00 Plenary Session
10:00 – 10:30 Refreshment Break
10:30 – 12:00 Plenary Session
12:00 – 13:30 Lunch
13:30 – 15:40 Plenary Sessions
15:40 – 16:10 Refreshment Break
16:10 – 17:30 Plenary Sessions
17:30 – 18:00 Conference Closing

SCIENTIFIC PROGRAM

SUNDAY, 7 OCTOBER 2007

Note: Registration will be available 16:00 – 18:00.

18:00 – 20:00 *Ice Breaker and Poster Viewing to be held in Conference Hall Foyer. Events are open to conference participants and registered guests)*

MONDAY, 8 OCTOBER 2007

Note: Registration will be available 7:00 – 18:00.

8:00 – 8:30 CONFERENCE OPENING LOCATION: ISTRA

INTRODUCTIONS, ANNOUNCEMENTS AND LOGISTICS
NENAD SMODLAKA: MODERATOR

8:30 – 9:00 **James E. Cloern** *Conference purpose, objectives, guiding questions and approach*

9:00 – 10:00 **Jacco C. Kromkamp,** *(INVITED) Phytoplankton Primary Production in the Western and Eastern Scheldt Estuaries During the Period 1990-2006: did Changes Occur?*

10:00 Refreshment Break 10:30

10:30 – 11:30 **Jacob Carstensen,** *(INVITED) Effects of a Large-Scale Eutrophication and Oligotrophication Experiment on Phytoplankton Biomass, Blooms and Composition in Danish Waters*

11:30 – 12:30 **Elgin S. Perry,** *(INVITED) A Cross-Sectional Time Series Analysis of Surface Chlorophyll a in Chesapeake Bay*

12:30 Lunch 14:00

JAMES E. CLOERN: MODERATOR LOCATION: ISTRA

14:00 – 15:00 **C. J. M. Philippart,** *(INVITED) Impacts of Nutrient Enrichment and Reduction on Coastal Communities: What Goes up Must Come Down?*

15:00 – 16:00 **Karen Wiltshire,** *(INVITED) Top Down and Bottom up Control of North Sea Phytoplankton Blooms: an Analyses in Conjunction With Warmer Waters*

16:00 Refreshment Break 16:30

16:30 – 17:00 **Thomas C. Malone,** *Guidance and charge to Working Groups*

17:00 – 18:00 *Working groups meet to begin organizing future breakout sessions*

- Working Group 1 Location: Ulika
- Working Group 2 Location: Ladonja
- Working Group 3 Location: Istra

TUESDAY, 9 OCTOBER 2007

SUSAN I. BLACKBURN: MODERATOR LOCATION: ISTRA

9:00 – 10:00 **Trevor Platt,** *(INVITED) Time Series of Phytoplankton from Remote Sensing*

10:00 – 11:00 Breakout Session: Working Group 1 Location: Ulika

Chair: Susan I. Blackburn
Synthesizers: James E. Cloern (lead) and Thomas C. Malone
Analyst: Elgin S. Perry
Rapporteur: Cary B. Lopez

What are the dominant scales of variability in phytoplankton biomass, abundance, floristic composition, species composition, and/or species diversity? Is there evidence for secular trends or regime shifts? With which criteria can we best differentiate long-term signals from interannual noise?

10:00 – 11:00 Breakout Session: Working Group 2 Location: Ladonja

Chair: Hans Paerl
Synthesizers: Trevor Platt, Daniel Conley and Nenad Smodlaka
Analyst: Jacob Carstensen
Rapporteur: Jonathan H. Sharp

Is there evidence for external forcings of variability and change (e.g., effects of climate change, basin scale oscillations, land-based inputs, atmospheric deposition, alien species)? Are changes coherent in space and/or time?

10:00 – 11:00 Breakout Session: Working Group 3 Location: Istra

Chair: Paul Harrison
Synthesizers: Ted Smayda (lead), Victor Smetacek, Adriana Zingone
Analysts: Laurent Dubroca and Michele Scardi
Rapporteur: TBA

Are there consistent patterns among ecosystems in terms of relationships between environmental parameters, phytoplankton biomass and changes in species/floristic composition?

11:00 Refreshment Break 11:30

11:30 – 12:30 *Working groups continue meeting in breakouts*

12:30 Lunch 14:00

14:00 – 15:30 *Working groups continue meeting in breakouts*

15:30 Refreshment Break 16:00

16:00 – 17:00 *Working groups continue meeting in breakouts*

17:00 – 18:00 **Susan I. Blackburn,** *Reports of Working Group Chairs (progress, problems, next steps)*

WEDNESDAY, 10 OCTOBER 2007

ADRIANA ZINGONE: MODERATOR LOCATION: ISTRA

9:00 – 10:00 **Marina Montresor,** *(INVITED) Interpreting Phytoplankton Variations Through the Life Cycle Perspective*

10:00 – 10:15 **Nenad Smodlaka,** *Review of logistics for afternoon and evening events*

10:15 Refreshment Break 10:30

10:30 – 12:30 *Working groups meet in breakouts*

12:30 Lunch 14:00

14:00 *Field Trip and Conference Dinner. Events are open to conference participants and registered guests)*

THURSDAY, 11 OCTOBER 2007

PAUL HARRISON: MODERATOR LOCATION: ISTRA

9:00 – 10:00 **Kedong Yin,** *(INVITED) Dynamics of Phytoplankton Species Composition in the Pearl River Estuarine and Coastal Waters During 1991-2004*

10:00 – 11:00 *Working groups continue meeting in breakouts*

11:00 Refreshment Break 11:30

11:30 – 12:30 *Working groups continue meeting in breakouts*

12:30 **Lunch** **14:00**

14:00 – 15:30 *Working groups continue meeting in breakouts*

15:30 **Refreshment Break** **16:00**

16:00 – 17:00 *Working groups continue meeting in breakouts*

FRIDAY, 12 OCTOBER 2007

DANIEL CONLEY: MODERATOR **LOCATION: ISTRA**

8:30 – 10:00 **Ted Smayda (with Paul Harrison),** *Final Report of Working Group 3, including major findings, rules validated with comparative analyses, new emerging rules and knowledge gaps (45 minute presentation followed by a 45-min discussion)*

10:00 **Refreshment Break** **10:30**

10:30 – 12:00 **Hans Pearl (with Nenad Smodlaka),** *Final Report of Working Group 2*

12:00 **Lunch** **13:30**

TREVOR PLATT: MODERATOR **LOCATION: ISTRA**

13:30 – 15:00 **James E. Cloern (with Susan I. Blackburn),** *Final Report of Working Group 1*

15:00 – 15:20 **Adriana Zingone,** *(INVITED) Perspective on Emerging Rules of Coastal Phytoplankton Dynamics – Synthesis to Guide Coastal Research*

15:20 – 15:40 **Tom Malone,** *(INVITED) Perspective on Emerging Rules of Coastal Phytoplankton Dynamics – Synthesis to Guide Management of Coastal Ecosystems and Design of Coastal Observing Systems*

15:40 **Refreshment Break** **16:10**

16:10 – 17:00 **Paul Harrison,** *Open discussion on publication of conference results*

17:00 – 17:30 **Victor Smetacek,** *(INVITED) Perspective on Challenges to Biological Oceanographers in the 21st Century*

17:30 – 18:00 **Nenad Smodlaka,** *Conference Closing*

WORKING GROUP ASSIGNMENTS

Participants who have not yet been assigned a Working Group, will be able to do so during the conference.

WORKING GROUP 1

Name	Country	Ecosystem	Series
Paulo C. Abreu	Brazil	Patos Lagoon Estuary	1986-1990, 1993-2007
Susan I. Blackburn	Australia	Huon Estuary, Tasmania	1996-2005
H. O. Briceño	U.S.	Biscayne Bay, Florida Bay, Florida Shelf	1989-2007
Francisco.P. Chavez	U.S.	Monterey Bay	1988-2007
James E. Cloern	U.S.	North & South San Francisco Bay	1969-2007
Valerie David	France	Gironde Estuary	1978-2003
Svein Rune Erga	Norway		
S. Fonda Umani	Italy	Gulf of Trieste	1986-2005
Miles Furnas	Australia	Great Barrier Reef Lagoon	1992-2007
S.A. Gaeta	Brazil	Brazil Coastal Waters	2004-2007
Charles L. Gallegos	U.S.	Rhode River Estuary	1969-2007
Amatzia Genin	Israel	N Gulf of Aqaba	1988-2007
Rita A. Horner	U.S.	Washington Coast	1997-2007
Arantza Iriarte	Spain	Bilbao & Urdaibai . Estuary	1997-2007
Jacco C. Kromkamp	The Netherlands	Oosterschelde/Westerschelde	1987-2006
Robert Le Borgne	France	Ivory Coast, New Caledonia	1969-1979, 1979-1989
WKW Li	Canada	Bedford Basin	1967-2007
Michael W. Lomas	U.S.	Bermuda Atlantic Series	1989-2007
Cary B. Lopez	U.S.		
Thomas Malone	U.S.		

Emma Orive	Spain	Nervion River Estuary	2000-2006
Elgin S. Perry	U.S	Chesapeake Bay	1985-2004
N. Ramaiah	India	Bay of Bengal	1962-1965, 2001-2006
Diana Sarno	Italy	Gulf of Naples	1984-1991, 1995-2008
Dietmar Straile	Germany	Lake Constance	1980-2006
Sanna Suikkanen	Finland	Northern Baltic Sea	1979-2003
Alexander Vershinin	Russia	NE Black Sea	2001-2006
Hidekatsu Yamazaki	Japan	Tokyo Bay	1996-2006

WORKING GROUP 2

Name	Country	Ecosystem	Series
Ana B. Barbosa	Portugal	Ria Formasa Lagoon	1991-1993
Vanda Brotas	Portugal	Tagus Estuary	1999-2007
Rita B Domingues	Portugal	Guadiana River Estuary	1999-2005
Naomi Greenwood	U.K.	Liverpool Bay	1989-2006
Malcolm S. Robb	Australia	Swan Canning Estuary	
Bradley Eyre	Australia	Moreton Bay & Brunswick Estuary	1984-1991; 1995-2007
David G. Borkman	U.S.	Narragansett Bay	1959-1997; 1999-2006
Jonathan H. Sharp	U.S.	Delaware Bay	1980-2003; 1950s – present
Larry W. Harding, Jr.	U.S.	Chesapeake Bay	1989-2007
Hans W. Paerl	U.S.	Neuse River-Pamlico Sound	1993-2006
Clarisse Odebrecht	Brazil	Patos Lagoon Estuary, Cassino Beach	1987, 1989-1990, 1992-2006
M Ribera d'Alcalà	Italy	Gulf of Naples	1979-2006

Alina Tunin-Ley	France	Ligurian & Tyrrhenian Seas	1908-1914, 1915, 1929-1931, 1969-1970, 1984, 1988, 2002-2005
Nenad Smodlaka	Croatia		1987-2007
Jacob Carstensen	Denmark	Kattegat	1993-2007
Daniel Conley	Sweden		
Hans Christian Eilertsen	Norway	Norwegian Coast/Barents Sea	1974-2007
Karen Helen Wiltshire	Germany	North Sea Helogland	10 years
Xavier Desmit	The Netherlands	North Sea	1975-2003 ; 1990-2006 (Phyto)
Martina Loebl	Germany	Belgian, Dutch, German Coastal	1990-2005
C J M Philippart	The Netherlands	Wadden Sea	1995-2004
Jennifer L. Martin	Canada	Bay of Fundy	1980-2007
Michael L. Parsons	U.S.	N Gulf of Mexico	
Trevor Platt	Canada	NW Atlantic, remote sensing	1990-2005

WORKING GROUP 3

Name	Country	Ecosystem	Series
Malcolm C. Baptie	U.K.	North Sea, UK NE coast	1969-2007
Mauro Bastianini	U.K.	Gulf of Venice	1986-2007
Suncica Bosak	Croatia	N Adriatic Sea	1998-2006
Eileen Bresnan	Scotland	NE Scotland Coastal	1997-2007
Maria Degerlund	Norway	Norwegian coast/Barents Sea	
Laurent Dubroca	France		
R. H. Freije	Argentina	Bahía Blanca Estuary	1978-2006
Paul Harrison	Hong Kong		
Inga Hense	Germany	Baltic Sea	1975-2006

Carlton D. Hunt	U.S.	Boston Harbor, Cape Cod Bay, Massachusetts Bay	1992-2008
Tapan Kumar Jana	India	Sundarban Mangrove Forest	1988-2001
R. Kraus	Croatia	Northern Adriatic	1972-2006
Dongyan Liu	China	Jiaozhou Bay	
A. Lincoln MacKenzie	New Zealand	Marlborough Sound, Tasman & Golden Bays	1993-2007
Ivona Marasović	Croatia	Northern Adriatic	1962-1982
Snejana P. Moncheva	Bulgaria	Black Sea	1954-2003
Marina Montresor	Italy		
Patricija Mozetic	Slovenia	Gulf of Trieste	1984-2006
Tatyana Osadchaya	Ukraine	Black Sea	1998
Edward J. Phlips	U.S.	Indian River Lagoon	1997-2007
Igor G Polikarpov	Ukraine	Sevastopol Bay	1937-1938, 1960-1968, 2001-2007
M. Scardi	Italy		
Kevin G. Sellner	U.S.	Chesapeake Bay	1984-2007
Ted Smayda	U.S.	Narragansett Bay	1974-2007
Victor Smetacek	Germany		
Cosimo Solidoro	Italy	Northern Adriatic	
Kuninao Tada	Japan	Seto Inland Sea	1991-2006, 1973-2005
Luke J. Twomey	Australia	Swan Canning Estuary	
Norbert Wasmund	Germany	Baltic Sea, Mecklenburg Bight	1979-2006
Kedong YIN	Hong Kong	Hong Kong Coastal	1991-2004
A. Zingone	Italy	Gulf of Naples	1984-1991, 1995-2009

POSTER SESSIONS

All posters will be on display in the Conference Hall Foyer for the duration of the conference. Note: Posters are listed below in alphabetical order by last name of First Author; each listing begins with Poster Number.

B01 M. C. Baptie, J. E. Delany, *Phytoplankton Population Dynamics off the Northumberland Coast, UK: The Dove Time Series*

B02 A. B. Barbosa, *Seasonal Dynamics of Phytoplankton Specific in Situ Growth and Microzooplankton Grazing Rates in a Temperate Coastal Lagoon (Ria Formosa, South-East Portugal)*

B03 M. Bastianini, F. Acri, F. Bianchi, A. M. Bazzoni, F. B. Aubry, A. Pugnetti, G. Socal, *Phytoplankton Seasonal Patterns From Pluriannual Time Series in a Highly Variable Coastal Ecosystem: the Northern Adriatic Sea Case*

B04 S. Bosak, Z. Burić, D. Viličić, *Temporal Distribution of Phytoplankton at One Station in the Northern Adriatic Sea*

D01 R. B. Domingues, A. Barbosa, H. Galvão, *Phytoplankton Succession in a Dam Regulated Temperate Estuary (the Guadiana, South-East Portugal)*

F01 C. C. Fujita, C. Odebrecht, P. C. Abreu, *Long Term Variability of Chlorophyll a and Abiotic Factors in the Patos Lagoon Estuary and Adjacent Coastal Zone (1993-2006); Lagoon Estuary and Adjacent Coastal Zone (1993-2006)*

G01 S.A. Gaeta, M. Kampel, M Pompeu, GP Ortiz, *Phytoplankton and Biooptical Properties Time Series in the Coastal Ecosystem of Southeast Brazil*

G02 N. Greenwood, V. Creach, S. J. Cutchey, D. J. Mills, R.M. Forster, *Phytoplankton Bloom Dynamics in Liverpool Bay*

H01 R. A. Horner, N. G. Adams, J R Postel, V L Trainer, *Phytoplankton and Environmental Monitoring on the Pacific Coast of Washington, USA*

I01 A. Iriarte, F. Villate, G. Aravena, I. Uriarte, *The North Atlantic Oscillation and Chlorophyll a in Two Estuaries of the Basque Coast, Bay of Biscay (1997-2006)*

L01 D. Liu, J. Sun, J. Zhang, G. Liu, *Response of Diatom Flora on the Long-term Environmental Change in Jiaozhou Bay, China During the Last Century as Evidenced in a Sediment Core*

O01 E. Orive, A Butrón, A. Laza, I. Madariaga, S. Seoane, *Seasonal Dynamics of Phytoplankton Biomass and Taxonomic Composition in the Nervion River Estuary*

O02 T. Osadchaya, I. V. Sycoeva , A. A. Sysoev, *Characteristic of Size Structure and Functioning Peculiarities of Coastal Area Phytoplankton on Chlorophyll "a" and ATP Measurements (Black Sea)*

S01 C. Solidoro, V. Bandelj, M. Cabrini, G. Cossarini, M. Bastianini, F. Bernardi-Aubry, G. Socal, S. Fonda Umani, *Plankton Dynamic in Coastal Area of Northern Adriatic Sea*

V01 A. Vershinin, V. Akatov, S. Pankov, *Phytoplankton in NE Black Sea Coastal Waters: Annual Succession, Community Structure, Species Diversity, Interanual Changes in 2001-2006*

PARTICIPANT LIST

Paulo Cesar Abreu
Federal University of Rio Grande - FURG (Brazil)
Phone: 51.52.3233.6509
E-Mail: docpca@furg.br

Malcolm Baptie
Dove Marine Laboratory (United Kingdom)
Phone: 44.0.1912524850 ext 115
E-Mail: malcolm.baptie@ncl.ac.uk

Ana Barbosa
CIMA-Centre for Marine and Environmental Research, University of Algarve, Campus de Gambelas (Portugal)
Phone: 351.289.800.900 ext. 7353
E-Mail: abarbosa@ualg.pt

Mauro Bastianini
ISMAR CNR Istituto Scienze Marine (Italy)
Phone: 39.041.2404711
E-Mail: mauro.bastianini@ismar.cnr.it

Susan Blackburn
CSIRO Marine and Atmospheric Research (Australia)
Phone: 61.3.62325307
E-Mail: susan.blackburn@csiro.au

David Borkman
Graduate School of Oceanography, University of Rhode Island (USA)
Phone: 401.874.6686
E-Mail: dborkman@gso.uri.edu

Sunčica Bosak
University of Zagreb, Division of Biology (Croatia)
Phone: 3851.487.77.45
E-Mail: sbosak@biol.pmf.hr

Eileen Bresnan
Fisheries Research Services Laboratory (FRS) (Scotland)
Phone: 1224.876544
E-Mail: e.bresnan@marlab.ac.uk

Henry O. Briceño
Florida International University (USA)
Phone: 305.348.1269
E-Mail: bricenoh@fiu.edu

Vanda Brotas
Inst. Oceanografia, FCUL (Portugal)
Phone: 351217500156
E-Mail: vbrotas@fc.ul.pt

Zrinka Burić
University of Zagreb, Division of Biology (Croatia)
Phone: 3851.487.77.16
E-Mail: zburic@biol.pmf.hr

Jacob Carstensen
National Environmental Research Institute, Univ. of Aarhus (Denmark)
Phone: 45.46301345
E-Mail: jac@dmu.dk

Francisco Chavez
MBARI (USA)
Phone: 831.775.1709
E-Mail: chfr@mbari.org

James E. Cloern
U.S. Geological Survey (USA)
Phone: 650.329.4594
E-Mail: jecloern@usgs.gov

Daniel Conley
Geobiosphere Science Centre, Lund University (Sweden)
Phone: 46462220449
E-Mail: daniel.conley@geol.lu.se

Caroline Cusack
Marine Institute (Ireland) (Ireland)
Phone: 353.0.91.387200
E-Mail: caroline.cusack@marine.ie

Maurizio Ribera d'Alcalà
Stazione Zoologica 'A. Dohrn' (Italy)
Phone: 39 081 5833245
E-Mail: maurizio@szn.it

Maria Degerlund
Dept. of Aquatic Biosciences, Norwegian College of Fishery Science, University of Tromsø (Norway)
Phone: 47.77646871
E-Mail: maria.degerlund@nfh.uit.no

Xavier Desmit
Water Quality and Ecology, WL | Delft Hydraulics (De Nederland)
Phone: 31.15.285.84.63
E-Mail: xavier.desmit@wldelft.nl

Rita B. Domingues
CIMA-Centre for Marine and Environmental Research, University of Algarve, Campus de Gambelas (Portugal)
Phone: 351.289.800.900 ext. 7373
E-Mail: rbdomingues@ualg.pt

Laurent Dubroca
Stazione Zoologica 'A. Dohrn' (80121)
Phone: 39.081.5833245
E-Mail: maurizio@szn.it

Hans Chr. Eilertsen
Norwegian College of Fishery Science, University of Tromsø (Norway)
Phone: 47.77644540
E-Mail: hans@phaeocystis.com

Svein Rune Erga
University of Bergen, Department of Biology (Norway)
Phone: 47.55582679
E-Mail: svein.erga@bio.uib.no

Bradley Eyre
Southern Cross University (Australia)
Phone: 61.2.66203773
E-Mail: bradley.eyre@scu.edu.au

Janja France
Marine Biology Station, National Institute of Biology (Slovenia)
Phone: 386.31.819.115
E-Mail: france@mbss.org

Rubén Hugo Freije
Lab. Química Ambiental, Universidad Nacional del Sur (Argentina)
Phone: 54.291.4565063
E-Mail: qmfreije@criba.edu.ar

Miles J. Furnas
Australian Institute of Marine Science (Australia)
Phone: 61.747.534323
E-Mail: m.furnas@aims.gov.au

Charles L. Gallegos
Smithsonian Environmental Research Center (USA)
Phone: 443.482.2240
E-Mail: gallegosc@si.edu

Helena Galvão
CIMA-Centre for Marine and Environmental Research, University of Algarve, Campus de Gambelas (Portugal)
Phone: 351.289.800.900 ext. 7380
E-Mail: hgalvao@ualg.pt

Carla Lapa Gameiro
Institute of Oceanography, Faculty of Sciences, University of Lisbon (FCUL) (Portugal)
Phone: 351.96.670.33.63
E-Mail: clgameiro@fc.ul.pt

Amatzia Genin
The Hebrew University and the Interuniversity Institute for Marine Sciences (Israel)
Phone: 972.8.6360124
E-Mail: amatzia@vms.huji.ac.il

Zivana Ninčević Gladan
Institute of Oceanography and Fisheries (Croatia)
Phone: 385.21.408015
E-Mail: nincevic@izor.hr

Naomi Greenwood
Cefas, Lowestoft Laboratory (England)
Phone: 44.1.1502.524547
E-Mail: naomi.greenwood@cefas.co.uk

Lawrence W. Harding, Jr.
Horn Point Laboratory, University of Maryland Center for Environmental Science (USA)
Phone: 410.221.8247
E-Mail: larry@hpl.umces.edu

Paul J. Harrison
AMCE Program, Hong Kong Univeristy of Science & Technology (China)
Phone: 852.2358.7348
E-Mail: harrison@ust.hk

Inga Hense
Baltic Sea Research Institute (IOW) (Germany)
Phone: 49.381.5197.263
E-Mail: inga.hense@io-warnemuende.de

Carlton D. Hunt
Battelle (USA)
Phone: 781.952.5374
E-Mail: Huntc@Battelle.org

Arantza Iriarte
University of the Basque Country (Spain)
Phone: 34.946015299
E-Mail: arantza.iriarte@ehu.es

Tapan Kumar Jana
University of Calcutta, Department of Marine Science (India)
Phone: 9433859588
E-Mail: tkjana@hotmail.com

Romina Kraus
Rudjer Boskovic Institute, Center for Marine Research (Croatia)
Phone: 00.385.52.804.746
E-Mail: kraus@cim.irb.hr

Jacco C. Kromkamp
Netherlands Institute of Ecology, Centre for Estuarine and Marine Ecology (NIOO-CEME) (The Netherlands)
Phone: 31.0113.577481
E-Mail: j.kromkamp@nioo.knaw.nl

Robert Le Borgne
Centre IRD de Noumea (France)
Phone: 687.26.07.86
E-Mail: leborgne@noumea.ird.nc

William Li
Bedford Institute of Oceanography (Canada)
Phone: 902.426.6349
E-Mail: LiB@mar.dfo-mpo.gc.ca

Marina Loebl
GKSS Forschungszentrum Geesthacht GmbH (Gemany)
Phone: 49.4651.956157
E-Mail: Martina.Loebl@awi.de

Cary Lopez
NOAA (USA)
Phone: 301.713.3338 ext. 170
E-Mail: cary.lopez@noaa.gov

Thomas C. Malone
Ocean.US: National Office for Integrated and Sustained Ocean Observations (USA)
Phone: 410.476.3732
E-Mail: t.malone@ocean.us

Ivona Marasović
Institute of Oceanography and Fisheries (Croatia)
Phone: 00385.21408002
E-Mail: marasovic@izor.hr

Jennifer Martin
Fisheries and Oceans Canada (Canada)
Phone: 506.529.5921
E-Mail: MartinJL@mar.dfo-mpo.gc.ca

Snejana Moncheva
Institute of Oceanology, BAS (Bulgaria)
Phone: 00359.52.370485
E-Mail: snejanam@abv.bg

Marina Montresor
Stazione Zoologica 'A. Dohrn' (Italy)
Phone: 39.081.5833259
E-Mail: mmontr@szn.it

Patricija Mozetic
National Instituteof Biology (Slovenia)
Phone: 386.5.6712914
E-Mail: mozetic@mbss.org

Clarisse Odebrecht
Dept of Oceanography, Fed Univ of Rio Grande-FURG (Brazil)
Phone: 55.53.3233.6520
E-Mail: doclar@furg.br

Emma Orive
Universidad Pais Vasco (Spain)
Phone: 946012570
E-Mail: emma.orive@ehu.es

Hans W. Paerl
University of North Carolina, Institute of Marine Sciences (USA)
Phone: 252.726.6841 ext. 133
E-Mail: hpaerl@email.unc.edu

Michael L. Parsons
Florida Gulf Coast University (USA)
Phone: 239.590.7526
E-Mail: mparsons@fgcu.edu

Elgin Perry
(USA)
Phone: 410.535.2949
E-Mail: eperry@chesapeake.net

C.J.M. Philippart
Royal Netherlands Institute for Sea Research (The Netherlands)
Phone: 31.222.369.563
E-Mail: katja@nioz.nl

Edward J. Phlips
Dept. Fisheries and Aquatic Sciences, Univ of Fla (USA)
Phone: 352.393.9617 ext. 248
E-Mail: phlips@ufl.edu

Trevor Platt
Bedford Institute of Oceanography (Canada)
Phone: 902.426.3793
E-Mail: tplatt@dal.ca

Malcolm Robb
Department of Water, Western Austrlaia (Australia)
Phone: 61.8.6364.7852
E-Mail: malcolm.robb@water.wa.gov.au

Diana Sarno
Stazione Zoologica A. Dohrn, Villa Comunale (Italy)
Phone: 39.081.5833282
E-Mail: diana@szn.it

Michele Scardi
Dept. of Biology, 'Tor Vegata' University, Via della Ricerca Scientifica (Italy)
Phone: 39.06.72595991
E-Mail: mscardi@mclink.it

Kevin Sellner
Chesapeake Research Consortium (USA)
Phone: 410.796.1286
E-Mail: sellerk@si.edu

Jonathan H. Sharp
College of Marine and Earth Studies, University of Delaware (USA)
Phone: 302.645.4259
E-Mail: jsharp@udel.edu

Theodore J. Smayda
University of Rhode Island, Graduate School of Oceanography (USA)
Phone: 401.874.6171
E-Mail: tsmayda@gso.uri.edu

Victor Smetacek
Alfred Wegener Institute for Polar and Marine Research (Germany)
Phone: 49.471.4831.1440
E-Mail: Victor.Smetacek@awi.de

Nenad Smodlaka
Rudjer Boskovic Institute, Center for Marine Research (Croatia)
Phone: 385.52.3804.701
E-Mail: smodlaka@cim.irb.hr

Cosimo Solidoro
OGS (Italy)
Phone: 39.040.2140315
E-Mail: csolidoro@inogs.it

Dietmar Straile
Limnological Institute, University of Konstanz (Germany)
Phone: 0049.7531.882969
E-Mail: dietmar.straile@uni-konstanz.de

Kuninao Tada
Kagawa University (Japan)
Phone: 81.87.894.5771
E-Mail: tada@ag.kagawa-u.ac.jp

Alina Tunin-Ley
Laboratoire d'Océanographie de Villefranche (LOV) (France)
Phone: 33.0.4.93.76.38.43
E-Mail: tunin@obs-vlfr.fr

Serena Fonda Umani
Department of Biology, University of Trieste (Italy)
Phone: 39.040.5582007
E-Mail: LABBIOMA@UNITS.IT

Norbert Wasmund
Baltic Sea Research Institute (Germany)
Phone: 49.381.5197212
E-Mail: norbert.wasmund@io-warnemuende.de

Karen Helen Wiltshire
Biologische Anstalt Helgoland, Alfred Wegener Institute (Germany)
Phone: 0049.4725.8193238
E-Mail: kwiltshire@awi-bremerhaven.de

Hidekatsu Yamazaki
Tokyo University of Marine Science and Technology (Japan)
Phone: 81.3.5463.0466
E-Mail: hide@kaiyodai.ac.jp

Kedong Yin
Australian Rivers Institute, Griffith University (Australia)
Phone: 61.7.3735.4256
E-Mail: k.yin@griffith.edu.au

Adriana Zingone
Stazione Zoologica A. Dohrn, Villa Communale (Italy)
Phone: 39.081.5833295
E-Mail: zingone@szn.it

ABSTRACTS

Scales of Variability of Phytoplankton Chlorophyll a in the Shallow Micro-tidal Patos Lagoon Estuary, Southern Brazil

Paulo C. Abreu [*Paulo C. Abreu*] (Department of Oceanography - Federal University of Rio Grande. Cx. P. 474. Rio Grande - RS, Brazil. 96201-900. Phone +55 53 3233 6509; Fax: +55 53 3233 6601; e-mail: docpca@furg.br); Marli Bergesch; Luis A. Proença and Clarisse Odebrecht

Chlorophyll a (Chl a) variability was studied at different time scales (hours to years) during 17 years in the shallow micro-tidal Patos Lagoon estuary, southern Brazil (32° 07¹ S - 52° 06¹ W). Tides in this system are of small amplitude (mean= 0.40 m), and hydrology is primarily driven by meteorological factors like wind, rainfall and evaporation. Hourly and daily Chl a variability were of minor importance, while a 7 to 10 days cycle represented the most significant Chl a short-term variability. This larger frequency is in accordance with the periodicity of atmospheric frontal system passage over the region (6 to 12 days). The intrusion of atmospheric frontal systems is characterized by the prevalence of Southerly winds, which increase the water residence time in the estuary, allowing the accumulation of phytoplankton biomass. Seasonal variation shows lowest Chl a values in winter months, due to limited light conditions. On the other hand, inter-annual comparisons of data set indicate that the amount of rainfall has direct influence on the level of annual mean Chl a. In this sense, large-scale Chl a variability would be related to the El Niño-Southern Oscillation (ENSO) climatic anomaly, which influences Southern Brazil rainfall levels and climate.

Phytoplankton Population Dynamics off the Northumberland Coast, UK: The Dove Time Series

Malcolm C. Baptie [*M C Baptie*] (Dove Marine Laboratory, Newcastle University, Front Street, Cullercoats, Tyne & Wear, UK, NE30 4PZ; ph. +44(0)1912524850 ext115; fax +44(0)1912521054; email: malcolm.baptie@ncl.ac.uk); J E Delany (Dove Marine Laboratory, Newcastle University, Front Street, Cullercoats, Tyne & Wear, UK, NE30 4PZ; ph. +44(0)1912524850 ext111; fax +44(0)1912521054; email: j.e.delany@ncl.ac.uk)

Newcastle University has conducted a monthly sampling schedule for phytoplankton and zooplankton since 1969 at a station 5.5 nautical miles off the Northumberland coast, UK: the Dove Time Series. As the station is located at a point close to the front where water masses from northern and southern origins meet, it represents an ideal point to study how phytoplankton react to changing influence of water from different sources in the central North Sea. Zooplankton abundance in the time series shows clear peaks in warm adapted species associated with the warm-temperate state of the North Atlantic in the late 1980s which was masked in local temperature and salinity readings, possibly by river input. Phytoplankton population dynamics are

now being analysed within the context of these zooplankton trends. The current project involves the identification of Dove Time Series phytoplankton and through comparison with local and basin scale climatic explanatory variables, detection of small persistent changes in phenology and abundance maxima associated with hydroclimatic change. Nutrient, chlorophyll and CTD data are being gathered alongside phytoplankton to establish present characteristics of the sea off Northumberland in the course of seasonal blooms.

Seasonal Dynamics of Phytoplankton Specific in Situ Growth and Microzooplankton Grazing Rates in a Temperate Coastal Lagoon (Ria Formosa, South-East Portugal)

Ana B. Barbosa [*A B Barbosa*] (CIMA – Centre for Marine and Environmental Research, University of Algarve, Campus de Gambelas, 8005-139 Faro, Portugal; ph. +351289800900; fax +351289800069; e-mail: abarbosa@ualg.pt).

Size structure, composition, abundance and biomass of phytoplankton were weekly evaluated inside the western sector of the Ria Formosa coastal lagoon (SE-Portugal) and at its interface with adjacent coastal waters along a seasonal cycle. Application of differential filtration, coupled with in situ incubations using diffusion chambers, allowed estimation of species specific growth rates and microzooplankton grazing rates. Under maximum coastal influence, phytoplankton exhibited a bimodal cycle with diatom biomass maxima during spring and late summer-autumn. This pattern was probably associated to resource variability induced by changes in water column mixing and upwelling events. Seasonal variability of Synechococcus evidenced the importance of grazing by aplastidic nanoflagellates, particularly during summer. Inside the lagoon, phytoplankton exhibited a unimodal seasonal cycle with biomass and in situ growth maxima during summer. Summer phytoplankton was dominated by eukaryotic picophytoplankton and diatoms whereas nanoplanktonic flagellates dominated biomass during spring, autumn, and winter. Phytoplankton community growth rates were apparently controlled by light and by temperature for higher light intensities, particularly in case of diatoms. During summer, the relative decrease of specific in situ growth rates compared to maximum potential growth rates probably reflected a nutrient growth limitation. However, diatoms showed no evidence of growth limitation due to nutrient availability. The reduced importance of diatoms during spring and autumn-winter was not related to a growth differential but most likely to a stronger grazer control. Despite the high density of bivalve grazers, the microzooplankton smaller than 100 µm, dominated by phagotrophic protists, represented the main removal process and removed, on a daily average, 44% of phytoplankton production. Average estimated impacts of tidal advection and grazing by planktonic and benthic metazoans were smaller. Microzooplankton grazing upon eukaryotic picophytoplankton and plastidic nanoflagellates was significantly higher and can, to a great extent, explain seasonal variability patterns. Synechococcus seasonal behaviour inside the lagoon mainly

reflected its passive importation from adjacent coastal area and in situ growth data points at a growth inhibiting factor, particularly during summer. Overall, this study illustrates the importance of different bottom-up and top-down processes in the seasonal regulation of specific phytoplankton taxa. Contrary to the pattern usually referred for other exposed and protected coastal systems, inside the Ria Formosa diatoms were less regulated by resources and more strongly regulated by grazing. In spite of strong microzooplankton grazing impact on both pico- and nanophytoplankton, these size classes evidenced a more intensively limited in situ growth rate, particularly during summer.

Phytoplankton Seasonal Patterns From Pluriannual Time Series in a Highly Variable Coastal Ecosystem: the Northern Adriatic Sea Case.

Mauro Bastianini [*Mauro Bastianini*] (C.N.R. – Istituto di Scienze Marine, Castello 1364/a, I-30122 Venice; ph. 0412404710; fax 0415204126; e-mail: mauro.bastianini@ismar.cnr.it);
Francesco Acri; Franco Bianchi; Anna Maria Bazzoni; Fabrizio Bernardi Aubry; Alessandra Pugnetti; Giorgio Socal.

The broad variability of marine environment conditions, occurring as a consequence of meteo-climatic forcing and anthropogenic pressure, might induce changes of the plankton community structure at a wide range of time scales. Phytoplankton appears very sensitive to climatic changes and could be used as a proxy of the variations occurring in the environment. The overall complexity of coastal ecosystems and the remarkable interannual variability of environmental factors, make multiannual series of data a powerful tool for a reliable reconstruction of the plankton seasonal cycles and of their driving factors.

The phytoplankton studies in the Northern Adriatic Sea (a shallow, eutrophic, coastal basin) started more than 20 years ago but, in the last 10 years, the investigations have become more intensive, both in space and time. The ecological monitoring activities carried out in this ecosystem permit, from one side, to define the short-term (monthly, seasonal) and interannual phytoplankton variability, and, from the other, to understand the time scales of the processes that control and modulate the variability of the hydrochemical features (temperature, salinity, nutrients) of the area.

A clear trend of increasing water temperature, related to the eastern Mediterranean climatic transient, has been evidenced in the whole Northern Adriatic basin, starting form the late eighties. The long-term studies on the phytoplankton allowed the elucidation of the seasonal pattern of biomass and the description of the seasonal variations of the prevalent phytoplankton species, so that a sort of “calendar of plankton” could be defined.

The availability of a wide array of ecological parameters and the joint efforts of different researchers and institutions working in this coastal ecosystem, entitled the Northern Adriatic Sea to enter the International Long Term Ecological Research network (ILTER) as a fundamental site for marine studies on long-term series.

Temporal Analysis of Phytoplankton in a Microtidal Estuary Experiencing Eutrophication and Climate Variability

Susan I. Blackburn P A Thompson, (CSIRO Marine and Atmospheric Research and the Aquafin CRC, GPO Box 1538, Hobart, 7001, Australia; ph 61-3-6232-5298; fax 61-3-6232-5000; email: peter.a.thompson@csiro.au); K. Wild-Allen; [*S. I. Blackburn*] (CSIRO Marine and Atmospheric Research and the Aquafin CRC, GPO Box 1538, Hobart, 7001, Australia; ph 61-3-6232-5307; fax 61-3-6232-5000; email: susan.blackburn@csiro.au.)

In the microtidal, salt-wedge Huon Estuary, Tasmania, Australia (43°S, 147°E) diatoms tend to be the dominant taxa in spring and dinoflagellates, including the toxic bloom-forming Gymnodinium catenatum, tend to dominate in summer and autumn. Spring blooms are smaller (~ 1 µg chlorophyll a L-1) and less persistent than summer and autumn blooms (~ 3 µg chlorophyll a L-1). Between 1996 and 2005 the mean annual chlorophyll a concentrations increased 60%, the overall peridinin:chlorophyll a ratio increased 100% and relative abundance of autotrophic spring dinoflagellates increased ~ 8 times. Simultaneously nitrogen inputs due to fish farming have risen by ~ 600 tonnes or a factor of 3. Time series analysis of a single coastal station over the period 1944 to 2005 indicates long term warming and an increase in spring time stratification intensity. The rise in absolute abundance of peridinin concentrations during spring from 1996 to 2004 in the Huon Estuary may represent earlier seeding of dinoflagellate blooms (either from within-estuary sources or offshore) and more favourable conditions for local growth. The heterotrophic dinoflagellate Noctiluca scintillans was absent in the Huon Estuary during extensive sampling from1996 to 1998 but has been persistently present since 2002. This arrival of N. scintillans at 43°S follows previous range extensions from 28°S to 34°S in the 1990s, and appears to be associated with warming of the Tasman Sea and strengthening of the East Australia Current between 1944 and 2005.

Climate and Long-term Changes in the Abundance and Annual Bloom Pattern of Skeletonema costatum (sensu lato) in Narragansett Bay (1959-1996)

David G. Borkman [*D G Borkman*] (Graduate School of Oceanography, University of Rhode Island, Narragansett, RI, USA, 02882; ph. 1-401-874-6686; fax: 1-401-874-6682; e-mail: dborkman@gso.uri.edu); T J Smayda ((Graduate School of Oceanography, University of Rhode Island, Narragansett, RI, USA, 02882; ph. 1-401-874-6171; fax: 1-401-874-6682; e-mail: tsmayda@gso.uri.edu)

A 38-year (1959 – 1996) time series based on weekly observations in lower Narragansett Bay (NBay) was analyzed to identify long-term abundance and seasonal pattern changes in the diatom Skeletonema costatum (sensu lato) and to identify drivers of these changes. Skeletonema was the dominant diatom in NBay, with its abundance explaining ca. 80% of the long-term variance in total diatom abundance. A ca. 45% decline in Skeletonema mean annual

abundance occurred, from 2,292 cells ml-1 (before 1974) to 1,263 cells ml-1 (1980 - 1996). Subsequent observations have indicated that Skeletonema abundance has remained at reduced levels of 1,000 – 1,500 cells ml-1 during 2000-2006. Winter-spring decreases were greatest; March abundance of Skeletonema declined from ca. 3,400 cells ml-1 prior to a 1977 change-point, to ca. 1,000 cells ml-1 after 1977. Three types of Skeletonema annual abundance patterns were found: winter-spring, summer, and autumn maxima. The frequency of winter-spring dominated annual cycles has decreased in the later portion of the time series.

Winter-spring Skeletonema bloom years tended to be bright, windy, cold, and had reduced first quarter zooplankton (Acartia hudsonica) abundance. Summer and fall Skeletonema bloom years were dark, warm, and had calm winds and elevated A. hudsonica abundance in the first quarter. Years in which the North Atlantic Oscillation Index (NAOI) was low had colder winter-water temperature and an annual cycle dominated by the winter-spring bloom. In elevated NAOI years (1980s and 1990s), winters were warmer and summer or autumn blooms prevailed. Threshold levels for Skeletonema's response to environmental variables were established. Most discerning threshold variables were operative in the first quarter of the year (winter). A threshold winter (1Q) water temperature of + 2oC was identified as discerning between a Skeletonema annual pattern dominated by a winter-spring bloom (1Q T <2oC) versus a summer bloom (1Q T > 2oC). An NAOI threshold of -0.7 which discriminated between a winter-spring Skeletonema pattern (NAOI < -0.7) versus a summer bloom pattern (NAOI > -0.7) was also identified. In years in which a summer bloom pattern was dominant, the size of the summer Skeletonema bloom varied with the position of the Gulf Stream, with larger summer blooms in years of a southerly displaced Gulf Stream path. Linear regression models suggested that NBay Skeletonema annual bloom patterns were strongly influenced by farfield (= climate) forces, with both the NAOI and the position of the Gulf Stream north-wall explaining significant portions of the long-term variation in Skeletonema's annual bloom pattern and abundance.

Temporal Distribution of Phytoplankton at One Station in the Northern Adriatic Sea

Suncica Bosak [* S Bosak *] (Faculty of Science, University of Zagreb, Rooseveltov trg 6, 10000 Zagreb ; ph. +3851 48 77 745; fax. +3851 48 26 260; e-mail:sbosak@biol.pmf.hr); Z Burić (Faculty of Science, University of Zagreb, Rooseveltov trg 6, 10000 Zagreb ; ph. +3851 48 77 716; fax. +3851 48 26 260; e-mail: zburic@biol.pmf.hr); D Viličić (Faculty of Science, University of Zagreb Rooseveltov trg 6, 10000 Zagreb ; ph. +3851 48 77 745; fax. +3851 48 26 260; e-mail:dvilici@biol.pmf.hr)

Temporal distribution of phytoplankton at one offshore station (45°02'8.99' N, 13°19'00.02" E) in the Northern Adriatic Sea was investigated from May 1998 to November 2006. The investigation was performed in approximately monthly intervals at four depths (surface, 5 m, 10 m and 20 m). The study has been carried out as a part of Croatian national monitoring programme, project Adriatic. Phytoplankton species composition, species richness, diversity, taxa dominance and community dissimilarities were determined. The results were subjected to univariate, multivariate and distributional analyses. Total of 178 taxa were identified. The most abundant groups were diatoms (82 taxa) and dinoflagellates (72 taxa). Total abundance ranged from 200 cells L-1 to 1.86 x 106 cells L-1, with exception in 2003 and 2004 when total number reached 1.14 X 107 cells L-1 and 8.90 x 106 cells L-1, respectively. Taxa dominance showed prevalence of different diatom taxa with species like Thalassionema nitzchioides, Cerataulina pelagica, Nitzchia longissima being numerous and frequent during whole 8-year period while some species, like Pseudonitzchia spp. and Skeletonema costatum, had high abundance and frequency of appearance during some seasons or years. Statistical analysis showed significant difference between phytoplankton assemblages in 1998, 1999, 2000 and 2006. Results of the performed analysis indicated some seasonal community patterns, spring and autumn maxima, which were strongly emphasized during two years. In November 2003 and February 2004 diatom blooms were recorded with dominant species, Skeletonema costatum (1.12 x 107 cells L-1) and Chaetoceros socialis (8.86 x 106 cells L-1), respectively.

Decadal Variation in Phytoplankton Community Structure in the North East of Scotland

Eileen Bresnan [*E Bresnan*] (Fisheries Research Services Marine Laboratory, 375 Victoria Road, Aberdeen, AB11 9DB, Scotland. Ph: 44 – 1224 – 876544,: fax 44-1224-295511; e-mail: E.bresnan@marlab.ac.uk); S Fraser (Fisheries Research Services Marine Laboratory, 375 Victoria Road, Aberdeen, AB11 9DB, Scotland. Ph: 44 – 1224 – 876544,: fax 44-1224-295511); L Brown (Fisheries Research Services Marine Laboratory, 375 Victoria Road, Aberdeen, AB11 9DB, Scotland. Ph: 44 – 1224 – 876544,: fax 44-1224-295511); K Cook (Fisheries Research Services Marine Laboratory, 375 Victoria Road, Aberdeen, AB11 9DB, Scotland. Ph: 44 – 1224 – 876544,: fax 44-1224-295511); J Dunn (Fisheries Research Services Marine Laboratory, 375 Victoria Road, Aberdeen, AB11 9DB, Scotland. Ph: 44 – 1224 – 876544,: fax 44-1224-295511); J Fraser (Fisheries Research Services Marine Laboratory, 375 Victoria Road, Aberdeen, AB11 9DB, Scotland. Ph: 44 – 1224 – 876544,: fax 44-1224-295511); S Hay (Fisheries Research Services Marine Laboratory, 375 Victoria Road, Aberdeen, AB11 9DB, Scotland. Ph: 44 – 1224 – 876544,: fax 44-1224-295511); J Rasmussen (Fisheries Research Services Marine Laboratory, 375 Victoria Road, Aberdeen, AB11 9DB, Scotland. Ph: 44 – 1224 – 876544,: fax 44-1224-295511) S Robinson (Fisheries Research Services Marine Laboratory, 375 Victoria Road, Aberdeen, AB11 9DB, Scotland. Ph: 44 – 1224 – 876544,: fax 44-1224-295511); M Heath (Fisheries Research Services Marine Laboratory, 375 Victoria Road, Aberdeen, AB11 9DB, Scotland. Ph: 44 – 1224 – 876544,: fax 44-1224-295511)

A long term coastal ecosystem station, 3km offshore of Stonehaven in the

North East of Scotland (57N 2W), has been monitored weekly for temperature, salinity, nutrients, phytoplankton and zooplankton since 1997. During this period, considerable variation has been observed in the pattern of occurrence of many of the key phytoplankton species at this site. The spring bloom, comprising mainly of Skeletonema species, appears to be occurring earlier in the water column while very high cell densities of Chaetoceros socialis, which occurred regularly in May during the late 1990s, have not been observed for a number of years. Elevated numbers of diatoms during late summer/early autumn are only observed some years. Larger dinoflagellate species such as Ceratium are decreasing while other genera such as Dinophysis show considerable variation in the abundance and diversity of species that occur. Considerable change in the structure of the zooplankton community has also been detected, with much higher numbers of Calanus helgolandicus observed since 2000. This suggests a considerable increase in the grazing pressure exerted by large copepods, especially in autumn when C. helgolandicus numbers peak.

Spatial and Temporal Trends of Water Quality in the South Florida Coastal Region

H. O. Briceño [*H O Briceño *] (Florida International University, 11200 SW 8th St, OE-148, Miami, FL 33199, USA; ph. 1-305-348-1269; fax 1-305-348-4096; e-mail: bricenoh@fiu.edu); J O Boyer (Florida International University, 11200 SW 8th St, OE-148, Miami, FL 33199, USA; ph. 1-305-348-4076; fax 1-305-348-4096; e-mail: boyerj@fiu.edu)

Since 1989 the Southeast Environmental Research Center at Florida International University has monitored water quality in South Florida coastal ecosystems (177 stations). Besides grouping water quality types using Principal Components and Cluster analysis, we have analyzed the data for spatial and temporal trends and for freshwater loading effects. We have detected regional secular decreasing trends for TOC, TN and TP since the early nineties. Precipitation rate and water management practices in the Everglades seem to be the driving mechanisms behind nutrient behavior, in turn controlling phytoplankton biomass as displayed by chlorophyll-a trends. Within the mangrove forest, nutrient remobilization from soils as a function of salinity, flooding and groundwater input modulate nutrient dynamics in this upside-down estuary. High chlorophyll values usually occur from August to December. Finally, we have developed a new and simple methodology and a graphical tool from % cumulative data to explore time-series and then highlight partial trends and internal structure of the series.

Environmental Drivers of Phytoplankton Distribution and Composition in Tagus Estuary, Portugal

Vanda Brotas Gameiro, C., (Instituto de Oceanografia, Faculdade de Ciências da Universidaed de Lisboa, Campo Grande, 1749-016 Lisboa, Portugal; email clgameiro@fc.ul.pt); P. Cartaxana, (Laboratório Maritimo da Guia, Estrada do Guincho, 2750-374 Cascais, Portugal, pcartaxana@fc.ul.pt); [*V Brotas *], (Instituto de Oceanografia, Faculdade de Ciências da Universidaed de Lisboa, Campo Grande, 1749-016 Lisboa, Portugal; email vbrotas@fc.ul.pt, fax +351217500009

In order to measure anthropogenic influence on a certain ecosystem, a good knowledge of the system natural variability is a necessary requisite. Variability and unsteadiness are intrinsic properties of coastal ecosystems, where the action of natural forcing factors is difficult to isolate from anthropogenic ones. A long-term (March 1999-November 2005) monitoring program was developed in Tagus estuary to study phytoplankton dynamics and several key controlling factors, namely nutrient content, light availability, atmospheric and hydrodynamic conditions (temperature, wind, rainfall, river flow, and salinity). Water was collected at four sampling sites on a monthly basis. Phytoplankton biomass, analyzed as Chl a, was moderate to low, when compared to other mesotidal estuaries: interannual average Chl a values ranged from 1.4 in winter to 8.0 µg L-1 in summer. A consistent seasonal pattern was observed, with a unimodal peak extending from late spring to summer. Phytoplankton community, as determined by biomarker pigment concentration using HPLC and CHEMTAX, was dominated by diatoms (57%), and included cryptophytes (23%), dinoflagellates (6.8%), chlorophytes (5.4%), euglenophytes (4.9%), and prasinophytes (2.6%). Diatoms were the main bloom-formers in the summer chlorophyll a maximum. A stepwise regression analysis showed that air temperature, river flow and irradiance explained 47% of the observed Chl a variance, illustrating the importance of climatic factors as driving forces for phytoplankton seasonal and interannual variability. The present work aims to contribute to the challenge of comparing variability scales of phytoplankton throughout the world by presenting data from a vast ecosystem (Tagus Estuary) which suffers great human pressure.

Effects of a Large-Scale Eutrophication and Oligotrophication Experiment on Phytoplankton Biomass, Blooms and Composition in Danish Waters

Jacob Carstensen Jacob Carstensen, Senior Scientist, National Environmental Research Institute Aarhus University

The Danish phytoplankton monitoring program aims at identifying trends and drivers of phytoplankton variability, particularly inputs of nutrients from land. With almost 30 years of data during periods of both eutrophication and oligotrophication there should be sufficient data and
variation to link drivers and impacts, but the trends are also confounded with signatures of global warming and potential regime shifts in addition to the inherent large variation in phytoplankton data. The strength of such relationships can be improved by pooling data from
several coastal ecosystems acknowledging that ecosystem-specific features modulate phytoplankton responses. Phytoplankton biomass increased up to the 1980s following nutrient enrichment, however, after actions were taken to reduce nutrient inputs phytoplankton biomass decreased along a different pathway. Analyses of

phytoplankton composition from monitoring data are compounded by increasing taxonomic precision. Taking this into account the phytoplankton community has changed over the monitoring period through introduction of invasive species but the most pronounced driver appears to be temperature increase. Nutrient enrichment enhances the formation of blooms with an increasing complexity in the underlying mechanisms from stratified open waters to shallow coastal ecosystems. Indicators of phytoplankton biomass, blooms and composition, accounting for climatic forcing, are essential to the implementation of the European Water Framework Directive aiming at managing ecosystem pressures to obtain good ecological status.

Long Term Changes in a Coastal Upwelling Ecosystem

Francisco. P. Chavez [*F P Chavez *], T P Pennington (Monterey Bay Aquarium Research Institute, 7700 Sandholdt Road, Moss Landing, CA 95039 USA, ph: 831-775-1709, fax: 831-775-1620, e-mail: chfr@mbari.org)

Since 1988 the Monterey Bay Aquarium Research Institute (MBARI) has measured physical, chemical and biological properties in Monterey Bay and the contiguous waters of the California Current System. This time series has documented physical changes in the California Current System that have resulted in (1) increased chlorophyll and primary production after the 1997-98 El Niño and (2) the replacement of centric diatoms by dinoflagellates as the dominant phytoplankton after 2003. The increased production was associated with a decadal or multi-decadal basin-scale shoaling of the thermocline and nutricline. The flip-flop in dominant phytoplankton resulted from an interplay between the basin-scale shoaling and a local-scale decrease in upwelling, which produced a stratified water column over a still-shallow nutricline. The increased productivity and the shift in 'keystone' phytoplankton must necessarily impact higher trophic level organisms.

Surprising Trends of Phytoplankton Increase in San Francisco Bay

James E. Cloern [* J E Cloern *] (U.S. Geological Survey, 345 Middlefield Rd., Menlo Park, CA, USA, 94025; ph. 1-650-329-4594; fax 1-650-329-4327; e-mail: jecloern@usgs.gov)

Since 1977 the U.S. Geological Survey has measured chlorophyll a in San Francisco Bay as an index of phytoplankton biomass. Phytoplankton dynamics are characterized by a spring bloom followed by low chlorophyll the remainder of the year. This pattern changed in the late 1990s when we began to observe secondary blooms during autumn-winter and progressive increase in the annual minimum chlorophyll. These changes imply a near doubling of primary production over the past decade. Causes of this regime change have not been identified, but several independent hypotheses are supported by concurrent changes including: reduced abundances of suspension-feeding clams; anomalously strong coastal upwelling; reduced riverine inputs of sediments and increasing water transparency; and reduced inputs of toxic metals from wastewater treatment plants. This case study illustrates how trends of changing phytoplankton dynamics in estuaries can be driven by: processes originating across ocean basins and manifested in coastal currents; changing inputs of sediments, water and contaminants from watersheds; and top-down processes caused by changes in consumer populations within estuaries.

Multiannual Patterns in Size and Shape Structure of Phytoplankton Assemblages from the Gulf of Naples

M Ribera d'Alcalà [*M Ribera d'Alcalà *] (Stazione Zoologica A. Dohrn, Villa Comunale 80121, Napoli, Italy, Tel. +39-081-5833245, Fax +39-081-7641355, e-mail: maurizio@szn.it); L Dubroca (Stazione Zoologica A. Dohrn, Villa Comunale 80121, Napoli, Italy, Tel. +39-081-5833247, Fax +39-081-76 41 355, e-mail: dubroca@szn.it); V Botte (Stazione Zoologica A. Dohrn, Villa Comunale 80121, Napoli, Italy, Tel. +39-081-5833201, Fax +39-081-7641355, e-mail: botte@szn.it); D Iudicone (Stazione Zoologica A. Dohrn, Villa Comunale 80121, Napoli, Italy, Tel. +39-081-5833201, Fax +39-081-7641355, e-mail: iudicone@szn.it); F Corato (Stazione Zoologica A. Dohrn, Villa Comunale 80121, Napoli, Italy, Tel. +39-081-5833242, Fax +39-081-7641355, e-mail: fede@szn.it); F Margiotta (Stazione Zoologica A. Dohrn, Villa Comunale 80121, Napoli, Italy, Tel. +39-081-58332343, Fax +39-081-7641355, e-mail: margiot@szn.it); V Saggiomo (Stazione Zoologica A. Dohrn, Villa Comunale 80121, Napoli, Italy, Tel. +39-081-5833240, Fax +39-081-7641355, e-mail: saggiomo@szn.it); D Sarno (Stazione Zoologica A. Dohrn, Villa Comunale 80121, Napoli, Italy, Tel. +39-081-5833282, Fax +39-081-7641355, e-mail: diana@szn.it); A Zingone (Stazione Zoologica A. Dohrn, Villa Comunale 80121, Napoli, Italy, Tel. +39-081-5833295, Fax +39-081-7641355, e-mail: zingone@szn.it)

During the last decade there has been a renewed interest in the patterns of size spectra of plankton communities in the ocean. Some significant contributions have appeared in the literature aimed at using size spectra as synthetic descriptors of energy and matter transfers through the food web, on one side, or at analyzing the relationship between biodiversity and size spectra on the other. Several studies are currently focused on determining whether changes in the abiotic scenario, e.g., climate change, are reflected in variations of the size spectra of plankton. We use our time series to trace seasonal and pluriannual variability in the atmospheric forcing (local and basin scale) and hydrographic conditions and the concurrent variability, if any, in the size structure of phytoplankton community. We will test two hypotheses:

1. That the slope of phytoplankton spectrum follows the trophic regime and therefore changes over the seasons and with the concurrent phase shifts.

3. That general shape should be considered in addition to size as a syntheic descriptor of phytoplankton communities.

An attempt to give a semiquantitative description of the latter hypothesis will be conducted.

Long Term Changes of the Vegetal Particulate Matter Biomass and the Mesozooplankton in the Gironde Estuary (SW France)

Valerie David [*V David*] (Department of Life Science, Virginia Commonwealth University, 1000 West Cary Street, Richmond, VA, USA, 23284; ph. 804-828-0153; e-mail: vdavid@vcu.edu); B Sautour (Station Marine d'Arcachon, UMR EPOC 5805 CNRS/Universite Bordeaux 1, 2 rue du Professeur Jolyet, 33120 Arcachon; ph. 011- 33- 556223901; e-mail: b.sautour@epoc.u-bordeaux1.fr);); P Chardy (Station Marine d'Arcachon, UMR EPOC 5805 CNRS/Universite Bordeaux 1, 2 rue du Professeur Jolyet, 33120 Arcachon; ph. 011- 33- 556223900; e-mail: p.chardy@epoc.u-bordeaux1.fr)

Since 1978, the UMR EPOC 5805 has measured pigment concentrations in the oligomesohaline area of the Gironde estuary using Chlorophyll a as an index of the vegetal particulate organic matter biomasses and active chlorophyll a as an index of its quality. The Gironde estuary is characterized by very high turbidities (>500 mg L-1) which highly limit the phytoplankton production and Chl a is thus an index of the vegetal POM biomass essentially represented by allochtonous detritic. Vegetal POM biomass has been significantly increasing whereas its quality has been decreasing since 1978. A significant increase of the seasonality deviation has also been observed for both parameters. These results could be related to the marinisation (+2PSU) and the upstream displacement of the maximum turbidity zone observed in the Gironde estuary. These environmental changes and the water warming (+2ºC) had had consequences on the zooplanktonic community: (1) a significant upstream displacement of the population of autochtonous copepods (Eurytemora affinis and Acartia bifilosa), (2) the colonization of the copepod Acartia tonsa: the abundances of which are now as important as the dominant species which occurs in winter spring, implying a second peak of zooplanktonic biomass in summer in the recent period; (3) a change of demographic parameters for some species.

Main Species Characteristics of Northern Phytoplankton Spring Blooms

Maria Degerlund [Maria Degerlund* & Hans Christian Eilertsen, Department of Aquatic Biosciences, Norwegian College of Fishery Science, University of Tromsø, N-9037 Tromsø, Norway*) E-mail: maria.degerlund@nfh.uit.no, Tel.: +47-77646871, Fax: +47-77646020]

A compilation of large amounts of data from the spring bloom along the north Norwegian coast and the Barents Sea shows that the main species are common temperate diatoms and the prymnesiophyte Phaeocystis pouchetii. The relative abundance of diatoms and Phaeocystis varies highly between years. Species compositions in coastal fjords at 70oN have high similarities with those of the shelf waters further north in the Barents Sea (up to approximately 80oN). An exception is Skeletonema costatum which is seldom observed in Arctic waters. The development of the spring bloom follows a characteristic succession of species, starting with

smaller centric diatoms (Skeletonema costatum, Chaetoceros socialis, C. compressus, C. furcellatus, C. debilis) and pennates (Nitzschia grunowii, Fragilariopsis oceanica/F. cylindrus, Pseudo-nitzschia spp.), followed by larger centric diatoms (Thalassiosira nordenskioeldii, T. antarctica var. borealis, T. gravida, T. hyalina, Chaetoceros decipiens). Close to the ice edge in the Barents Sea some typical ice-associated diatoms (Nitzschia frigida, Melosira arctica, Navicula vanhoeffenii, Thalassiosira bioculata) occur together with many of the other pelagic diatoms also common further south. P. pouchetii occurs during all stages of the spring bloom and may sometimes completely dominate the phytoplankton community during the spring.

Long-Term Trends in Phytoplankton and Related Parameters in the North Sea

Xavier Desmit [*---*] ; X Desmit (Water Quality and Ecology, WL | Delft Hydraulics, Rotterdamseweg 185, 2629 HD Delft, The Netherlands; ph.: +31 15 285 84 63; e-mail: xavier.desmit@wldelft.nl) ; G Alvarez (Marine and Coastal Management, WL | Delft Hydraulics, Rotterdamseweg 185, 2629 HD Delft, The Netherlands; ph.: +31 15 285 84 63; e-mail: gabriela.alvarez@wldelft.nl)

During the last fifteen years, three groups of phytoplankton (Diatoms, Marine flagellates and Dinoflagellates) as well as one potentially harmful species (Phaeocystis) have been recorded along the Dutch coast and in the North Sea. Changes in the seasonal patterns and in the cell abundances are observed for each algal groups, and some trends appear to be consistent during the observation period. In particular, regime shifts are occuring, which especially affect the spring-bloom maximum.

In an attempt to understand those changes, we also analyse three decades of water-quality measurements, including chlorophyll a concentrations. Hypothesis are formulated to identify the possible mechanisms responsible for the observed changes in phytoplankton dynamics. The present study is ultimately intended for building long-term scenarios, in order to further predict by modelling the future phytoplankton dynamics in the North Sea.

Phytoplankton Succession in a Dam Regulated Temperate Estuary (the Guadiana, South-East Portugal)

Rita B Domingues [*Rita B Domingues*] (CIMA – Centre for Marine and Environmental Research, University of Algarve, Campus de Gambelas, 8005-139 Faro, Portugal; ph. +351289800900; fax +351289800069; e-mail: rbdomingues@ualg.pt); Ana Barbosa (CIMA – Centre for Marine and Environmental Research, University of Algarve, Campus de Gambelas, 8005-139 Faro, Portugal; ph. +351289800900; fax +351289800069; e-mail: abarbosa@ualg.pt); Helena Galvão (CIMA – Centre for Marine and Environmental Research, University of Algarve, Campus de Gambelas, 8005-139 Faro, Portugal; ph. +351289800900; fax +351289800069; e-mail: hgalvao@ualg.pt)

With the construction of the Alqueva dam, 150 km from the Guadiana river mouth, increasing attention has been given to the impacts of flow regulation on the Guadiana estuarine ecosystem. Phytoplankton composition, abundance and biomass (biovolume-based), and chlorophyll a concentration have been analysed in 2001 (before dam construction), 2002-3 (during reservoir filling) and 2004-5 (after flow regularization), in the Guadiana upper estuary (freshwater zone). Other environmental variables (eg. dissolved inorganic macronutrients, suspended particulate matter, light, salinity, temperature) were determined. In 2001, phytoplankton succession followed the typical succession in temperate freshwaters: a clear transition from a diatom spring bloom to cyanobacteria dominance in the summer was observed. Moreover, phytoplankton succession seemed related to variations in nutrient ratios. During dam filling (2002-3), the diatom spring bloom was dramatically reduced, despite higher silica concentrations in the water column. Cyanobacteria bloomed not only during summer, but also in autumn and winter months, despite relatively similar levels of light in the mixed layer in relation to the previous year. In the last years (2004-5), with the Alqueva dam filled and operational, phytoplankton succession followed the pattern observed in 2001, ie, the diatom spring bloom was replaced by cyanobacteria summer blooms. However, no significant relationships were found between phytoplankton succession and nutrient concentrations and ratios. Other bottom-up (eg. light) and top-down (eg. grazing) regulatory factors should be evaluated in the future.

Environmental Conditions vs. Spring Bloom Onset and Species Succession, Tracing the Regulators

Hans Christian Eilertsen [Hans Christian Eilertsen & Maria Degerlund, Department of Aquatic Biosciences, Norwegian College of Fishery Science, University of Tromsø, N-9037 Tromsø, Norway*) E-mail: hans@phaeocystis.com, Tel.: +47-77644540, Fax: +47-77646020]

Analysis of large sets of data from the coast of north Norway and the Barents Sea suggests that it is somewhat difficult to pinpoint a single “clear cut” spring bloom triggering factor. The only significant correlation in statistical analysis of the data was linear and between bloom magnitude and day-length. Also we observed significant correlations between log Chlorophyll a and critical depth, irradiance and heat flux. From early March to mid May day-length increases from 7 to 24 hours in north Norway, while daily integrated irradiance increases ca. 14 times. A suggested explanation is that if blooms in the north have not yet triggered early in April, water turbidity will remain low and critical depth will deepen rapidly. This causes blooms to start after this date irrespectively of latitude, i.e. irradiance will become the main forcing function if initial stocks are present. Also contributes to this, we believe, that the water remains clearer after a bloom in the north than further south, presumably caused by less amounts of exudates being released by coldwater phytoplankton.

Comparison of Phytoplankton Dynamics Between Tropical and Temperate Estuaries

Bradley Eyre (B D Eyre) (Centre for Coastal Biogeochemistry, Southern Cross University, PO Box 157, Lismore NSW 2480, Australia. bradley.eyre@scu.edu.au); A J P Ferguson, Aquatic Biogeochemical and Ecological Research, Ocean Shores, NSW 2483, Australia; A Browne, Centre for Coastal Biogeochemistry, Southern Cross University, PO Box 157, Lismore NSW 2480, Australia)

Case Study I: Chlorophyll-a measurements have been undertaken continuously in Moreton Bay (a subtropical coastal embayment) since 1989. Wastewater nitrogen (N) and phosphorus (P) loads discharged directly into western Moreton Bay steadily increased from 1946 to 2000, after which nitrogen loads were dramatically reduced. Despite the reduction in nitrogen loads, and small-scale nutrient enrichment experiments and N:P ratios indicating N-limitation, there has been no corresponding significant reduction in algal biomass. In addition, there has been a rapid increase in the occurrence of N-fixing Lyngbya majuscula in Moreton Bay as wastewater P loads have increased relative to wastewater N loads (i.e since 2000). Whole ecosystem scale nutrient budgeting showed that N-fixation is the largest source of N for Moreton Bay and that the bay is potentially P-limited. This work supports the premise that there may be fundamental differences in nutrient limitation of primary production between tropical and temperate coastal systems due to benthic N-fixation.

Case Study II: Chlorophyll-a measurements have been undertaken in the Brunswick Estuary (a subtropical river dominated system) since 1996. Phytoplankton growth is highly dynamic driven by short-lived episodic flood events that deliver nutrients and change the flushing of the system. Blooms can occur any time of the year in response to episodic runoff events. This contrasts with temperate systems where the effect of more regular and extended spring freshets, and large flood events associated with storms, on phytoplankton dynamics typically last upto months. Phytoplankton dynamics in river dominated subtropical east Australian estuaries are very sensitive to long-term changes in rainfall and river hydrology which are linked to global scale climate factors such as changes in the Southern Oscillation Index (SOI).

Long Term Phytoplankton Dynamics in the Gulf of Trieste (Northern Adriatic Sea)

S. Fonda Umani [*S Fonda Umani *] (Department of Biology, University of Trieste, v. Valerio, 28/A, 34143 Trieste, Italy; ph. +39-040-5582007; fax +39-040-5584010; e-mail: labbioma@units.it); M Cabrini (Department of Biological Oceanography, National Institute of Oceanography and Experimental Geophysics via A. Piccard, 54, 34010 Trieste, Italy; e-mail: mcabrini@ogs.trieste.it); D Virgilio (Department of Biological Oceanography, National Institute of Oceanography and Experimental Geophysics via A. Piccard, 54, 34010 Trieste, Italy; e-mail: dvirgilio@ogs.trieste.it); N Burba

(Department of Biological Oceanography, National Institute of Oceanography and Experimental Geophysics via A. Piccard, 54, 34010 Trieste, Italy; e-mail: nburba@ogs.trieste.it);

We analysed the temporal evolution of phytoplankton abundance and species composition on a monthly - fortnightly base over a 20 years' time span (from 1986 to 2005) at a permanent site in the Gulf of Trieste (northern Adriatic Sea). Seasonal dynamics matched the typical cold temperate sea one: a late winter absolute maximum, a second less intense fall bloom, few sporadic surface peaks in summer, and a scarce winter biomass, although large inter-annual fluctuations were observed. We recognized two distinct periods: the first from 1986 to 1993 when phytoplankton abundance was high, and the second until 2005 when the decrease was almost continuous, mostly due to the gradual disappearance of small and large flagellates. Meanwhile species composition changed: in the first period it generally was Skeletonema costatum to produce the late winter bloom, after 1993 it was almost completely substituted by Pseudo-nitzschia genus, in the last years the late winter blooms were less intense and they were due to Chaetoceros genus or to a more diversified diatom assemblage. The most relevant shift was identified in 1993 both in term of biomass and species composition. Similar shifts were observed for mesozooplankton biomass and composition and they might be due to climatic changes occurred over the basin in that period.

Long-term Phytoplankton and Environmental Variables Observations in the Bahía Blanca Estuary, Argentina

R. H. Freije C A Popovich (Laboratorio de Ficología y Micología, Universidad Nacional del Sur, San Juan 670, B8000 Bahía Blanca, ph. 54-0291-4595101/int. 2426, fax: 54-0291-4595130 , e-mail:bmpopovi@criba.edu.ar, Argentina); R. Asteasuain (Instituto Argentino de Oceanografía, Casilla de Correo 804, B8000 Bahía Blanca, ph: 54- 0291- 4861112, fax: 54 0291 4861112, e-mail: qmastes1@criba.edu.ar); C. Spetter (Instituto Argentino de Oceanografía, Casilla de Correo 804, B8000 Bahía Blanca, ph: 54- 0291- 4861112, fax: 54 0291 4861112, e-mail: cspetter@criba.edu.ar); J. E. Marcovecchio (Instituto Argentino de Oceanografía, Casilla de Correo 804, B8000 Bahía Blanca, ph: 54- 0291- 4861112, fax: 54 0291 4861112, e-mail: jorgemar@criba.edu.ar); [*R H Freije*] (Lab. Química Ambiental, Universidad Nacional del Sur, Av. Alem 1253, B8000 Bahía Blanca; ph.54-0291-4595101/int.3572 fax: +54 291 4595160, Argentina)

Long-term observations for waters of inner Bahía Blanca estuary (a semi-arid region at the boundary of the pampas and Patagonia, located at 38º 45'S, 62º 22'W, in the south of Buenos Aires Province, Argentina) are available from a 28-years time-series (1978-2007). This data set (probably the most extensive continuous record from South America) described the variations and changes observed within phytoplankton biomass (as chlorophyll a), abundance and composition, and environmental

variables. Bahía Blanca estuary is a shallow, well mixed, highly turbid and mesotidal estuary. Since 1978 to 2007 quantitative fortnightly samples were collected during high tide at two permanent station located in the inner zone, where the mean depth is 6 m. Measures included temperature, salinity, turbidity, pH, dissolved oxygen, nitrate, nitrite, ammonium, phosphate, silicates, chlorophyll a and phaeopigments. Phytoplankton abundance and composition was measured from 1978 to 1991 (Gayoso, 1998), from 1991-1994 and 2002-2003. Phytoplankton annual cycle has been characterized by a recurrent winter-early diatom bloom, dominated by Thalassiosira spp. and Chaetoceros spp. This bloom finished upon nutrient depletion. Sporadic peaks of Chl. a occurred in summer and these were not associated with specific phytoplankton populations. We observed that since 2000s secondary blooms caused by diatoms during summer-autumn has been mores frequent. In addition both a lower magnitude and duration of the winter diatom bloom have been recorded. With this scenario, several hypotheses relative to these observations have been proposed.

Long Term Variability of Chlorophyll a and Abiotic Factors in the Patos Lagoon Estuary and Adjacent Coastal Zone (1993-2006); Lagoon Estuary and Adjacent Coastal Zone (1993-2006)

C. C. Fujita [*C C Fujita*] (Department of Oceanography – Federal University of Rio
Grande. Brazil. ph. +55 53 3233 6535; fax: +55 53 3233 6601; e-mail: oceccyof@furg.br); C Odebrecht (Department of Oceanography – Federal University of Rio Grande. Brazil. ph. +55 53 3233 6520; fax: +55 53 3233 6601; e-mail: doclar@furg.br); P C Abreu (Department of Oceanography – Federal University of Rio Grande. Brazil. ph. +55 53 3233 6509; fax: +55 53 3233 6601; e-mail: docpca@furg.br)

We have investigated the interannual variability (1993-2006, monthly data) of phytoplankton chlorophyll a and abiotic parameters (rainfall, temperature, salinity and dissolved inorganic N, P and Si) in three representative environments of Patos Lagoon estuary, southern Brazil: (1) a shallow embayment, (2) the main navigation channel, which connects the estuary with the ocean, and (3) the surf-zone of the adjacent oceanic Cassino Beach. These three areas present distinct hydrological characteristics and important differences in absolute values of most analyzed parameters, remarkably in salinity, but also in chlorophyll a. Analysis of the annual deviation from the historical mean (14 years) in the three environments showed similar interannual trends for all abiotic parameters and slightly differences for chlorophyll a variability. The effect of the large-scale phenomenon El Niño South Oscillation (ENSO) generated positive (in El Niño periods) and negative (La Niña periods) deviations of historical mean of rainfall and other parameters. The strongest La Niña event (1999-2001) coincided with high positive anomalies for salinity and ammonium and negative deviations for chlorophyll a concentration in the three environments, coinciding with low silicate concentration. The 2002-2003 El Niño event (moderate intensity) was

related with highest rainfall and lowest salinity in the region, matching the highest positive nitrate and chlorophyll a anomalies of the study period. Inconsistencies were observed during the strongest 1997–1998 El Niño, when high rainfall generated low nutrient and chlorophyll a concentration. An eutrophication signal was detected since the 1999-2001 La Niña through an increase in the frequency of N:Si ratio to values close to 1 or >1.

Regional-scale Temporal and Spatial Variability of Phytoplankton Biomass (Chlorophyll) and Nutrients in the Great Barrier Reef lagoon, Australia (1989-2007)

Miles Furnas [*M Furnas*] (Australian Institute of Marine Science, Townsville, Qld., Australia, 4810; ph. +61-747-534323; fax. +61-747-725852; email: m.furnas@aims.gov.au); G De'ath (Australian Institute of Marine Science, Townsville,, Qld., Australia, 4810; ph. +61-747-534316; fax. +61-747-725852; email: g.de'ath@aims.gov.au) and J Brodie (Australian Centre for Tropical Freshwater Research, James Cook University, Townsville, Qld., Australia; ph. +61-747-816435; email: jon.brodie@jcu.edu.au)

Two extended monitoring programs are being or were carried out in coastal and open shelf waters of the Great Barrier Reef (GBR) lagoon to resolve spatial-temporal variability and long-term secular trends in phytoplankton biomass and nutrient levels, particularly those arising from modern enhanced runoff of terrestrial nutrients from the adjacent catchments. Plankton standing crop and a suite of nutrient species are being sampled on a semi-annual basis (1989-present) at 11 coastal and lagoonal sites in the central GBR (ca. 17S). Surface chlorophyll was sampled on a near-monthly basis within 5 latitudinal zones between 15S and 23S and on a semi-annual basis for a shorter period in the remote far-northern GBR (12-14S). Phytoplankton biomass is dominated by prokaryotic picoplankters (Prochlorococcus, Synechococcus), with episodic biomass spikes associated with larger diatoms or Trichodesmium. Mean chlorophyll concentrations exhibit persistent cross-shelf and latitudinal gradients with a muted seasonal cycle coupled to the regional wet-dry monsoonal climate. To date, no long-term secular trends in phytoplankton biomass have been identified. Both phytoplankton biomass (chlorophyll) and concentrations of some individual nutrient species exhibit discernable multi-year fluctuations in mean concentration. Causes of these fluctuations are currently unresolved. Short-lived local and regional fluctuations in phytoplankton biomass, community structure and nutrient levels are primarily related to disturbance events (wind-driven sediment resuspension, cyclones, flood plumes, upwelling). Experience to date indicates that a multi-decadal time frame is essential to detect significant persistent changes in coastal waters of the GBR.

Phytoplankton and Biooptical Properties Time Series in the Coastal Ecosystem of Southeast Brazil

S.A. Gaeta [*SA Gaeta*](Instituto Oceanográfico da USP, Cidade Universitária, Sao Paulo, SP, Brazil, 05508-900; ph. 55-11-30916600; fax 55-11-30323092;e-mail:sagaeta@usp.br); M Kampel(Instituto Nacional de Pesquisas Espaciais, Av. dos Astronautas 1758, SJ dos Campos, SP, Brazil, 12227-010; ph.55-12-39456501; fax 55-12-39456488; milton@dsr.inpe.br); M Pompeu(Instituto Oceanográfico da USP, Cidade Universitária, Sao Paulo, SP, Brazil, 05508-900; ph. 55-11-30916600; fax 55-11-30323092;e-mail:pompeum@usp.br); GP Ortiz(Instituto Oceanográfico da USP, Cidade Universitária, Sao Paulo, SP, Brazil, 05508-900; ph. 55-11-30916600; fax 55-11-30323092;e-mail:gusortiz@gmail.com)

Since december 2004 the Instituto Oceanográfico of the University of Sao Paulo (IOUSP) and Instituto Nacional de Pesquisas Espaciais (INPE)have been measuring phytoplankton biomass (chlorophyll a) and biooptical properties, monthly at a fixed station in the coastal ecosystem of southeast Brazil (23o44'S 45o00'W). Data set analysis for the first year of observations has revealed that phytoplankton dynamics is mainly determined by the shelf wind field. Zonal component during the passage of cold fronts promotes onshore water transport, strong mixing and ressuspension of ammonia from the sediments enhancing nanophytoplankton biomass and primary productivity. Meridional component drives the South Atlantic Central Water intrusions on the shelf and, as a result, increased microphytoplankton contribution for biomass and productivity. Further analysis of data are ongoing, for example, sea surface temperature and sea color images. These mesoscale images will help us to understand the spatial variance of the Brazilian Current regime and its meandering which may determine the intensity of interannual and multidecadal changes in the phytoplankton dynamics.

Long-term Phytoplankton Dynamics in the Rhode River, Maryland (USA)

Charles L. Gallegos [*C L Gallegos *] (Smithsonian Environmental Research Center, P.O. Box 28, Edgewater, MD, USA, 21037; ph. 1-443-482-2240; fax 1-443-482-2380; e-mail: gallegosc@si.edu); T E Jordan (Smithsonian Environmental Research Center, P.O. Box 28, Edgewater, MD, USA, 21037; ph. 1-443-482-2209; fax 1-443-482-2380; e-mail: jordanth@si.edu); D E Weller (Smithsonian Environmental Research Center, P.O. Box 28, Edgewater, MD, USA, 21037; ph. 1-443-482-2214; fax 1-443-482-2380; e-mail: wellerd@si.edu);

The Smithsonian Environmental Research Center (SERC) was established in 1965 as an outdoor laboratory for the study of watershed-estuary interactions. SERC is located on the Rhode River, a mesohaline tributary of Chesapeake Bay. Measurements of some properties, such as phytoplankton chlorophyll, date back to the early 1970's. More recent studies include phytoplankton species identifications, light saturation curves, and nutrient concentrations. For some parameters, such as light-saturated photosynthetic rate normalized to chlorophyll, interannual differences are as large as seasonal differences. The main factor governing interannual variability in annual primary production is the presence or absence of extraordinary

spring blooms of the dinoflagellate, Prorocentrum minimum. In years with extraordinary blooms, primary production peaks in spring with the high biomass of P. minimum, in contrast with the main stem Chesapeake Bay, where primary productivity always peaks in summer. Long-term trends in summertime phytoplankton chlorophyll have not been observed, though temporary directional trends related to precipitation patterns have sometimes persisted for a decade before reversing. Currently there appears to be a trend toward reduced water clarity and increased chlorophyll during winter, though the cause is not presently known. These observations underscore the need for multi-decadal observations to document trends and anthropogenic impacts in coastal systems.

The Monitoring Program in the Northern Gulf of Aqaba: 19 Years of Daily Measurements of Sea Surface Chlorophyll and Temperature in a Sub-tropical, Oligotrophic Coastal Environment

Amatzia Genin [*A Genin*] (The Hebrew University, Steinitz Marine Biology Laboratory, POB 469, Eilat 88103, Israel; ph 972-8-6360124; fax 972-8-6374329; e-mail: Amatzia@vms.huji.ac.il).

The initial phase (1988-2002) of the monitoring program at the Steinitz Marine Lab consisted of daily measurements of sea-surface chlorophyll a and SST and intermittent oceanographic cruises to a permanent, deep-water station ~3 km off shore. Since 2002, the program has expanded to include, in addition to the aforementioned measurements, a diverse array of routine measurements at several deep water stations, the coastal region and the local coral reef. Phytoplankton is now measured both by extracted chlorophyll a and flow cytometer.

The data show a strong seasonality in phytoplankton abundance and taxonomic composition, ranging from highly oligotrophic conditions (~0.2 mg Chl/m^3) during the summer, where Synechococcus and Prochlorococcus are the dominant taxa, through a minor bloom (~0.4 mg Chl/m^3) in the autumn to a strong bloom (>0.7 mg Chl/m^3), picoeukaryotes-dominated community in the spring. Unusually deep convective mixing (> 400 m), in some years exceeding the critical depth, limits phytoplankton growth during the winter. The intensity of the spring bloom is determined by the depth of mixing during the preceding winter, which is a function of air temperature, rendering the local phytoplankton dynamics sensitive to remote forcing (e.g. the Pinatubo eruption in 1991). The long time series indicate the occurrence of substantial inter-annual variability with no evidence for long-term changes, neither in chlorophyll nor SST.

Phytoplankton Bloom Dynamics in Liverpool Bay

Naomi Greenwood [*N. Greenwood*] (Cefas, Pakefield Road, Lowestoft, Suffolk, NR33 0HT; ph. 01502 524547; fax 01502 513865; e-mail naomi.greenwood@cefas.co.uk); V. Creach (Cefas, Pakefield Road, Lowestoft, Suffolk, NR33 0HT; ph. 01502 524279; fax 01502 513865; e-mail veronique.creach@cefas.co.uk); S. J. Cutchey (Cefas, Pakefield Road, Lowestoft, Suffolk, NR33 0HT; ph. 01502 524509; fax 01502 513865; e-mail stewart.cutchey@cefas.co.uk); D. J. Mills (Cefas, Pakefield Road, Lowestoft, Suffolk, NR33 0HT; ph. 01502 524253; fax 01502 513865; e-mail david.mills@cefas.co.uk); R.M. Forster (Cefas, Pakefield Road, Lowestoft, Suffolk, NR33 0HT; ph. 01502 527748; fax 01502 513865; e-mail rodney.forster@cefas.co.uk);

Liverpool Bay has been identified as an area where enrichment with anthropogenic nutrients may lead to eutrophication in terms of accelerated growth of plants and an undesirable disturbance to the balance of organisms. To improve the evidence base required by the UK for formal assessment of eutrophication, high-frequency (weekly – hourly) measurements have been carried out since 2002. These observations form part of a wider UK operational network of eutrophication monitoring buoys (www.cefas.co.uk/montoring). The measurements show that multiple summer blooms (> 10 mg chl m-3) of phytoplankton are a regular annual feature with blooms often initiated at neap tides and with peaks occurring at spring tides. In this nutrient replete environment, summer phytoplankton growth is limited by light supply that is determined by the interplay between wind and tide induced turbulent mixing, inputs of thermal freshwater buoyancy and resuspension of fine inorganic material. Floristic analysis of the phytoplankton is currently being carried out and is being analysed in relation to environmental control variables including atmospheric conditions and land based inputs and will be reported at the this meeting. We will also report on the effectiveness of a multi-parameter high-frequency in situ buoy network for improving observation and understanding of our relationships between environmental parameters, phytoplankton biomass and changes in species/floristic composition.

Long-Term Data on Floral Composition, Biomass, and Primary Productivity to Resolve Historical Trends and Climatic Forcing of Phytoplankton in Chesapeake Bay

Larry W. Harding, Jr. [*L. W. Harding, Jr. *] (Research Professor, University of Maryland Center for Environmental Science, Horn Point Laboratory, Box 775, Cambridge, MD, USA, 21613-0775; ph. 1-301-221-8247; email: larry@hpl.umces.edu)
[J. E. Adolf] (Assistant Research Scientist, University of Maryland Biotechnology Institute, Center of Marine Biotechnology, Columbus Center, Suite 236, 701 E. Pratt St., Baltimore, MD, USA, 21202; ph. 1-410-234-8830; email: adolf@umbi.umd.edu)
[W. D. Miller] (National Research Council Postdoctoral Fellow, Naval Research Laboratory, 4555 Overlook Ave. S.W.,Washington, DC, USA, 20375; ph. 1-703-768-8162; email: dave.miller@nrl.navy.mil) [E. S. Perry] (Statistics Consultant, 2000 Kings Landing Rd.,
Huntingtown, MD, USA, 20639-9743; ph. 1-410-535-2949; email: eperry@chesapeake.net)

This presentation draws on historical and recent data on floral composition, biomass, and primary productivity in Chesapeake Bay to quantify long-term trends against a backdrop of strong climatic forcing resulting in a high degree of interannual variability in this dynamic estuarine ecosystem. Data sources include historical observations (1950-1983), monitoring cruises (1984-present), individual research programmes (1982-2005), and aircraft remote sensing of chlorophyll biomass (1989-present). We describe decadal patterns of chlorophyll in the Bay that reflect variability of freshwater flow and the effects on nutrient loading and light availability; seasonal to interannual variability of primary productivity; statistical methods to classify regional climate; coincident forcing of floral composition, biomass, and primary productivity by flow/climate; applications of historical and recent data in developing ‘chlorophyll criteria’ to assess ecosystem responses to mandated reductions of nutrients. Data from these sources combined with climate analyses and biogeochemical modeling support our current understanding of phytoplankton dynamics in Chesapeake Bay, leading to predictive capabilities heretofore unrealized for this complex ecosystem.

Interannual Variability of Cyanobacteria in the Baltic Sea - the Role of Life Cycle Processes

Inga Hense [*I Hense*] (Baltic Sea Research Institute, IOW, Germany; ph. +49-381-5197-263; fax +49-381-5197-440; e-mail: inga.hense@io-warnemuende.de); H Burchard (IOW; e-mail: hans.burchard@io-warnemuende.de); T Neumann (IOW; e-mail: thomas.neumann@io-warnemuende.de); B Schneider (IOW; e-mail: bernd.schneider@io-warnemuende.de); N Wasmund (IOW; e-mail: norbert.wasmund@io-warnemuende.de)

Surface accumulation of cyanobacteria is common in the Baltic Sea and traditionally associated with external factors like high phosphate concentrations and sea surface temperature. However, observations often indicate a rather poor correlation between actual environmental conditions and the abundance of cyanobacteria which raises the question about other factors stimulating their mass occurrence. So far, the role of internal factors like the life cycle on the generation of cyanobacteria blooms have been only insufficiently taken into account. To illustrate the advantages of considering life cycle, two ecosystem models are applied to one station in the Baltic Sea for the time period 1970 to 2005: one NPZD-type model with phosporous and a cyanobacterial life cycle model which distinguish pelagic growth and benthic resting stages . The results of both models are compared with observations. While the decadal variations are represented reasonably well by both models, the year to year fluctuations are strongly underestimated by the biogeochmical model in which the growth of cyanobacteria is exclusively governed by external factors. This is in contrast to the cyanobacteria life cycle model, in which a large part of the observed interannual variability is reproduced. The results indicate that an improved understanding of cyanobacteria bloom dynamics might be achieved by considering the organisms' life history. This is in particular important for coastal areas where the benthic-pelagic coupling is strong.

Phytoplankton and Environmental Monitoring on the Pacific Coast of Washington, USA

Rita A. Horner [R A Horner*] (School of Oceanography, University of Washington, Box 357940, Seattle, WA, USA, 98195-7940; ph. 1-206-543-8599; fax 1-206-543-0275; e-mail: rita@ocean.washington.edu); N G Adams (National Marine Fisheries Service, Northwest Fisheries Science Center, 2725 Montlake Boulevard East, Seattle, WA, USA, 98112; ph. 1-206-860-6787; fax 1-206-860-3335; e-mail: Nicolaus.Adams@noaa.gov); J R Postel (School of Oceanography, University of Washington, Box 357940, Seattle, WA, USA, 98195-7940; ph. 1-206-543-4485; fax 1-206-543-0275; e-mail: postel@ocean.washington.edu); V L Trainer (National Marine Fisheries Service, Northwest Fisheries Science Center, 2725 Montlake Boulevard East, Seattle, WA, USA, 98112; ph. 1-206-860-6788; fax 1-206-860-3335; e-mail: Vera.L.Trainer@noaa.gov)

Phytoplankton species, chlorophyll, and water properties (temperature, salinity, nitrate, nitrite, ammonia, phosphate, and silicate) have been measured from beaches along the Pacific coast of Washington since April 1997. Additionally, cruise-of-opportunity data have been collected in the offshore waters of Washington State yearly since 1996; however these cruises usually have occurred once per year in June-November and were 2-3 weeks in length. Emphasis has been on harmful algal bloom (HAB) species, in particular Pseudo-nitzschia spp. because of the potential for domoic acid toxicity in razor clams, a major recreational and commercial species, and Alexandrium catenella because of paralytic shellfish toxins in clams and oysters commercially raised in coastal embayments. Other potential HAB organisms include species of Dinophysis, Phaeocystis, and Heterosigma although these have apparently not caused problems on the open coast.

From April 1997-January 2000, sampling was done on a twice monthly basis because of funding and logistical constraints even though it was obvious that both species variations and biomass changes were missed. With the advent of the Olympic Region Harmful Algal Bloom (ORHAB) project in August 2000 and continuing to the present time, twice weekly sampling was initiated that is much more suitable to trend analysis of the often changing phytoplankton community and environmental conditions. Historical data have shown that razor clams often become toxic following storm events thought to bring domoic-acid producing cells from offshore initiation sites to the coast. Thus a major finding of the ORHAB project is that frequent quantification of Pseudo-nitzschia cells can give coastal resource managers up to 10 days' early warning of toxic events that impact razor clam fisheries.

Phytoplankton Trends in Massachusetts Bay – 1992-2006

Carlton D. Hunt [*Carlton D. Hunt*] (Battelle, 397 Washington Street, Duxbury, MA USA, 02332; ph. 781 952-5374; fax: 781 934-2124; Email: Huntc@Battelle.org); David G. Borkman Graduate School of Oceanography, University of Rhode

Island, Narragansett, Rhode Island 02882, USA (ph. 401 874-6686; fax: 401 874-6160; Email: dborkman@gsosun1.gso.uri.edu); J T Turner (Biology Department and School for Marine Science and Technology, 285 Old Westport Road, University of Massachusetts Dartmouth, North Dartmouth, Massachusetts USA 02747, ph. 508 999-8229; fax: 508 999-8901; Email: jturner@umassd.edu); Scott Libby (Battelle, 153 B Park Row, Brunswick, ME USA, 004011; ph. 207-725-9572; fax: 207-725-9572(call first); Email: Libby@Battelle.org); Michael Mickelson (Massachusetts Water Resources Authority. Charlestown Navy Yard, 100 First Avenue, Boston, MA USA 02129; ph. 617-788-4951; fax:617-788-4889; Email: Mike.Mickelson@mwra.state.ma.us)

The Massachusetts Water Resources Authority's (MWRA) discharge permit requires it to conduct a comprehensive multidisciplinary monitoring program to assess the environmental effects of the relocation of secondary-treated effluent discharge from Boston Harbor to Massachusetts Bay. Through December 2006, 15 years of continuous water column monitoring (8.7 years before and 6.3 years after relocation) has been conducted. These data show that relocating the outfall led to substantial improvements in the harbor while causing only minor acceptable effects on the bay. No impact of the discharge on phytoplankton communities has as yet been identified. MWRA's monitoring and other studies make Massachusetts Bay and Boston Harbor one of the most thoroughly-studied and well-described marine systems in the world, and provide evidence of effects of large regional and hemispheric-scale processes (NAO) on local variability and trends in phytoplankton and zooplankton including a decline in some species and a notable increase in prevalence of Phaeocystis pouchetii (2000-2006) and Alexandrium fundyense (2005 and 2006). Although the accumulated information suggests that the outfall is generally benign, some level of ongoing outfall monitoring may be appropriate to provide surveillance for unusual events and to contribute to understanding of marine waters at various scales of spatial and temporal variability.

The North Atlantic Oscillation and Chlorophyll a in Two Estuaries of the Basque Coast, Bay of Biscay (1997-2006)

Arantza Iriarte F. Villate (Department of Plant Biology and Ecology, Science and Technology Faculty, University of the Basque Country, 644 P.K., 48080 Bilbao, Spain; ph. 34- 946015515; fax 34- 946013500; e-mail: fernando.villate@ehu.es); G. Aravena (Department of Plant Biology and Ecology, Science and Technology Faculty, University of the Basque Country, 644 P.K., 48080 Bilbao, Spain; ph. 34- 946015960; fax 34- 946013500; e-mail: gvbarcug@ehu.es); [*A. Iriarte *] (Department of Plant Biology and Ecology, Science and Technology Faculty, University of the Basque Country, 644 P.K., 48080 Bilbao, Spain; ph. 34- 946015299; fax 34- 946013500; e-mail: arantza.iriarte@ehu.es); I. Uriarte (Department of Plant Biology and Ecology, Science and Technology Faculty, University of the Basque Country, 644 P.K., 48080 Bilbao, Spain;

ph. 34- 946015960; fax 34- 946013500; e-mail: ibon.uriarte@ehu.es)

As part of an on-going monitoring programme, chlorophyll a concentration has been measured monthly in two estuaries of the Basque coast, Bay of Biscay (43ºN, 2-3ºW) for the last 10 years (1997 to 2006). In both estuaries (Urdaibai and Bilbao) mean chlorophyll a concentration in the high salinity region (33-35) shows maximum values in summer months. The relationship between the NAO, climate factors and chlorophyll a on an inter-annual time scale was investigated using transfer function models. For this analysis quarterly mean (Jan-March, April-June, July-Sep, Oct-Dec) values of the variables were used. Results revealed that in this region the NAO index was significantly and negatively correlated with air temperature. No significant correlations were observed between the NAO and rainfall nor NAO and insolation. The NAO showed a significant negative relationship with chlorophyll a concentration with a lag time of one quarter, and air temperature was significantly and positively correlated with chlorophyll a, also with a lag time of one quarter.

Time Series Observation on Phytoplankton Dynamics at the Land-Ocean Boundary Condition of Sundarban Mangrove Forest, NE Coast of Bay of Bengal

Tapan Kumar Jana [*T. K. Jana *](Department of Marine Science, Calcutta University, 35, B. C. Road, Kolkata-700019, India; Ph.: 91-033-24383875, mobile: 9433859588, Fax: 91-033-24614849; email: tkjana@hotmail.com); H. Biswas (Department of Marine Science, Calcutta University, 35, B. C. Road, Kolkata-700019, India; Ph.: 91-033-2461-4891; email: bhaimanti@hotmail.com); T. K. De (Department of Marine Science, Calcutta University, 35, B. C. Road, Kolkata-700019, India; Ph.: 91-033-2461-4891 email: tarunde@yahoo.co.in)

Since 1988 phytoplankton community organization and primary production has been measured at the land-ocean boundary condition of Sundarban mangrove forest (210 32 / and220 40 /N, 880 05 / and 890E) , NE coast of Bay of Bengal. Phytoplankton dynamics are characterized by blooming of six species out of total nos. of (12.2 – 77) x 105 cells m-3 of phytoplankton comprising of twenty nine species and dominated by the genus Coscinodiscus between December and February (postmonsoon-early premonsoon) followed by the lowering of productivity along with its decreased population during the monsoon time. This pattern changed in the 2001 when near doubling of primary production with considerable decrease of surface area from 7423- 21493 μ m2 to 5904 – 11970 of the ten blooming species out of total (18.85 –197) x 105 cells m-3 comprising of forty species of phytoplankton. However, the general heterotrophic character and low transparency of the water column (< 1m) remained unchanged with little variations of N: P: Si ratio from 10: 1: 47 to 12: 1 : 53.

References:

1. S. K. Mukhopadhyay, H. Biswas, T. K. De and T. K. Jana, 2006. Fluxes of nutrients from the tropical River Hooghly at the land-ocean boundary of Sundarbans, NE Coast of Bay of

Bengal, India. Journal of Marine Systems, (Elsevier, U. K), Vol. 62, 9-21.

2. Biswas, A. Chatterjee, S. K. Mukhopadhya, T. K. De, S. Sen and T. K. Jana. 2005. Estimation of ammonia exchange at the land-ocean boundary condition of Sundarban mangrove, nortneast coast of Bay of Bengal, India. Atmospheric Environment (Elsevier, U.K.) , 39, 4489-4499.

3. H. Biswas, S. K. Mukhopadhyay, T. K. De, S. Sen and T. K. Jana, 2004. Biogenic controls on the air water carbon dioxide exchange in the Sundarban Mangrove environment, NE coast of Bay of Bengal, India. Limnology and Oceanography (American Society of Limnology and Oceanography) 49: 95 –101

4. S. K. Mukhopadhyay, H. Biswas, T. K. De, B. K. Sen, S. Sen and T. K. Jana, 2002. Impact of Sundarban mangrove biosphere on the carbon dioxide and methane mixing ration at the NE coast of Bay of Bengal, India. Atmospheric Environment (Elsevier Science Ltd., U. K.), 36: 629 – 638.

5. S. K. Mukhopadhyay, H. Biswas, T. K. De, S. Sen and T. K. Jana, 2001, Seasonal effects on the air-water carbon dioxide exchange in the Hooghly estuary, NE coast of Bay of Bengal, India. Journal of Environmental Monitoring (The Royal Society of Chemistry, U. K.) 4(4): 549 – 552.

6. T. K. De and T. K. Jana, 1996. Phytoplankton pigments in the Hugli estuary (North-East Bay of Bengal), India. Sea explorers, 3:16-20.

7. T. K. De, A. Choudhury and T. K. Jana, 1994. Phytoplankton community organization and species diversity in the Hugli estuary, India. Indian J. Marine Sciences (CSIR), 23:152-156.

8. S. K. Ghosh, T. K. De, A. Choudhury and T. K. Jana, 1992. Distribution of nutrients in estuarine waters of Hugli river, Tropical Ecology, (International society of Tropical Ecology), vol. 33(1): 72-77.

9. T. K. De, S. K. Ghosh, T. K. Jana and A. Choudhury, 1991. Size-fractionated primary productivity in Hugli Estuary, Mahasagar, National Institute of Oceanography, Goa, India. Vol. 24(2): 127-131.

10. S. K. Ghosh, T. K. De, A. Choudhury and T. K. Jana, 1991. Oxygen deficiency in Hugli estuary, east coast of India. Indian Journal of marine Sciences (CSIR) Vol. 20 pp 216-217.

11. T. K. De, S. K. Ghosh, T. K. Jana and A. Choudhury, 1991. Extinction coefficient and primary productivity in the mixing zone of Hugli estuary, Journal of Aquaculture in the Tropics, Vol. 5, pp 201-206.

12. T. K. De, S. K. Ghosh, T. K. Jana and A. Choudhury, 1991. Phytoplankton bloom in the Hugli estuary, Indian Journal of marine Sciences (CSIR) Vol. 20 pp 134 –137.

13. T. K. De, S. Ghosh, T. K. Jana, B. N. Singh and A. Choudhury, 1987. The physico-chemical characteristics and primary productivity in waters around Lower long Sands, Hugli estuary, Sundarbans, India, Proc. National Symposium on Marine Resources, Techniques, Evaluation and Management, Weltair, May, 1987, pp 19-21.

14. T.K. De, T. K. Jana and A. Choudhury, 1990. Control of Primary productivity by suspended particulate matter in the Hugli estuary , India, , Tropical Ecology, (International society of Tropical Ecology), vol. 31(2) pp 98-103. 1989-1985

Satellite-Derived Time Series of Cyanobacteria Accumulations in the Baltic Sea

Mati Kahru [*M Kahru *] (Scripps Institution of Oceanography, University of California San Diego, La Jolla, CA 02093-0218, USA; ph. 1-858-534-8947; fax 1-858-822-0562; e-mail: mkahru@ucsd.edu)

Massive surface accumulations of cyanobacteria, primarily of the species Nodularia spumigena, are a characteristic phenomenon in the Baltic Sea. Cyanobacteria are a dominant component of the Baltic ecosystem during the summer and their capability for nitrogen-fixation as well as toxicity makes their management an important task.

Quantitative mapping and estimation of the long-term trends in cyanobacteria accumulations in the Baltic Sea is practically impossible using in situ methods due to their high spatial and temporal variability. The surface manifestation of cyanobacteria accumulations makes them a perfect object for detection and quantification by remote sensors. In contrast to the need for the specialized and accurately calibrated sensors in ocean color work, the Nodularia accumulations are often very bright and easily detectable even with generic sensors like AVHRR. The possibility to use various sensors makes it possible to extend a continuous, satellite-derived time series as far back as at least 1979 using CZCS and AVHRR. The possibility of using satellite sensors with limited atmospheric correction to detect a biologically relevant variable is unprecedented for any satellite-derived bio-optical variable. In contrast, satellite detection of most bio-optical characteristics in complex Case-2 waters such as the Baltic Sea presents a huge problem for both the atmospheric correction and for the inversion of radiances.

While the first satellite observations of cyanobacteria accumulations in the Baltic Sea were made in 1975 with Landsat MSS (Öström 1976), quantitative mapping of the occurrence and extent of the accumulations was started with AVHRR data (Kahru et al. 1994, Kahru 1997). This work showed that during 1982-1994 the accumulations were particularly prominent in the two periods 1982-1984 and 1991-1994, but no long-term trend could be detected. Kahru et al. (2000) showed a drastic change in the Gulf of Finland where the toxic Nodularia blooms had been absent for approximately 15 years but suddenly re-appeared en masse in 1995, being likely triggered by an environmental event (inflow of the salty North Sea waters). From 1995 onwards these toxic blooms have occurred annually in the Gulf of Finland. Using recently reprocessed ocean color data Kahru et al (2007) showed a 39% increase in the mean frequency of accumulations from the period of CZCS (1979-1984) to the modern period of ocean color data (1998-2006). Combining of the various sources of satellite data into a unified, inter-calibrated time series is underway.

Phytoplankton in the Northern Adriatic Sea from 1972 to 2006

R. Kraus [*R Kraus*] (Centre for Marine Research, Rudjer Boskovic

Institute, Rovinj 52210, Croatia, ph. 00 385 52 804 746, fax. 00 385 52 813 496, kraus@cim.irb.hr); N Smodlaka; D Degobbis; R Precali; T Djakovac; J Godrijan; D Maric

Northern Adriatic Sea is an oligotrophic shallow basin (with average depth 35 m) relatively small in volume (635 km3) spreading over the area of 19000 km2. However, due to intense nutrient-rich freshwater inflows, with major impact of the Po River, western part of northern Adriatic is eutrophic. Influence of the trophic state in different parts of the region reflects on the qualitative and quantitative characteristics of the phytoplankton, indicating even some species as possible indicators. Over the past decades, qualitative changes of the phytoplankton community were observed. With statistical analyses of solely phytoplankton as well as together with environmental data, we aim to explain long-term changes and differences in this region to result from the following: nutrient concentration and ratio variations primarily due to freshwater inflow oscillations of Po River, decrease of phosphorous due to its reduction in the Italian detergents during the eighties and the trend of sea surface warming which also started in the eighties.

Phytoplankton Primary Production in the Western and Eastern Scheldt Estuaries During the Period 1990-2006: Did Changes Occur?

Jacco C. Kromkamp Jacco C. Kromkamp* and Jan Peene
Netherlands Institute of Ecology, Centre for Estuarine and Coastal Research (NIOO-KNAW), PO box 140, 4400 AC Yerseke, The Netherlands.*E-mail: j.kromkamp@nioo.knaw.nl

The Eastern Scheldt estuary changed from eutrophic estuary to a mesotrophic lagoon when river discharge from the Rine and Meuse was reduced by 67% in 1987. Construction of a storm surge barrier in the mouth of the estuary reduced the tides by > 30% and as a result the ecosystem changed considerably from a turbid system rich in nutrients to a system with relative high water transparency and relative low nutrients. Nevertheless initial observations suggested that primary productivity did not change, despite a change in phytoplankton species composition. However, continuation of the monitoring activity revealed that productivity dropped between 1995 and 2000. This decrease in productivity seems to be caused by deterioration of the light climate due, we think, to an increase in CDOM. A possible reason for this reason will be discussed.
The Western Scheldt estuary is still a true estuary with a full salinity gradient. Early '90's nutrient and DOM/POM concentrations were high leading to low oxygen concentration in the freshwater region. However, cleaning up of waste water discharges increased water quality. Added to this was an increased amount of dredging (the estuary is the entrance to the port of Antwerp, Belgium). A preliminary analysis seems to indicate that primary production as well as phytoplankton species composition was affected by these changes, but that the changes in productivity were mainly the result of a change in phytoplankton biomass as the relationship between water transparency, phytoplankton biomass and C-fixation did not change.

The results show that it is important to monitor primary production as accurately as possible in order to understand phytoplankton primary production, an important determinant of the carrying capacity of the ecosystem. In the final part of the presentation we will present an alternative method which allows primary production measurements to be automated and which are based on the principle of variable fluorescence.

Long Term Variability at Two Tropical Coastal Stations of IRD (ex-ORSTOM): Abidjan and Noumea

Robert Le Borgne [Robert Le Borgne*, Centre IRD de Nouméa * Centre IRD, B.P. A5, 98848 Nouméa Cédex, New Caledonia E-mail: leborgne@noumea.ird.nc]

Weekly hydrographical and phytoplanktonic data were acquired at coastal stations off Abidjan (Ivory Coast, Western Africa) and Noumea (New Caledonia, SW Pacific), from 1969 to 1979 for the former and 1979-1989 for the latter. Clear seasonal variations are observed in Abdjan and are related to the seasonal coastal upwelling, while temporal variability can be ascribed to the rainfall one in Noumea. These data sets also clearly show interannual variability effect, through the upwelling strength and duration in Abidjan and rainfalls in Noumea. Finally, while those stations were close to urban areas, data sets do not show any clear trend which could be ascribed to antthropogenic influences. Reasons are discussed and deal with the observational period, adequacy of the measured parameters and the pre-eminence of seasonal and interannual variabilities.

Multiyear Trends of Microbial Plankton Change in Bedford Basin

WKW Li [*WKW Li*] (Bedford Institute of Oceanography, PO Box 1006, Dartmouth,
NS, Canada, B2Y 4A2; ph. 1-902-426-6349; fax 1-902-426-9388; e-mail: LiB@mar.dfo-mpo.gc.ca)

Bedford Basin is the inner portion of Halifax Harbour on the Atlantic coast of Canada. Since 1992, the phytoplankton and bacterioplankton of Bedford Basin have been monitored on a weekly basis with the goal of discerning anomaly departures from climatology. At temperate latitudes, year-to-year change in the annual average value of an ocean variable is almost always much smaller than the within-year seasonal variability. This is true, say of temperature, and also of microbial abundance. Thus, multiyear trends cannot be predicted solely from knowing how microbes respond to short-term environmental change. For example, in the Bedford Basin, weekly phytoplankton abundance is strongly correlated with weekly temperature, but not so with weekly nitrate concentration. Conversely, on an annual basis, phytoplankton increase and decrease coherently with nitrate, but not with temperature. This case study affirms that detecting long term change superimposed on recurring annual cycles requires many observations in a year, and many years of observation.

Response of Diatom Flora on the Long-term Environmental Change in

Jiaozhou Bay, China During the Last Century as Evidenced in a Sediment Core

Dongyan Liu [Dongyan Liu] (School of Earth and Environmental Sciences, University of Wollongong, NSW, 2522, Australia; College of Marine Life Science, Ocean University of China, 5 Yushan Road, Qingdao, 266003, China; Ph: 61 2 42214134; Fax: 61 2 42214665; Email: dl988@uow.edu.au) Jun Sun (Institute of Oceanology, The Chinese Academy of Science, Qingdao, 266071, China. Email: phytoplankton@163.com), Jing Zhang (State Key Lab of Estuarine and Coastal Research, East China Normal University, 3663 Zhongshan Road North, Shanghai, 200062, China. Email: jzhang@sklec.ecnu.edu.cn); Guangshan Liu (Oceanography Department, Xiamen University, 422 Siming Road South, Xiamen, 361005, China. Email: lgshan@public.xm.fj.cn)

The diatom flora in a 164 cm long sediment core obtained from Jiaozhou Bay (Yellow Sea, China) was analyzed in order to trace the response of diatoms to environmental changes over the past 100 years. The sediment core was dated by 210Pb and 137Cs and represented approximately 100 years of settlement (1899-2001 AD). The flora was mainly composed of centric diatoms (59-96%). The total diatom concentration declined sharply above 30 cm (~1981 AD), while the dominant species changed from Thalassiosira anguste-lineatus, Thalassiosira eccentria, Coscinodiscus excentricus, Coscinodiscus concinnus and Diploneis gorjanovici to Cyclotella stylorum and Paralia sulcata and species richness decreased slightly, whereas the cell abundance of warm species increased. We argue that these floral changes were probably caused by climate change in combination with eutrophication resulting from aquaculture and sewage discharge.

Eutrophication Along the European Continental Coast: The Role of Nutrients and Underwater Irradiance as Limiting Factors for Phytoplankton Growth

Martina Loebl [*M Loebl*] (Institut für Küstenforschung, GKSS Forschungszentrum Geesthacht GmbH, Max-Planck-Strasse 1, 21502 Geesthacht; ph. 0049 4651 956157; fax 0049 4651 870 408; e-mail:Martina.Loebl@awi.de); F Colijn (Institut für Küstenforschung, GKSS Forschungszentrum Geesthacht GmbH, Max-Planck-Strasse 1, 21502 Geesthacht, Germany; ph. 0049 4152 871533/1534; e-mail:colijn@gkss.de); J E E van Beusekom (Alfred-Wegener-Institute for Polar and Marine Research, Wadden Sea Station Sylt, Hafenstrasse 43, 25992 List/ Sylt, Germany ph. 0049 4651 956151; fax 0049 4651 870 408; e-mail: beusekom@awi.de); J G Baretta-Bekker (RIKZ, National Institute for Coastal and Marine Management Sea and Delta division / Sea Policy section, Kortenaerkade 1 P.O. Box 20907 2500 EX Den Haag; ph. 0031 70 311 4439; fax 0031 70 311 4200; e-mail:j.g.baretta-bekker@rikz.rws.minvenw.nl); C Lancelot (ESA (Ecologie des Systemes Aquatiques) Université Libre de Bruxelles Campus Plaine CP 221, Boulevard du triomphe B-1050 , Belgium; ph. 0032 2 6505988/89; fax 0032 2 6505993; e-mail: lancelot@ulb.ac.be); C J M Philippart

(Royal Netherlands Institute for Sea Research (NIOZ), Department of Marine Ecology and Evolution, P.O. Box 59, NL-1790 AB Den Burg (Texel), The Netherlands; ph. 0031 222 369300; fax 0031 222 319674; e-mail: katja@nioz.de; K H Wiltshire (Alfred-Wegener-Institute for Polar and Marine Research, Postfach 180 D 27483 Helgoland, Germany; ph. 0049 4725 819 238; fax 00494725 819 283; e-mail: Karen.Wiltshire@awi.de)

The European coastal zone is characterized by high anthropogenic riverine nutrient loads and turbid waters. Riverine nutrient inputs showed an increase since the mid 1950's and thereafter a gradual decrease since the mid 1980's. To determine how light and nutrients relate in terms of being limiting factors for phytoplankton growth, seven long term time series along the European coast were analysed using the methods developed by Cloern. We included data on light and nutrients (DIN, P, Si) from 1990-2005 from the Belgian coastal zone, the Dutch coastal zone (inshore & offshore), the Marsdiep tidal inlet, the Helgoland Roads series, a long term station inside the Wadden Sea (Büsum) as well as the permanent monitoring station at Sylt. Main outcome of the analysis is that the intensity of eutrophication depends on the proximity of the nutrient discharges. Despite an ongoing de-eutrophication, light is still the dominant limiting factor for phytoplankton growth in the Wadden Sea.

A slight increase in nitrogen limitation during summer within the past fifteen years could be observed for the offshore stations of Noordwijk (The Netherlands) and Helgoland and also for the northern Wadden Sea (Sylt). For the Marsdiep tidal inlet and Noordwijk we observed a slight increase in phosphorus limitation during summer since the mid 1990's. At these stations (Noordwijk, Marsdiep, Helgoland, Sylt) also the period of nutrient limitation during summer has extended with ~2-4 weeks, indicating an extension of the phytoplankton growth season in autumn within the past fifteen years, due to later remineralisation of the summer nutrients.

Multi-year Oscillations in Phytoplankton Community Composition in the Sargasso Sea

Michael W. Lomas [*M W Lomas*] (Bermuda Institute of Ocean Sciences, 17 Biological Lane, St. George's, GE01, Bermuda; ph. 1-441-297-1880; fax -441-297-8143; e-mail: Michael.Lomas@bios.edu <mailto:Michael.Lomas@bios.edu>)

Since 1989 the Bermuda Atlantic Time-series Study (BATS) has analyzed samples for chlorophyll a and accessory pigments in the oligotrophic Sargasso Sea as indices of total biomass and taxonomic composition, respectively. The general pattern was a short-lived spring bloom, dominated by haptophytes, with nearly constant chlorophyll the remainder of the year. Starting in the winter/spring of 1997, the spring blooms have diminished in magnitude, while summer chlorophyll concentrations have increased slightly leading to a minimal change in annual primary production. Associated with this change in biomass/production patterns has been a change in phytoplankton functional groups, most notably a decline in importance of haptophytes from >50 to <35% of the spring assemblage. At the same time, a multi-year 'stripping' of silicate from the euphotic zone was observed. Although euphotic zone diatom biomass (as biogenic silica or fucoxanthin concentrations) did not increase, biogenic silica concentrations in the twilight zone during this period increased by a factor of three, consistent with the drawdown in silicate. We can only speculate on the reasons for these changes in phytoplankton community composition, but these changes initiated when winter NAO indices made a shift from negative to positive values (indicative of less stormy winters in the Sargasso Sea) and a general shoaling of winter/spring mixed layer depths for a ~5-year period. This rich biogeochemical dataset highlights the potential importance of climate forcing on phytoplankton community dynamics and ecosystem function, even in the 'stable' oligotrophic ocean.

Time Series Observations of Phytoplankton Biomass Dynamics and Phenology in Central New Zealand Coastal Waters

A. Lincoln MacKenzie [*A.L. MacKenzie*]; B. Knight (Cawthron Institute, Private Bag 2, Nelson, New Zealand, ph. +64 3 5482319; fax +64 3 5469464; e-mail: lincoln.mackenzie@cawthron.org.nz; ben.knight @cawthron.org.nz)

Various time series data bases on the biomass and composition of the phytoplankton from the central New Zealand region (40-41oS latitude) have been complied over the last two decades. The parameters measured and the duration of data collection vary depending on the purpose for which the sampling was carried out, however, overall they provide a consistent overview of the main drivers of productivity and phytoplankton floristics in this region. Since the mid 1990s a weekly nationwide phytoplankton sampling programme (80-110 sites) has been in operation to provide early warning of the occurrence of toxic blooms. In addition to the identification and enumeration of nuisance species, the analysis of these samples provides a general characterisation of the phytoplankton communities at the sample sites. This data base contains a wealth of information on the seasonal and inter-annual variations in the coastal phytoplankton. Although a comprehensive analysis of this data has not been attempted, it is clear that community structures typical of specific locations are strongly related to differences in the hydrographic and nutrient milieu. These in term are affected by the El Nino/La Nina southern oscillation cycle and so reflect major global scale climatic influences. More subtle biological factors such as zooplankton grazing and interspecies competition are more difficult to identify although substantial community perturbations brought about by allelopathic interactions have been observed. The resolution of current satellite borne sensors (e.g. MODIS and SeaWifs) is inadequate to observe biomass changes in the narrow enclosed waterways of the Marlborough Sounds where much of the phytoplankton monitoring effort is focussed, however in more open coastal regions (e.g. Tasman Bay) remote sensing data provides detailed images of spatial and temporal dynamics. Examples illustrating fundamental differences in phytoplankton community structure over short spatial scales that are a consequence of consistently different hydrographic properties of the water column will be presented.

Long Term Trends in the Abundance of Phytoplankton, Primary Production and Changes in Phytoplankton Community Structure

Ivona Marasović [Ivona Marasović, Ž. Ninčević, S. Skejić, M. Bužančić, Institute of Oceanography and Fisheries, Plankton Laboratory, Šetalište I. Meštrovića 63, 21000 Split, Croatia, tel: 385 21 408 002, fax:385 21 358 650, e-mail: marasovic@izor.hr]

Data on phytoplankton abundance, structure of phytoplankton community and level of primary production were collected on the basis of monthly sampling in the open and coastal waters of middle Adriatic (1962 – 1982). By analysis of these data there has been noticed an increase of abundance of phytoplankton cells in coastal and in open waters as well. Increase of phytoplankton abundance was followed by increase of primary production. In the coastal waters trend of higher phytoplankton abundance together with increase of primary production level initiated in late 60's, while the same trend in open waters was recorded in late 70's.

Besides occurred changes in abundance of phytoplankton cells, there were also observed changes in the phytoplankton community structure, especially in relations between the main phytoplankton groups, i.e. diatom and dinoflagellate in coastal waters and diatom and coccolithophorid in the open waters of the middle Adriatic.
The obtained data were compared with the latest collected data by the end of 90's and the beginning of 2000 and on. Results were studied in relation to impact of anthropogenic eutrophication and impact of climatic changes.

Spatial and Temporal Trends in Phytoplankton from Long Term Monitoring in the Bay of Fundy, Eastern Canada

Jennifer L. Martin [*J.L. Martin*] (Fisheries and Oceans Canada, 531 Brandy Cove Road, St. Andrews, NB. E5B 2L9; phone 506-529-5921; fax 506-529-5862; e-mail MartinJL@mar.dfo-mpo.gc.ca)

A monitoring program was initiated in May 1987 to study phytoplankton populations in the Bay of Fundy, southwest New Brunswick, eastern Canada. Samples are collected for phytoplankton at five locations in the Bay of Fundy. Other parameters measured include plant nutrients (ammonia, nitrate, phosphate and silicate), secchi depth, and depth profiles for fluorescence, temperature and salinity. Phytoplankton abundance from 5 study sites is compared between years and sites to physical and chemical properties of seawater using principle component analyses (PCA) to identify factors showing the greatest amount of variance in temporal and spatial distribution patterns. Analysis of abundance of most species from the 18 yr period 1987-2005 indicates that cell abundance from one year does not reflect the following year and for one particular species, Alexandrium fundyense, nitrate values and cell densities appear to have a negative relationship. A further comparison between the 2 years, 2004 and '05 (years with very different intensities of A. fundyense maximum cell concentrations) further supported these findings.

Preliminary analyses indicate that phytoplankton abundance and intensity appears to be more climate related than nutrient flux related. Various analytical approaches to examine relationships between cell density, nutrients and environmental variables as well as trends from the Bay of Fundy will be presented.

On the Recent Shifts in the Coastal Black Sea Phytoplankton - a Transient to an Ecosystem Recovery, or a Response to Changing Drivers

Snejana P. Moncheva [*S.P. Moncheva *] (IO-BAS, Parvi Mai str. No 40, P.O. Box 152, Varna-9000, Bulgaria; ph/fax:00359-52-370485 ; e-mail: snejanam@abv.bg); V. Alexandrova (PhD student, e-mail: vesialeks@gmail.com); N. Slabakova (PhD student, e-mail: n.slabakova@abv.bg); V. Doncheva (e-mail: valentina.doncheva@gmail.com)

The analysis of the long-term trends (1954-2003) of phytoplankton blooms in the Varna Bay coastal zone (Bulgarian Black Sea) provided enough evidence that the ecosystem has shifted from a relatively pristine phase around the 70-ies (healthy ecosystem) to a phase of severe ecosystem degradation - till early 90-ies (pathology), manifested by increase in the number, frequency, duration, timing and species involved, related to the cascading effect of multiple drivers - overfishing, eutrophication and exotic species introduction. Still a lot of uncertainties exist about the recent stage of the ecosystem evolution and the controlling mechanisms underlying the current alternating states. Since mid 90-ies the decrease of total phytoplankton abundance and biomass, reduced magnitude and frequency of phytoplankton blooms and regained dominance of diatoms have been considered as signs of "recovery" as a result of reduced land-based nutrient loads due to industrial and agricultural collaps.

The 2000 marked further changes in the phytoplankton communities: increased proportion of mixotrophs along with the diatoms, proliferation of uncommon, different from the habitual diatoms/dinoflagellates species and surprising changes in species succession. Not ignoring the signs of "improvement" of the ecosystem health the results are more in favor of the hypothesis that the recent alterations are induced by the increase of temperature (climatic signal) superimposed to the shifts in nutrient ratios related to the uncontrolled expansion of tourist industry as new emerging drivers of ecosystem threats.

Interpreting Phytoplankton Variations Through the life Cycle Perspective

Marina Montresor [Marina Montresor, Stazione Zoologica A. Dohrn. Villa Comunale, 80121-Napoli (Italy)]

Long term plankton datasets provide information on the structure of the communities along time, highlighting recurrent patterns at the annual scale, interannual variations and long term shifts in species abundance. Experimental and field ecologists have been struggling for decades attempting to define species-specific windows niches for optimal growth delimited by e.g. temperature, light availability, type and concentration of nutrients. However, limited attention has been given to the life cycle features of the single species in explaining population dynamics at both temporal and spatial scales. Laboratory investigations show that planktonic species are characterized by complex life cycles including life forms with markedly different morphological and physiological features such as cysts, spores and resting cells, or the different ploidy stages of prymnesiophytes. Morever, sexual phases seem to be widespread features among protists and can be related to e.g. the formation of resting stages or to restoration of large cell size in diatom populations. However, our appreciation of the temporal shifts amongst different life forms in the natural environment is still extremely scanty. The switch amongst the quiescent and active phases is recognized as crucial for the appearance of the planktonic phase in the water column though the factors affecting it are still controversial. The role of life cycles in the end of blooms has been seldom considered, despite some evidence of massive sinking related to sexuality and cyst formation. At the interannual scales, cysts and spores in the sediments keep the memory of past fluctuations, but a proper understanding of the conditions under which these stages are produced in nature is crucial for a correct interpretation of these "benthic fingerprints".

I will attempt to review the existing information on phytoplankton life cycle as related to population dynamics within the main scales of variability, from seasonal to multidecadal, highlighting possible paths for future research, relevant lack of knowledge and methodological constraints.

Trends and Changes of Phytoplankton Assemblage in a Shallow Coastal sea (Northern Adriatic) from mid-80's Onwards

Patricija Mozetic [*P Mozetic] (Marine Biology Station Piran, National Institute of Biology, Fornace 41, Piran, Slovenia, 6330; ph. 386-5-671-2914; fax 386-5-671-2901; e-mail: mozetic@mbss.org); J France (Marine Biology Station Piran, National Institute of Biology, Fornace 41, Piran, Slovenia, 6330; ph. 386-5-671-2934; fax 386-5-671-2901; e-mail: france@mbss.org)

Regular measurements of chlorophyll a as a proxy of phytoplankton biomass on a coastal station in Gulf of Trieste (northern Adriatic) date back to 1984, while determination of phytoplankton abundance and community structure commenced in 1989 at the same station. From late 80's/early 90's onwards four more stations were monitored for Chl-a distribution. Different statistical approaches performed on this large data set showed spatial and temporal differences in Chl-a distribution. Based on average Chl-a concentrations we can statistically significantly discriminate between one oligotrophic station, one station influenced by land run-offs and a group of stations with intermediate Chl-a concentrations. Nevertheless, all stations were characterised by similar temporal evolution. The longest data set of 23 years indicated 3 periods (5-7 years) of increased Chl-a concentrations separated by years of very low biomass (1985, 1993, 2000 and 2006). A modest increasing trend can be detected at all stations except for the one with the highest average biomass where inverse trend was observed.

Increasing trend in the last two decades was observed in phytoplankton abundance as well, mainly due to increased abundance of nanoflagellates that on average almost doubled in the last seven years (since 2000) as compared to the previous decade. Although diatoms determine the size and duration of seasonal blooms they do not contribute greatly to total abundance and Chl-a biomass on yearly basis. In fact, their abundance didn't change through time except for occasional peaks registered in some years that could be presumably related to abundant freshwater discharges in those years (1991, 1994, 1997, and 2000). Despite increasing trends observed in both parameters that characterise phytoplankton assemblage, there was an uncoupling between Chl-a biomass and total abundance especially from late 90's onwards. We hypothesized that this could be due to the fact that increase of abundance was merely due to increase of small nanoflagellates that do not contribute much to Chl-a biomass. Another important fact that revealed the long time-series analysis was an increase of dinoflagellates, roughly from mid 90's onwards. This increase is of minor relative importance to total yearly abundance but is significantly correlated to Chl-a biomass.

Short- and Long-Term Phytoplankton Composition Responses to Environmental Variability in the Patos Lagoon Estuary and Cassino Beach Surf-Zone, Southern Brazil

Clarisse Odebrecht [*Clarisse Odebrecht*] (Department of Oceanography – Federal University of Rio Grande. Cx. P. 474. Rio Grande - RS, 96201-900, Brazil. Ph: +55 53 3233 6520; Fax: +55 53 3233 6602; e-mail: doclar@furg.br); Marli Bergesch, Carlos Cesar Fujita, Leonardo Rubi Rörig and Paulo Cesar Abreu.

The response of phytoplankton community composition to environmental variability was analyzed in short- and long-time frequencies (daily to inter-annual; 1987 to 2006) in a shallow estuarine bay (32° 09' S; 520 06' W), located 20 km inshore the mouth of Patos Lagoon, and in the intermediate to dissipative surf-zone of the sandy Cassino Beach (32° 10' S, 520 10' W), Southern Brazil. In a short-scale, the main controlling factor of phytoplankton in the estuarine system is related to the hydrology, mainly driven by the passage of atmospheric fronts from the South, with higher frequency in austral winter-spring (6-12 days) than in summer-autumn (8-21 days). During the passage of atmospheric fronts, Southerly winds force the coastal water into the lagoon and estuarine phytoplankton becomes dominated by marine species, while northerly winds leads to the export of freshwater species. During most of the year phytoplankton is dominated by small cells (< 20mm), while microphytoplankton increase in abundance in the austral spring-summer. However, stressful conditions of the estuary determine the dominance of few eurihalyne species, reaching high numbers (>106 cells l-1), as the diatoms Chaetoceros subtilis, Cerataulina bicornis, Cylindrotheca closterium and Skeletonema costatum, or the cyanobacteria Microcystis aeruginosa and Anabaena spp. during periods of high freshwater export. In a larger scale, inter-annual variability of species dominance in the estuary seems to be driven by the El Niño and La Niña phenomena, when the amount of rainfall and nutrients availability determine the dominance and abundance of freshwater or eurihaline species.

Cassino Beach differs from the estuarine embayment by the presence of a resident surf-zone diatom species, the relative higher abundance and frequency of dinoflagellates, and lower frequency of cyanobacteria. In the short-term, the passage of atmospheric fronts from the South results in the accumulation (106-9 - cells l-1) of the surf-zone diatom Asterionellopsis glacialis, which is re-suspended by waves from the sediment behind the surf-zone and concentrated towards the beach. However in summer, the oceanic cyanobacteria Trichodesmium erythraeum may also be accumulated in the surf-zone in response to passage of cold fronts. Seasonal analysis indicates that A. glacialis accumulations represent a local interference in the succession of neritic phytoplankton species, with increasing biomass and decreasing diversity. The impact of large scale processes on the surf-zone phytoplankton was revealed in the years 1998 (strong El Niño) and 2003 (moderate El Niño), when high amount of mud reached the Cassino beach due to the freshwater exportation from the lagoon. After these events A. glacialis numbers were significantly reduced in the following months, since waves could no be formed due to the presence of mud.

Seasonal Dynamics of Phytoplankton Biomass and Taxonomic Composition in the Nervion River Estuary

Emma Orive [*---*] A Butrón (Department of Plant Biology and Ecology, University of the Basque Country, Leioa, Spain, 48940; ph. 946015420; e-mail: gvbbumoa@lg.ehu.es); A Laza (Department of Plant Biology and Ecology, University of the Basque Country, Leioa, Spain, 48940; ph. 946012694; e-mail: gvblamaa@lg.ehu.es); I Madariaga (Diputación Foral of Biskay, Bilbao; ph. 944067900; e-mail: iosu.madariaga@bizkaia.net); E Orive (Department of Plant Biology and Ecology, University of the Basque Country, Leioa, Spain, 48940; ph. 946012570; e-mail: emma.orive@lg.ehu.es); S Seoane (Department of Plant Biology and Ecology, University of the Basque Country, Leioa, Spain, 48940; ph. 946012694; e-mail: sergio.seoane@ehu.es)

The Nervion River estuary supported in the last decades a strong eutrophication which is actually much less intense due to the implementation of a sewerage scheme which includes since 2002 a biological treatment. The monitoring of phytoplankton started in 2000 with the aim to know the frequency, magnitude and composition of the blooms as well as the presence of species potentially noxious. Blooms, some of them of toxic species, are recurrent events in summer both in the outer and inner estuary coinciding with maximum irradiance and shorter residence time of the water. The application of several diversity indices to selected phytoplankton taxa revealed a moderate increases in phytoplankton diversity after the implementation of the biological treatment.

Characteristic of Size Structure and Functioning Peculiarities of Coastal Area Phytoplankton on Chlorophyll "a" and ATP Measurements (Black Sea)

Tatyana Osadchaya [*T. S. Osadchaya*], I. V. Sycoeva , A. A. Sysoev (Institute of Biology of Southern Seas of NAS of the Ukraine (IBSS); Nakhimov av., 2; Sevastopol, Ukraine 99011; Tel: 380692 54 34 56; Fax: 380692 55 78 13; msh@ibss.iuf.net

The size of primary producers is one of the principal ecological features of marine environment, and main indices of photosynthetic and metabolic activities of microplankton community concern to size-depended parameters. Evidently, that hydro-chemical characteristic of data ecosystem finds a reflection in size structure of its primary energy-bearers. Study of phytoplankton distribution on the correlation between different groups or categories picked out in definite diapason of linear sizes allows to present all community as united living matter decomposed into "spectra of the biomasses" (Sieburth, Smetacek, Lenz; 1978). Size structure is represented as a set of size aggregates (the fractions, categories) each of which can be described by corresponding functional or morphological parameters. Variability of a correlation between picked out size subdivisions connected with seasonal changes of the biotic potential, vegetation peculiarities of separate populations and also the environmental conditions exerts an essential influence on an abilities and state of phytoplankton community as a whole. The measurements of chlorophyll "a" and ATP are indispensable condition in phytoplankton study. Steady intercommunication between the pigment and ATP distribution and main ecological characteristics of sea media confirms their information opportunities in study of the production processes and environmental monitoring. Key words: phytoplankton, size structure, chlorophyll a, ATP, HPI

Phytoplankton Community Indicators of Long-Term Ecological Change in the Nutrient and Climatically-Impacted Neuse River-Pamlico Sound System, North Carolina, USA

Hans W. Paerl [*H W Paerl*] (University of North Carolina at Chapel Hill, Institute of Marine Sciences, 3431 Arendell Street, Morehead City, NC, USA, 28516; ph 1-252-726-6841; fax 1-252-726-2426; e-mail: hpaerl@email.unc.edu); B M Peierls, (University of North Carolina at Chapel Hill, Institute of Marine Sciences, 3431 Arendell Street, Morehead City, NC, USA, 28516; ph 1-252-726-6841; fax 1-252-726-2426; e-mail: peierls@email.unc.edu); K L Rossignol (University of North Carolina at Chapel

Hill, Institute of Marine Sciences, 3431 Arendell Street, Morehead City, NC, USA, 28516; ph 1-252-726-6841; fax 1-252-726-2426; e-mail: krossign@email.unc.edu)

Nutrient over-enrichment and resultant eutrophication of estuarine and coastal waters are accelerating. There is a need to develop rapidly detectable, quantifiable and relevant indicators of these changes. Coastal systems are also impacted by climatic perturbations, including droughts, storms and floods; the frequencies of which appear to be increasing. Phytoplankton are excellent indicators of ecological change. They are relatively easy to identify and quantify, and they are ecologically-meaningful indicators, since the conduct a large share of primary production and are sensitive to a suite of environmental stressors and changes. Phytoplankton community biomass (chlorophyll a) and group specific chemotaxonomic indicators (chlorophylls and carotenoids) were examined over a 13 year (1994-2007) period to clarify community responses to such perturbations in the Neuse River Estuary-Pamlico Sound, NC. This estuarine-coastal continuum is experiencing anthropogenic nutrient enrichment and, since 1996, a rise in hurricane frequency. Freshwater input and flushing strongly interacted with supplies of the limiting nutrient nitrogen (N) to determine the location, magnitude and composition of phytoplankton biomass along this continuum. Elevated flow (high flushing) following hurricanes favored dominance by the fast growing chlorophytes and cryptophytes. Diatoms tended to dominate under moderate flow, while dinoflagellates and cyanobacteria increased in dominance when low flow prevailed in winter-spring and summer-fall respectively. Depending on seasonal hydrologic cycles and episodic (hurricane) conditions, phytoplankton community structure differed substantially. These changes impact trophic state and food web structure, biogeochemical (e.g. hypoxia) and habitat conditions in this and other coastal ecosystems currently experiencing changes in nutrient inputs and climatic events. These indicators are adaptable to unattended monitoring platforms (e.g. moorings, ferries) that can be coupled to remote sensing and modeling efforts, in order to evaluate and help manage ecological change at ecosystem and regional scales.

Phytoplankton Dynamics in the Plume of the Mississippi River: Responses to Nitrogen Enrichment, Silica Limitation, and Phosphorus Limitation

Michael L. Parsons [*M L Parsons *] (Department of Marine and Ecological Sciences, Florida Gulf Coast University, 10501 FGCU Blvd South, Fort Myers, FL, USA, 33965; ph. 1-239-590-7526; fax 1-239-590-7660; e-mail: mparsons@fgcu.edu); Q Dortch (NOAA/NOS/NCCOS/CSCOR, 1305 East West Highway, Silver Spring, MD, USA, 20910; ph. 1-301-713-3338; fax 1-301-713-4044; e-mail: quay.dortch@noaa.gov); W Morrison (Louisiana Universities Marine Consortium, 8124 Hwy 56, Chauvin, LA 70344; ph. 1-985-851-2800; fax 1-985-851-2874; e-mail: wmorrison@lumcon.edu), N N Rabalais (Louisiana Universities Marine Consortium, 8124 Hwy 56, Chauvin, LA 70344; ph. 1-985-851-2800; fax 1-985-851-2874; e-mail: nrabalais@lumcon.edu); R E Turner (Department of Oceanography and Coastal Sciences, Louisiana State University, 2173 Energy, Coast & Environment Building, Baton Rouge, LA, USA, 70803; ph. 1-225-578-6454; fax 1-225-578-6326; e-mail: euturne@lsu.edu); Alisa Maier (210 Waterberry Drive, Broussard, LA, USA, 70518; ph. 1-337-280-7347; fax: 1-337-280-7347; da_chickadee2003@yahoo.com).

The Mississippi River watershed is the largest in North America and terminates on the continental shelf in the northern Gulf of Mexico. Nitrate concentrations in the river have tripled over the last century, resulting in higher phytoplankton biomass and productivity that has contributed to the development of the second largest area of coastal hypoxia in the world. Silica concentrations in the river have dropped 50% during this time period, causing the N:Si ratio to drop from 4:1 to 1:1, resulting in episodes of silica limitation affecting phytoplankton dynamics since the 1980s. Recent studies suggest that phosphorus limitation is an even more recent development, further influencing the phytoplankton dynamics of this coastal ecosystem. Phytoplankton samples have been collected on a routine basis in the plume of the Mississippi River in the northern Gulf of Mexico since1990. Examination of these samples, coupled with comparisons with historical data, has indicated that 1) harmful algal species (primarily Pseudo-nitzschia sp.) are now more prominent versus the past; 2) larger, more heavily silicified diatom species (e.g., Paralia sulcata) have been replaced by smaller, more lightly silicified ones (e.g., Cyclotella choctawhatcheeana); and 3) primary consumer (copepod) biomass decreases substantially during periods of silica limitation. The dynamic nature of this system, i.e., high rates of productivity (~300 gC/m2/yr) coupled with multiple nutrient-limitation scenarios (P, Si, or N at various times of the year); and the resultant impacts (hypoxia, harmful algal blooms, uncoupling of trophic transfer) can be further studied (and modeled) through more rigorous (and better-suited) analysis of the fifteen-year database compiled for this system.

A Cross-Sectional Time Series Analysis of Surface Chlorophyll in Chesapeake Bay

Elgin S. Perry [*E. S. Perry *] (Statistics Consultant, 2000 Kings Landing Rd., Huntingtown, MD, USA, 20639-9743; ph. 1-410-535-2949; email: eperry@chesapeake.net); L. W. Harding, Jr. (Research Professor, University of Maryland Center for Environmental Science, Horn Point Laboratory, Box 775, Cambridge, MD, USA, 21613-0775; ph. 1-410-221-8247; email: larry@hpl.umces.edu)

This presentation is focused on statistical tools for assessing long term trend in surface chlorophyll in the presence of complicating variables that affect chlorophyll response but are not related to the trend hypothesis. The assessment of trend is motivated by the need to verify progress toward goals established by agreements among Chesapeake Bay Program Partners to protect and restore the Chesapeake Bay's ecosystem. These agreements were signed in 1983, 1987, and 2000 pledge to significantly reduce nutrient input to Chesapeake Bay. It is expected that a downward trend in phytoplankton biomass and hence chlorophyll is a good indicator of effective implementation of management actions to achieve this goal. The assessment of trend is complicated by many factors that induce changes in the phytoplankton standing crop including seasonality, flow, nutrient input, light availability, and stratification. In this work, we assemble these many factors into a predictive model of surface chlorophyll. The process involves selecting the most important of the many potential independent variables, identifying lags between the chlorophyll response and exogenous variables such as flow, and developing an appropriate stochastic model that accounts for dependence in space and time. Once assembled, the predictive model allows statistical control for the extraneous factors and optimizes the test for trend. Model development will be illustrated using surface chlorophyll measures taken from 50 stations along the main channel of Chesapeake Bay with a nearly monthly frequency for the period 1985 - 2004.

Impacts of Nutrient Enrichment and Reduction on Coastal Communities: What Goes up Must Come Down?

C J M Philippart [*C J M Philippart*] (Royal Netherlands Institute for Sea Research, Department of Marine Ecology & Evolution, P O Box 59, 1790 AB Den Burg, The Netherlands; ph. +31 – 222 – 369563; fax +31 – 222 – 319674; e-mail: katja@nioz.nl)

During the past decades, the western Wadden Sea has been subject to nutrient enrichment and reduction. Whilst the enrichment was followed by a doubling of phytoplankton biomass and production at the end of the 1970s, algal biomass remained high ever since in spite of reduction of nutrient loads since the mid-1980s. Phytoplankton species composition, however, changed drastically both between 1976 and 1978 and again between 1987 and 1988, and was relatively stable in-between (1974-1976, 1978-1987) and thereafter (1988-2003). These major changes in phytoplankton biomass and species composition coincided with changes in absolute and relative (N:P) nutrient concentrations. Both nutrient enrichment and reduction were directly followed by changes in the estuarine community as reflected in macrozoobenthos and estuarine birds. Although we cannot conclusively determine if, and if so to which extent, nutrient enrichment and subsequent nutrient reduction actually contributed to the concurrent trends in these communities, it appears likely that part of the variance in the studied coastal communities is related to changes in nutrient loads. These findings imply that nutrient reduction measures should not ignore potential consequences for policies aimed at bird conservation and exploitation of living marine resources.

Spatial and Temporal in Harmful Algal Blooms in the Indian River Lagoon, Florida, USA

Edward J. Phlips [*E J Phlips*] (University of Florida, 7922 N.W. 71st Street, Gainesville, FL, USA 32653; ph. 1-352-392-9617, ext. 248; fax 1-352-

392-3672; e-mail: phlips@ufl.edu); S. Badylak (University of Florida, 7922 N.W. 71st Street, Gainesville, FL, USA 32653; ph. 1-352-392-9617, ext. 283; fax 1-352-392-3672; e-mail: oceans@ufl.edu); M A Lasi (St. Johns River Water Management District, P.O. Box 1429, Palatka, FL 32178; ph.386-329-4825; fax 386-329-4585; e-mail: mlasi@sjrwmd.com)

The Indian River Lagoon stretches across 350 km of the eastern shore of Florida. Historically, the watershed of the lagoon has been the site of extensive agricultural activity, but more recently has become one of the fastest growing population centers in the United States. Since the mid-1990s the lagoon has been extensively monitored for water quality, including phytoplankton populations, because of concerns about the potential consequences of eutrophication for recreational activities and fisheries in the lagoon. Adding to the concerns about the health of the estuary is the recent upsurge in the intensity and frequency of harmful algal blooms, particularly the saxitoxin-producing dinoflagellate Pyrodinium bahamense. The specific causes of these changes in bloom dynamics have not been identified. Observations of the relationships between spatial and temporal patterns in phytoplankton populations and water quality parameters may provide important insights into the driving forces behind these bloom events. From these observations, it is possible to hypothesize that temporal change in watershed inputs and the hydrology of the lagoon may play major roles in the observed changes in phytoplankton dynamics over the past decade.

Time Series of Phytoplankton from Remote Sensing

Trevor Platt [Bedford Institute of Oceanography, Dartmouth, Nova Scotia, B2Y 4A2 Canada, Telephone 1-902-426-3793, Fax 1-902-426-9388, TPLATT@DAL.CA]

Remote sensing provides our only window into the phytoplankton community on synoptic scales, permitting the construction of spatially-distributed time series of biomass indexed as chlorophyll concentration. Data from the SeaWiFS mission have accumulated to the point that they meet the criterion of a ten-year series. Data from earlier missions exist, but the difficulty of merging data from different series limits the nature of reliable merged products. The most robust of these relate to the phase of the seasonal phytoplankton cycle (dominant mode of temporal variability). The time series can be used to construct a variety of ecological indicators of the pelagic system useful in ecosystem-based management. These are reviewed and examples of their implementation presented. Interannual variation in some of the indicators is strong, presumably a response to variation in large-scale forcing. Remote sensing imagery lends itself to the retrieval of information on community structure, in addition to biomass. The most information will be recovered from satellite imagery if the remote-sensing program is coupled closely to a ship program on which appropriate bio-optical observations are made.

Coastal Phytoplankton Community in Black Sea: Long-Term Patterns and Variations

Igor G Polikarpov [*I G Polikarpov *] (Mariculture, Fishery and Marine Environment Dept., Kuwait Institute for Scientific Research, P.O. Box 1638, 22107 Salmiya, Kuwait; ph. 965 571-6690-256; fax 965 5711293; e-mail: igor.polikarpov@gmail.com and IBSS, Sevastopol, Ukraine); M A Saburova (Department of Plankton, Institute of Biology of the Southern Seas, National Academy of Science of Ukraine, 2, Prosp. Nakhimova, Sevastopol 99011; ph. 38-0692-54-24-84; fax 38-0692-55-35-78; e-mail: msaburova@gmail.com); L A Manzhos (Department of Plankton, Institute of Biology of the Southern Seas, National Academy of Science of Ukraine, 2, Prosp. Nakhimova, Sevastopol 99011; ph. 38-0692-54-24-84; fax 38-0692-55-35-78; e-mail: manzhos@ibss.iuf.net)

A changes within phytoplankton community (species structure, composition of dominant species, and seasonal dynamics) have been analyzed throughout last 70 years. This evaluation has been conducted in relation to regular observation of phytoplankton interannual variability in Sevastopol Bay (Crimean Peninsula, Ukraine, Black Sea) in 2001-2006 (2-3 stations, bi-weekly samples) in comparison with previous phytoplankton studies in this area since 1937-1938.

Interannual variability of annual average values for total phytoplankton abundance and biomass was not significant; however, the range of seasonal variability of phytoplankton density decreased, resulted in increasing of evenness for total phytoplankton abundance throughout year.

The variability within composition of phytoplankton community core group (species complex contributed > 90 % of total abundance) was not significant. Complex of dominant species was contributed by four genera of diatoms: Chaetoceros, Skeletonema, Cerataulina and Leptocylindrus during 1937-1938. Dominant positions of these taxa in community were invariable till 1996-1997. After 2000, dominant species complex was supplemented by Pseudo-nitzschia delicatissima, which took the place of Cerataulina pelagica. The similar stability was observed for annual rank-species distributions: approximately same number of species (10-12) mainly contributed in total abundance and biomass of phytoplankton during all studied time.

Analysis of interannual changes within sub-dominant complex of phytoplankton community reveals progressive replacement of dinoflagellates from genera Glenodinium, Peridinium and Prorocentrum by complex of prymnesium algae (Lohmanosphaera, Syracosphaera, Emiliania, Coccolithinea).Observed significant persistence of taxonomical composition within dominant species complex during approximately 7 decades allows to conclude that phytoplankton in Sevastopol Bay form mature community, relative resistant to anthropogenic, climatic and biotic impacts. We connect some changes within community on the species and genus levels with biological invasion of new species.

Seasonal dynamics of phytoplankton demonstrated cyclicity with period close to year. It may be considered as remarkable example of cyclic constancy, when different complexes of dominant species forming as response to cyclical changes of environment. High similarity of phytoplankton structure was observed within separate seasons and its sharp step-down at spring (March) and summer end-early fall (August-September) was indicated to displacements within complex of dominant species.

An Overview of Seasonal and Decadal Changes in Phytoplankton Composition in the Bay of Bengal

N. Ramaiah Jane T. Paul (National Institute of Oceanography, Dona Paula, Goa 403 004, India; telephone: +91 832 2450518; fax: +91 832 2450602; email: jane@nio.org;); [*N. Ramaiah*] (National Institute of Oceanography, Dona Paula, Goa 403 004, India; telephone: +91 832 2450515; fax: +91 832 2450602; email: ramaiah@nio.org)

The International Indian Ocean Expedition (IIOE) during 1962-1965 laid foundation for systematic study of the Indian Ocean. Beginning from Torrington-Smith's systematic analysis of phytoplankton in the Arabian Sea and the Equatorial Indian Ocean, there have been numerous studies in the Bay of Bengal on their composition, seasonal shifts and distribution. The Bay of Bengal is a warm pool region receiving large volumes of freshwater, in particular during the Asian Monsoon season (June-September). Its surface waters are almost perennially stratified. With weak or no upwelling and the cloud cover persisting during most part of the year, the chlorophyll in the surface waters in the Bay is generally low. There is almost a complete lack of information on phytoplankton assemblages in the open waters of the Bay. As a part of the Bay of Bengal Process Study, seasonal samples were collected from a central Bay transect along 88 E and from the western Bay. We sampled during southwest monsoon (July-August 2001), post-monsoon (September-October, 2002), pre-monsoon (April-May 2003) and winter-monsoon (December 2005-January 2006). From this detailed analysis, 341 species of phytoplankton were identified. With >90% of them being diatoms both in the central and western Bay during all the four seasons. There were remarkable seasonal differences in the dominance of diatom species. Thalassiothrix longissima, Thalassiothrix fauenfeldii and Skeletonema costatum were the preponderant of the total 153 species during southwest monsoon 2002. With 123 species recorded during post-monsoon, Thalassionema nitzschioides, Navicula sp and Chaetoceros lorenzianus were the dominant forms. During pre-monsoon, Navicula sp contributed up to 31% of total phytoplankton cell counts followed by Trichodesmium sp (22%of total counts) in a total of 65 species. During winter-monsoon, 58 species were recorded. Navicula spp, Coscinodiscus spp and N. distans were predominant. In addition to describing the depth-, region- and season-wise differences observed, this presentation will focus also on highlighting the decadal changes in the phytoplankton composition recorded by various investigators from the estuarine, land-sea margins and near-shore regions.

A Decade of Change in the Swan Canning Estuary - Phytoplankton Trends in a Changing Climate

Malcolm S. Robb [*M.S. ROBB*] (Department of Water, Level 4 Septimus Roe Square, 256 Adelaide Terrace, Perth Western Australia, ph 61+ 8 6364 7852, fax 61 + 8 6364 7888)

Routine weekly water quality sampling has occurred in this urban estuary since 1994 in which phytoplankton have been measured as counts/ml at group level with dominant species recorded, with supporting chlorophyll a data. A full range of water quality variables include total and dissolved nutrients, salinity and dissolved oxygen. Australian estuaries tend to eutrophy with much lower nutrient concentrations than in the northern hemisphere. This highly productive mediterranenan estuary has recently experienced fish kills due to low oxygen and in the riverine reaches is tending to hypereutrophication. Although some of these fish kills have been associated with the toxic dinoflagellate Karlodinium micrum all fish kills are in areas of low oxygen. A ten year data set has been subjected to rigorous trend analysis which has both confirmed observed trends and highlighted emerging trends. Over the period of monitoring the estuary has become more marine in the lower reaches and the salt wedge has penetrated further into the riverine reaches. Stratification is more frequent and extensive and hypoxia is more common. Although there has been an apparent increase in dinoflagellates and indeed harmful species there has also been an increase in chlorophytes and diatoms even in the upper estuary. A drying climate with less flow from the catchment and more erratic rainfall has resulted in less flushing and higher retention times exacerbating the impacts of organic loading from the catchment. These patterns also occur in other estuaries of the South West of Western Australia.

Seasonal and Interannual Patterns in Phytoplankton Assemblages in the Gulf of Naples

Diana Sarno [*D Sarno*] (Stazione Zoologica A. Dohrn, Villa Comunale 80121, Napoli, Italy, Tel. +39-081-5833282, Fax +39-081-7641355, e-mail: diana@szn.it); L Dubroca (Stazione Zoologica A. Dohrn, Villa Comunale 80121, Napoli, Italy, Tel. +39-081-5833247, Fax +39-081-76 41 355, e-mail: dubroca@szn.it); P Licandro (Sir Alister Hardy Foundation for Ocean Science, The Laboratory, Citadel Hill PL1 2PB Plymouth PL1 2PB Devon, UK, Tel +44(0)1752633289, 44 (0)1752633102 prli@sahfos.ac.uk); A Zingone (Stazione Zoologica A. Dohrn, Villa Comunale 80121, Napoli, Italy, Tel. +39-081-5833295, Fax +39-081-7641355, e-mail: zingone@szn.it)

The seasonal alternation and interannual variations of phytoplankton are currently interpreted as the result of changing environmental conditions acting as selective factors on different species assemblages. In this view, species belonging to an assemblage share common ecophysiological traits and can be considered a recurrent and

stable functional group, whereby the occurrence of one single species is strongly affected by a stochastic component. This paradigm has been successfully applied to freshwater environments, where specific assemblages can be predicted based on seasonal and trophic conditions.
Are these concepts also applicable to coastal marine phytoplankton? Preliminary results from a R-mode analysis based on a hierarchical clustering methods, and from hierarchical classification of the observations, show that at the long term station in the Gulf of Naples a number of species do recurrently occur together, although the majority do not specifically characterize one or another species-groups or periods obtained. These results may partly depend on the poor taxonomic resolution of phytoplankton data and from the widespread presence of cryptic species. Besides these limitations, it seems that co-occurring species often belong to distinct functional groups, based on current knowledge on species physiology and ecology. For example, a relatively stable association may include species that would be hardly believed to share the same ecological requirements such as non-motile, colony forming and silica-requiring diatoms, solitary and scarcely silicified diatoms, tiny autotrophic flagellates, mixotrophic species, fast-swimming dinoflagellates. More likely, within each assemblage, members of distinct functional groups autonomously exploit different parts of the environmental spectrum.

Machine Learning Methods in Phytoplankton Time Series Analysis

M. Scardi [*M Scardi*] (Dept. of Biology, Tor Vergata University of Rome, Via della Ricerca Scientifica, 00133 Rome, Italy; ph. +39-06-72595991; fax +39-06-62275147; e-mail: mscardi@mclink.it)

Multivariate statistics has played a major role in community ecology during the last 30 years and at present it has become part of the methodological toolbox of most ecologists. Time series analysis of species assemblages, however, is not a trivial task, as the most effective statistical methods cannot be readily applied to complex multivariate data sets. Therefore, time patterns in community ecology are often indirectly analyzed using, for instance, ordination techniques and permutation tests based on distance or dissimilarity matrices. Phytoplankton assemblage studies are no exception to this habit, with additional problems due to their inherent complexity. Recently, some machine learning methods have been successfully applied to community ecology for predicting species assemblage structure, while others have a potential for analyzing coenoclines and ecological successions. The basic concepts as well as some existing applications of these methods will be presented, and the role they might play in phytoplankton time series analysis will be thoroughly discussed.

Long-term Tidal Chesapeake Bay Basin Phytoplankton: Potential Linkages to Land and Ecosystem Changes

Kevin G. Sellner [*K G Sellner*] (Chesapeake Research Consortium, 645 Contees Wharf Rd., Edgewater, MD, USA, 21037; ph. 1-443-482-2350; fax 1-443-482-2380; e-mail: sellnerk@si.edu); R V Lacouture and J Anderson (Morgan State University Estuarine Research Center, 10545 Mackall Rd., St. Leonard, MD, USA, 20685; ph. 1-410-586-9700; fax 1-410-586-9705; e-mails: rlacouture@moac.morgan.edu and janderson@moac.morgan.edu); H G Marshall, Department of Biological Sciences, Old Dominion University, Norfolk, VA, USA, 23529; ph. 1-757-683-3595; fax 1-757-683-5283; e-mail: hmarshal@odu.edu); J Johnson, Interstate Commission on the Potomac River Basin, 410 Severn Ave., Annapolis, MD, USA, 21403; ph. 1-410-267-5729; fax 410-267-5777; e-mail: jjohnson@chesapeakebay.net); G Shenk, EPA, 410 Severn Ave., Annapolis, MD, USA, 21403; ph. 1-410-267-5745; fax 1-410-267-5777; e-mail: GShenk@chesapeakebay.net)

River discharge and meteorology govern phytoplankton distributions in Chesapeake Bay. Phytoplankton (species, biomass) in tidal Chesapeake Bay and its primary tributaries has been assessed through a comprehensive monitoring program since 1984. Temporal distributions include a winter-spring diatom biomass maximum in oligo-polyhaline regions whose intensity is proportional to Susquehanna River discharge and N loading. The bloom largely settles to the bottom ungrazed due to a temporal decoupling of the spring maximum from dominant mesozooplanktonic copepods; sedimenting diatom biomass fuels the summer deep water hypoxia/anoxia with aperiodic summer mixing events leading to short-term diatom and dinoflagellate blooms. Summer phytoplankton in these same regions is dominated by flagellates, small centric diatoms, and autotrophic picoplankton, with recent increasing frequencies of a filamentous cyanobacterium; however, in tidal-fresh areas, there is increasing frequencies of cyanobacteria (e.g., hepatotoxic Microcystis aeruginosa). Although summer biomass is lower than observed in the spring, productivity reaches its annual maximum. Tributary-specific data permits examination of unique system responses, i.e., response to urban, suburban, or agriculture-dominated land use. Complementary data include water quality measures (nutrients, chlorophyll a, DO, salinity, T), other living resource estimates (zooplankton, submersed grasses, benthos) as well as routine estimates of nutrient and sediment loads across the watershed. Further, historic, current, and future (2030) land use and land cover for the basin are also available, permitting examinations of long-term changes in plankton as a function of anthropogenic activities.

Direct and Derived Long Time Records of Primary Production in the Delaware Estuary

<u>Jonathan H. Sharp</u> [*J H Sharp*](College of Marine and Earth Studies, University of Delaware, 700 Pilottown Rd, Lewes, DE, USA, 19958; ph. 1-302-645-4259; fax 1-302-645-4007; email: jsharp@udel.edu)

The estuary of the Delaware River and Bay, in the mid-Atlantic region of the United States, is one of the largest and most urbanized estuaries in the US. 250 years ago, the city of Philadelphia, then the nation's largest city, was perceived by Benjamin Franklin to have a major negative impact on the tidal river. I have recently constructed a 120 year simulated picture of the dissolved oxygen in the urban region of the river based on some direct data and anecdotal information that shows major deterioration of water quality to extreme summer hypoxia followed by major improvement. We have a good 40-year direct measurement monitoring record for the entire estuary of dissolved oxygen, nutrients, and chlorophyll which spans from the end of the period of extreme hypoxia to the present well oxygenated condition. I have a database from the past 28 years with directly measured depth-integrated primary production complemented with extensive biogeochemical data. The presentation will include evaluation of the real-time primary production of the past quarter of a century plus extension to a half century of simulated primary production derived from chlorophyll and from oxygen saturation modeling.

Multidecadal Trends in Community Bloom Behavior and in the Blooms of Key Species and Functional Groups in Narragansett Bay

Ted Smayda [*T J Smayda*] (Graduate School of Oceanography, University of Rhode Island, Narragansett, RI, USA, 02882; ph. 1-401-874-6171; fax: 1-401-874-6682; e-mail: tsmayda@gso.uri.edu); D G Borkman (Graduate School of Oceanography, University of Rhode Island, Narragansett, RI, USA, 02882; ph. 1-401-874-6686; fax: 1-401-874-6682; e-mail: dborkman@gso.uri.edu)

The long-term patterns, trends and changes in the annual bloom behavior of the collective phytoplankton community, key species and functional groups (diatoms vs. flagellates) in Narragansett Bay over a 38-year period (1959–1996) based on weekly sampling are described. Narragansett Bay is located in the biogeographical transitional region between Temperate and Boreal waters along the eastern coast of the U.S., ideally located in a geographical transition zone (ecotone) well suited to detect the effects of long-term climatological changes on plankton dynamics. Each community element to be discussed exhibited major, long-term changes in bloom occurrences, in bloom timing, and in annual mean numerical abundance, with evidence of rhythmic behavior in the numerical abundance ratio of the two functional groups, and in the bloom sequence patterns of some species. In contrast, the mean annual biomass (chlorophyll) declined 2.5-fold between 1972-1996. The relationships found between the observed patterns and trends in long-term bloom behavior and the changes in temperature and nutrients suggest that the bloom behavior of the community, individual species and functional group is more sensitive to altered nutrient and temperature conditions than expected from their well-established influence on short-term bloom variability, with the changed bloom behavior cryptically becoming deflected and/or transitioning towards new bloom equilibrium states. The patterns and trends in bloom behavior will also be considered from the perspective of the “open niche” theory and energy-flow.

Plankton Dynamic in Coastal Area of Northern Adriatic Sea

Cosimo Solidoro [*Solidoro C.*], Bandelj V., Cabrini M. Cossarini G., (Istituto Nazionale di Oceanografia e geofisica sperimentale –OGS, Trieste, Italy) Bastianini M. , Bernardi-Aubry F., Socal G. (CNR ISMAR Riva Sette Martiri, Venezia Italy), Fonda Umani S. (dipartimento di biologia, Università Trieste, Italy)

We present result from analysis of time serie of abundances and compositions of plankton collected in different coastal areas of the Northern Adriatic Sea, including the Gulf of Trieste, the lagoon of Venice, and the north-western coastal Adraitic Sea. The research included identification of trends and seasonality by means of standard time series analysis, and analysis of specie environment relationships by means of direct and indirect gradient analysis. Result of canonical analysis indicate that there is no clear realtionships among plankton community composition and environmental variables, whereas a relationship can be identified with the month of occurence and the temperature, and therefore it is possible to infer a seasonal succession of communities. Conversely, concentrations of nutrients are related to plankton abudances, with higher number of organisms in correspondence with higher concentration of nutrients. Artificial neural network were used to, in order to check wheter or not these nonlinear structure had better capabilities in modeling this data set. Our preliminary result indicated that unsuperivsed network are useful in patternizing the data set, and therefore in the ordination of communities and identification of possible typical successions to be used as a refernce term for the area considered. Supervised networks, while showing predictive capabilities better than regression analysis, were able to capture only a pretty modest fraction of variance in the data set.

Influence of Oligotrophication and Climate Variability on chla Dynamics and chla Profiles in a Deep Lake

Dietmar Straile [*D Straile *] (Limnological Institute, University of Konstanz, 78464 Konstanz, Germany ph. 0049 7531 88 2969; fax 0049 7531 883355; e-mail: Dietmar.straile@uni-konstanz.de)

Lake Constance is a large (500 km2) and deep (zmean = 101 m) lake in Central Europe. Total phosphorous concentrations declined continuously during the last decades from a maximum of 87 µg P/L towards less than 10 µg P/L during recent years. As a response chlorophyll a concentrations declined approximately 10 –fold. This decline was accompanied by strong changes in the seasonal and depth distribution of chl a. Using this data set we can show in an exemplary way how the seasonal biomass dynamics as well as depth profiles change in an aquatic ecosystem with changing nutrients. Interannual variability in chl a concentrations during specific periods of the year was additionally influenced by climatic variability associated with the North Atlantic Oscillation (NAO). However, the very start of the algal bloom was not related to the NAO but depended on a complex interaction of temperatures and wind speed. Using a coupled biological

– hydrodynamical model we are able to predict the timing of the spring bloom under present meteorological conditions and under global warming conditions.

Long-Term Changes in Summer Phytoplankton Communities of the Open Northern Baltic Sea

Sanna Suikkanen [* S Suikkanen*] (Finnish Institute of Marine Research, PO Box 2, FI-00561 Helsinki, Finland; ph. +358 9 61394548; fax +358 9 3232970; e-mail: sanna.suikkanen@fimr.fi); M Laamanen (Ministry of the Environment, PO Box 35, FI-00023 Government, Finland; ph. +358 20 4907338; fax +358 9 16039395; e-mail: maria.laamanen@ymparisto.fi); M Huttunen (Finnish Institute of Marine Research, PO Box 2, FI-00561 Helsinki, Finland; ph. +358 9 61394555; fax +358 9 3232970; e-mail: maija.huttunen@fimr.fi)

We investigated relationships between the late summer biomass of different phytoplankton taxa and environmental factors, and their long-term (1979-2003) trends in two areas of the Baltic Sea, the northern Baltic proper (NBP) and the Gulf of Finland (GF), with statistical analyses. An increasing trend was found in late summer temperature and chlorophyll a of the surface water layer (0-10 m) in both areas. There was also a significant decrease in summer salinity and an increase in winter dissolved inorganic nitrogen to phosphorus (DIN:DIP) ratio in the NBP, as well as increases in winter DIN concentrations and DIN:SiO 4 ratio in the GF. Simultaneously, the biomass of chrysophytes and chlorophytes increased in both areas. In the NBP, also the biomass of dinophytes increased and that of euglenophytes decreased, whereas in the GF, cyanobacteria increased and cryptophytes decreased. Redundancy analysis (RDA) indicated that summer temperature and winter DIN concentration were the most important factors with respect to changes in the phytoplankton community structure. Thus, the phytoplankton communities seem to reflect both hydrographic changes and the ongoing eutrophication process in the northern Baltic Sea.

Time Series of Chl a and Phytoplankton Species in the Eastern Seto Inland Sea, Japan

Kuninao Tada [*K Tada*](Kagawa University, Miki Kagawa Japan 761-0795; ph. +81-87-891-3148; fax +81-87-891-3148; e-mail: tada@ag.kagawa-u.ac.jp kuninao44@ybb.ne.jp); S Yoshimatsu (Akashiwo Research Institute of Kagawa Prefecture, ph. +81-878-43-6511; fax +81-878-41-8133; e-mail: jr4587@pref.kagawa.lg.jp); T. Nishikawa (Fisheries Technology Institute, Hyogo Prefecture, Hutami Akashi Japan 674-0093; ph. +81-78-941-8601; fax +81-78-941-8604; e-mail: tetsuya_nishikawa@pref.hyogo.jp); K. Tarutani (National Research Institute of Fisheries and Environment of Inland Sea, Fisheries Research Agency, Maruishi 2-17-5, Hatsukaichi, Hirosima Japan 739-0452; ph +81-829-55-0666; fax +81-829-54-1216; e-mail: tarutani@fra.affrc.go.jp)

The Seto Inland Sea is located in the western part of Japan and is famous for its beautiful landscape including as many as 600 islands. It is about 500 km long, 5 to 50 km wide, and with an average depth of 30 m. The surface area of the Seto inland Sea is 17,107 km2, which is nearly the same as Lake Ontario in North America. The Seto Inland Sea is also well known as one of the most industrially developed areas in Japan. About 34 million people live in the coastal area. There are 10 prefectures surrounding the Seto Inland Sea and each prefecture and some institutes have their own monitoring program.

We gathered the long term time series data sets for the Seto Inland Sea and determined the seasonal and annual phytoplankton variability. However unfortunately, not all prefectures and institutes determined chlorophyll a concentrations and phytoplankton species. Therefore we focused on seasonal variations of phytoplankton biomass (Chl a) for some areas, such as Harima-Nada, in the eastern Seto Inland Sea from 1991 to 2006.

Different seasonal patterns were observed depending on the different areas of Harima-Nada. Although a clear general seasonal variation of phytoplankton biomass was not observed, high Chl a values were observed during the summer period in some areas. The phytoplankton assemblage was dominated by diatoms, such as Skeletonema costatum, Chaetoceros spp. and there was a tendency for the Raphidophyceae to decrease during 1973 to 2005. Moreover, there were changes in the diatom species composition. Skeletonema costatum was the dominant species in the 1970s, but from the middle of the 1980s, the abundance of Skeletonema costatum decreased and Chaetoceros spp. increased. In addition, there were changes in the species composition of the Dinophyceae. Generally Dinophysis fortii was often observed in 1980s, but there was a reduction in its cell number in 1990s.

Interest of the Genus /Ceratium/ Schrank (Planktonic Dinoflagellates) as a Biological Indicator of Global Change in the NW Mediterranean: Comparison Between Recent Samples Data and old Bibliographic Data in Ligurian and Tyrrhenian Seas

Alina Tunin-Ley [*A Tunin-Ley*] (Université Pierre et Marie Curie-Paris6, Laboratoire d'Océanographie de Villefranche, 06230 Villefranche-sur-Mer, France ; CNRS, Laboratoire d'Océanographie de Villefranche, 06230 Villefranche-sur-Mer, France, phone: +33 4 93 76 38 43, fax: +33 4 93 76 38 34, e-mail: tunin@obs-vlfr.fr); F Ibañez^ (Université Pierre et Marie Curie-Paris6, Laboratoire d'Océanographie de Villefranche, 06230 Villefranche-sur-Mer, France ; CNRS, Laboratoire d'Océanographie de Villefranche, 06230 Villefranche-sur-Mer, France, phone: +33 4 93 76 39 04, fax: +33 4 93 76 38 34, e-mail: ibanez@obs-vlfr.fr); J-P Labat (Université Pierre et Marie Curie-Paris6, Laboratoire d'Océanographie de Villefranche, 06230 Villefranche-sur-Mer, France ; CNRS, Laboratoire d'Océanographie de Villefranche, 06230 Villefranche-sur-Mer, France, phone: +33 4 93 76 39 04, fax: +33 4 93 76 38 34, e-mail: labat@obs-vlfr.fr); A Zingone (Stazione Zoologica 'A. Dohrn', Villa Comunale 80121 Napoli, Italy, phone: +39 081 5833295, fax: +39

081 7641355, e-mail: zingone@szn.it); R Lemée (Université Pierre et Marie Curie-Paris6, Laboratoire d'Océanographie de Villefranche, 06230 Villefranche-sur-Mer, France ; CNRS, Laboratoire d'Océanographie de Villefranche, 06230 Villefranche-sur-Mer, France, phone: +33 4 93 76 38 39, fax: +33 4 93 76 38 34, e-mail: lemee@obs-vlfr.fr)

The impact of climate change on the biodiversity of phytoplankton remains largely unclear, because of the scarcity of long-time series for this group, especially in the Mediterranean Sea. Yet many studies, sometimes very old, describe microphytoplanktonic species observations throughout the annual cycle in the northwestern Mediterranean Sea. The planktonic Dinoflagellate genus /Ceratium/ is characterised by a very high specific richness in this area and has been much studied for more than one century. The present work consists in assessing the interest of the genus /Ceratium/ as a biological indicator of global change in the NW Mediterranean. It was based on the comparison between recent data from microscope counting on net samples, both realised in the Ligurian (Villefranche bay, France) and in the Tyrrhenian (Naples bay, Italy) seas, and older data in these areas, provided by the literature. The Multiple Correspondence Analysis (MCA) first revealed a specificity of the species composition during the annual cycle for each site. Besides, the specific composition also discriminated old samples from recent ones, in relation with an inversion in surface water temperatures anomaly. Thus, oldest samples were associated to a globally negative temperature anomaly, whereas the recent samples, both from Ligurian and Tyrrhenian Seas, were related to a positive temperature anomaly. This suggested water warming during the annual cycle that affected the specific composition of the genus /Ceratium/ in the NW Mediterranean.

An Increasing Trend of Harmful Algal Biomass in the Swan River Estuary

<u>Luke J. Twomey</u> [*L. J. Twomey*] (Swan River Trust, Level 1, 20 Terrace Rd., East Perth, Western Australia; ph. 61-8-9278-0955, fax 61-8-9325-7149; e-mail: Luke.Twomey@dec.wa.gov.au)

The seasonal dynamics of phytoplankton in the Swan Canning Estuary have been carefully monitored since 1994, however very little is understood about the environmental triggers that control biomass accumulation and community composition. The potentially icthyotoxic dinoflagellate Karlodinimum micrum has consistently formed large blooms in the autumn over the past four years. Although fish kills have been associated with K micrum, the blooms have always occurred during periods of low DO concentration. In recent years there has been a noticeable shift in the dominant phytoplankton species in the Swan Canning system. In particular there has been an apparent increase in phytoplankton biomass during the summer and autumn, which is largely the result of increase of dinoflagellates and other flagellate species. The trend of increasing dinoflagellate biomass has been observed in many temperate estuaries throughout the world. The workshop would provide an excellent opportunity to compare and contrast phytoplankton species shift in Western Australia with other temperate estuaries, such as the Neuse River Estuary, NC.

Phytoplankton in NE Black Sea Coastal Waters: Annual Succession, Community Structure, Species Diversity, Interanual Changes in 2001-2006

Alexander Vershinin [*Alexander Vershinin*] (P.P.Shirshov Institute of Oceanology RAS, Nakhimovsky prosp. 36, Moscow 117851, Russia. e-mail: avershinin@mail.ru); Vladimir Akatov (Dept. of Ecology, Maykop State University of Technology, Pervomayskaya 191, Maykop 385000 Krasnodarsky kray, Russia e-mail: akatovmgti@mail.ru); Sergey Pankov (Experimental Center for Marine Biotechnology Bolshoy Utrish, Lenina 175/230, Anapa, 353410 Krasnodarsky kray, Russia)

Phytoplankton was sampled weekly, in 2001-2006 period, by 10um-mesh-net at Bolshoi Utrish (Caucasian coast) 500 m offshore, and at 2 reference sites where sampling was made randomly. 94 phytoplankton species were identified. Several species new to the Black Sea phytoplankton list were found (including toxic ones), one new dinoflagelate species was discovered. The usual course of annual succession was found as following: winter depression (often no phytoplankton cells were found in January) is followed by spring peak in March-April, started by small-sized, opportunistic pioneering species (usually it’s either diatoms Pseudonitschia delicatissima or Thalassiosira sp. or coccolythofores), followed by the raise of mid-sized and large diatoms community dominated by Chaetoceros spp., with a smaller portion of dinoflagellates (dominant small Prorocentrum spp., Goniaulax spp.) and finalized by mixotrophic dinoflagellates (dominant species Ceratium spp., Prorocentrum micans, Dinophysis rotundata) and zooplankton. After the spring bloom counts of microphytoplankton decrease through May and June, at the same time coccolitophore community start developing, in some years coccolithophores were outcompeted by Pseudonitzschia or Thalassiosira. Most pronounced and prolonged phytoplankton peak takes place in August-October (max.count in 2001 621000cell/l, biomass 0,9 mg/L), the succession of dominant species’ patterns was observed in 2001 as: August [Chaetoceros tortissimus, C.compressus, Cochlodinium polykrikoides], September [C.compressus, C.curvisetus], October [C.curvisetus, Hemialus hauckii]. In some years general course of succession was changed, e.g. diatom spring bloom was shifted to February in 2001, and was not discernible at all in spring 2002. 2001 was a year of most abundant phytoplankton, both in counts and biomass; since then decline was observed. Described phytoplankton annual succession at North-East Black Sea differs significantly from that in the last investigation of 1978, and earlier observations. The data from different sites along the coast were uniform with respect to species composition thus showing the homogeneity of phytoplankton community along 300km of coast. No correlation between major nutrients (as measured at Gelenjik

sampling site) and phytoplankton was found. Besides the temperature and daylight, most conspicuous abiotic factors effecting nearshore phytoplankton community were strong winds from shore and seastorms. As inferred from the monitoring data major driving forces of annual phytoplankton succession were water temperature and biotic (foodweb) interactions. In many cases of quasi-stable microphytoplankton communities, their structure well corresponded the core-satellite model with the core species number 1-3; during the phytoplankton peak periods, core species portion reached 90%. Abundance distribution of core species and several most numerous satellite species in several studied cases of phytoplankton peak periods corresponded to geometrical distribution thus revealing strong competition for resourses. Distribution of satellite spesies was close to geometrical only during the depression periods. In most other periods of time their distribution was better described by lognormal function. Analysis of monitoring data shows that in most period of times NE Black Sea coastal microphytoplankton communities are species-undersaturated, one of the reason for that situation could be young age of Black Sea marine ecosystem (6-7000 years since Bosporus formation).

A phytoplankton data series taken in the frame of the monitoring program of the Helsinki Commission

Norbert Wasmund [Dr. Norbert Wasmund, Baltic Sea Research Institute, Seestr. 15,
D-18119 Warnemünde, GERMANY, Tel. *49 381 5197 212, Fax. *49 381 5197 440, e-mail: wasmund@io-warnemuende.de]

A phytoplankton data series taken in the frame of the monitoring program of the Helsinki Commission (HELCOM) will be presented. A trend analysis of the data series from 1979-2000 was already carried out by Wasmund and Uhlig (2003). Data of two selected stations were also evaluated by Möllmann et al. (2006). Recently I checked this HELCOM data series again for errors and found still some bugs which were corrected. A new analysis will be necessary. Moreover, the data of 2001-2005 have been appended. New data from the Kattegat area are not available. Therefore I offer the phytoplankton data set from 1979-2005 for 5 stations of the open Baltic Proper and 2 stations of Mecklenburg Bight which may be considered as „coastal“ for trend analyses as I am not able to do a professional trend analysis myself.

Literature:
Möllmann, C., Müller-Karulis, B., Diekmann, R., Flinkman, J., Kornilovs, G., Lysiak-Pastuszak, E., Modin, J., Plikshs, M., Walther, Y. and Wasmund, N. (2006): An integrated ecosystem assessment of the Central Baltic Sea and the Gulf of Riga. ICES CM 2006/P: 03

Wasmund, N., and Uhlig, S. (2003): Phytoplankton trends in the Baltic Sea. ICES Journal of Marine Science 60: 177-186.

Top Down and Bottom Up Control of North Sea Phytoplankton Blooms: an Analyses in Conjunction with Warmer Waters.

Karen Helen Wiltshire [Professor Karen Helen Wiltshire, Director, Biologische Anstalt Helgoland & Wadden Sea Station Sylt, Vice Director, Alfred-Wegener-Institut für Polar- und Meeresforschung, Postfach 180 D 27483 Helgoland, Germany, Tel: 0049 4725 - 819 3238, Fax: 00494725 - 819 3283, Email: kwiltshire@awi-bremerhaven.de]

In 1962 a long-term monitoring programme was started at the Biologische Anstalt Helgoland in the North Sea involving monitoring of pelagic nutrients, salinity, light penetration and plankton species composition on a work-daily basis. This data is used as the basis for a discussion on the control of phytoplankton blooms in the North Sea.

The warming trend in the North Sea (mean: 1.15 degrees since 1962) is an accepted phenomenon and was shown in this series. The vital question is how this effects phytoplankton blooms: is there a change in control mechanisms of timing and species?.
Recently it was shown that unlike lakes the spring blooms in the North Sea at Helgoland Roads have been occurring later and that this was related to warmer autumn temperatures. Analysing the Helgoland Roads time series, this phenomenon was investigated in detail. Zooplankton, nutrient, weather, salinity and phytoplankton data were combined to show that there has been a shift in trophic interactions in the North Sea affecting the spring bloom timing. Enhanced top-down control of net phytoplankton growth by zooplankton grazing and warmer temperatures explained the delay.
In this presentation the interaction between zooplankton grazing and phytoplankton growth are investigated concurrently, and the observed top down control evaluated.
Top-down control on phytoplankton growth in marine systems is an accepted phenomenon and it is generally accepted that in warmer waters (above 3-5oC) blooms can be terminated by grazing.

When the rate of photosynthesis is much higher than the metabolism of heterotrophs, less microalgae are consumed than are produced. A copepods´ metabolism and grazing rates are accelerated by increasing temperatures. This would directly be reflected in a reduction of diatom biomass. We know from the literature that copepods seem to benefit from warmer winters in terms of survival thus not only grazing rates are increased by warmer winter temperatures but also a larger standing stock of copepods is grazing on the over-wintering phytoplankton community. Some years, such as 2007 don’t show a pronounced first bloom at all at Helgoland Roads. This might be due to a constant grazing pressure of herbivores preventing the development of a mass increase of phytoplankters.

The second bloom at Helgoland which usually starts after week 14 ends with the depletion of nutrients. Indeed, in the the phytoplankton bloom dynamics of this pre-summer bloom at the Helgoland stratification can play a role, and nutrients, especially silicate become limiting giving rise to “classical” phytoplankton succession- i.e. diatoms followed by flagellates. There is no evidence as yet that this has changed significantly. However from pattern analyses we have noted that alongside the trend of rising temperatures observed at Helgoland G. delicatula is becoming more dominant in plankton samples. Being found mainly between June and October in the 1960s, this species can in some years now be encountered between March and December. At the same time other diatoms considered being key species and adapted to colder temperatures like T. nitzschioides are found to be less abundant.

The nutrient load of runoff into the North Sea is decreasing after eutrophication in the second half of the 20th century. Nevertheless, re-oligotrophication is not apparent and the carrying capacity remains high as algal cell numbers have not decreased.
It is recommend that when considering the dynamics of phytoplankton in aquatic systems related to warming trends that the secondary producers are taken into consideration. A spring bloom will not always come earlier because of different stratification and nutrient trigger processes; they also can be delayed by top down control.

Trends and Patterns of Phytoplankton Bloom in Tokyo Bay

Hidekatsu Yamazaki [*H Yamazaki*] (Department of Ocean Sciences, Tokyo University of Marine Science and Technology, 4-5-7 Konan, Minato-ku, Tokyo 108-8477 Japan; ph. 81-3-5463-0466; fax 81-3-5463-0379; e-mail: hide@kaiyodai.ac.jp); N Horimoto (Department of Ocean Sciences, Tokyo University of Marine Science and Technology, 4-5-7 Konan, Minato-ku, Tokyo 108-8477 Japan; ph. 81-3-5463-0513; fax 81-3-5463-0513; e-mail: hide@kaiyodai.ac.jp); Y Kokubu (Department of Ocean Sciences, Tokyo University of Marine Science and Technology, 4-5-7 Konan, Minato-ku, Tokyo 108-8477 Japan; ph. 81-3-5463-0466; fax 81-3-5463-0379; e-mail: turbomap@hotmail.com); K Mizuno (Department of Ocean Sciences, Tokyo University of Marine Science and Technology, 4-5-7 Konan, Minato-ku, Tokyo 108-8477 Japan; ph. 81-3-5463-0466; fax 81-3-5463-0379; e-mail: kouichiro1017@yahoo.co.jp)

Tokyo bay is the busiest port in Japan and is surrounded by over 20 million people along the coast. Due to the heavy population and advanced industrialization, the number of red tide incidents increased from 1960 to 1980. After the peak occurrence took place in 1982, the number of observed red tide stay at a constant level due to regulation in domestic discharge and increased level of sewage treatment. Despite the fact that extensive survey and monitoring for the red time in Tokyo bay are conducted, no clear dynamical mechanism has been identified to the onset of the red time. Clearly red tide occurs frequently during spring and summer; however, a time series obtained at a monitoring station (Chiba light house tower) indicates red tide occurs during winter as well. Spring and summer red tides are observed surface and subsurface water column, whereas, winter red tide appears between the intermediate water column and the bottom.

Dynamics of Phytoplankton Species Composition in the Pearl River Estuarine and Coastal Waters during 1991-2004

Kedong YIN [YIN, Kedong[1,2,3], 1. Australian Rivers Institute, Griffith University Nathan Campus, Brisbane, Queensland 4111, Australia, k.yin@griffith.edu.au, 2. Atmospheric, Marine & Coastal Environment (AMCE) Program, Hong Kong University of Science and Technology, Kowloon, Hong Kong, 3. Key Laboratory of Tropical Marine Environmental Dynamics, South China Sea Institute of Oceanology, CAS, Guangzhou, China]

As coastal waters are changing rapidly in response to natural processes and human activities, it is important for us to understand phytoplankton dynamics in terms of the assemblage composition because of its critical ecological function of primary production in food webs, biogeochemical processes, cycling of key elements, and its impact on coastal water quality. Our understanding of species diversity mechanisms has evolved from the Hutchison's resource competition hypothesis, or competition along a few resource gradients, to the hyper-dimensional concept where communities are assembled by selective forces operating on variation in factors such as algal size, motility, behaviour, life cycles, biochemical specializations, nutritional mode, chemical and physiological tolerances, and physical spatial/temporal disturbances. Diversity is promoted by variability along each of these dimensions (Cloern and Dufford 2005, MEPS285p11-28).

An estuary is an interface between rivers and oceans and hence, in the estuary and estuarine coastal waters, there is not only a large gradient of physical and chemical conditions, but also a hyper-dimensional matrix of various factors for phytoplankton species diversity. The dynamics of this matrix can contribute to an estuary's ecosystem buffering capacity against eutrophication, which may make some estuaries more vulnerable to nutrient enrichment and others more robust.

We hypothesize that whether anthropogenic influences such as an alteration of flow patterns and changes in loadings of nutrients, or the concentration of nutrients and ratios of nutrients lead to a significant change in the composition of the phytoplankton species assemblage may depend on how large the change is in the limiting factor or depend on which controlling factor is dominant at that time. These factors include physical dilution, vertical mixing, light limitation or nutrient limitation.

The Pearl River is the second largest river in China and the Pearl River estuary is located in the subtropical south coast of China. Hong Kong waters are located at the western edge of the estuary and they are largely influenced by the estuarine discharge, especially in summer. The Pearl River discharge is low in winter, starts to increase in spring and reaches a maximum in summer before decreasing again in the fall. The nitrogen concentration in the Pearl River is estimated to have increased in the past few decades and is very high at present (~100 uM), whereas phosphorus remains relatively low (~1 μM). As a result, the N/P ratio is > 16:1 in the ambient waters where there is an influence from the Pearl River discharge. We used a 14 year (1991-2004) data set of salinity, nutrients, and phytoplankton species abundance and composition, which were collected by the Hong Kong Environmental Protection Department who maintains a long term water quality monitoring program in Hong Kong waters. We used data from three zones which represent an estuarine condition in the west (estuarine zone) and a coastal/oceanic condition (oceanic zone) in the east and a seasonal transitional condition influenced by the estuary in summer and by coastal/oceanic water in winter (transitional zone). The preliminary data analysis has shown some interesting patterns. During the 14 years, total species richness including diatoms and dinoflagellates appeared to increase. Diatoms are the dominant group of phytoplankton. However, dinoflagellate species richness and abundance increased too. This may coincide with the increased frequency of Si limitation. A very interesting observation is that temporal increases in diatom abundance appear to be negatively correlated with the abundance of dinoflagellates and other species of phytoplankton. The above observations appeared to be more apparent before 1998, and between 1999 and 2004, the changes were more stable. This two phase trend of changes coincides with climatic changes. It is believed that there was a climatic change around 1996-1998 which is coherent with a regime shift in the PDO and large-scale changes in ocean temperature, regional wind patterns, and biological communities across the Pacific basin. There have been a few observations indicating a basin scale change oceanographic processes in South China Sea during the El Niño in 1997-1998 and consequently, there were more harmful algal blooms during the spring of 1998 in coastal waters of south China.

Phenological Traits of Phytoplankton Species in the Gulf of Naples: an Evolutionary Perspective

A. Zingone [*A Zingone*] (Stazione Zoologica A. Dohrn, Villa Comunale 80121, Napoli, Italy, Tel. +39-081-5833295, Fax +39-081-7641355, e-mail: zingone@szn.it); L Dubroca (Stazione Zoologica A. Dohrn, Villa Comunale 80121, Napoli, Italy, Tel. +39-081-5833247, Fax +39-081-7641355, e-mail: dubroca@szn.it); R Siano (Stazione Zoologica A. Dohrn, Villa Comunale 80121, Napoli, Italy, Tel. +39-081-5833296, Fax +39-081-7641355, e-mail: siano@szn.it); S M McDonald (Rostenstiel School of Marine and Atmospheric Science, University of Miami, 4600 Rickenbacker Causeway, Miami FL 33149, USA, Tel. +1 305-421-4214, Fax. +1 305-421-4600, e-mail: smcdonald@rsmas.miami.edu); D Sarno (Stazione Zoologica A. Dohrn, Villa Comunale 80121, Napoli, Italy, Tel. +39-081-5833282, Fax +39-081-7641355, e-mail: diana@szn.it)
A large number of phytoplankton species in the Gulf of Naples exhibit a remarkable regularity in their annual patterns of occurrence. Seasonal regularity is found in species scattered across the phylogenetic spectrum, and is apparently independent from size and shape characteristics, since similar congeneric species often occur at different periods of the year. Regularity is also independent from known life – cycle features, since it is found in both species that are known to form cysts and spores and in species for which

heteromorphic resting stages are apparently missing. The most accepted explanation in light of current paradigms is that recurrent sets of environmental parameters should select for species and/or functional groups that are most suitable for those conditions. Yet recurrent seasonal patterns for phytoplankton species clash with the wide interannual variability of several environmental parameters. On the other hand, seasonal patterns of environmental parameters hardly account for the initiation and termination of single species blooms. It is proposed that the interaction between endogenous-driven rhythms and environmental signals could better explain phenological patterns, and that temporal isolation over the year could be as effective as spatial isolation in promoting speciation in phytoplankton organisms.