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Report of MarBEF training course “Advanced Phytoplankton Taxonomy and Systematics”

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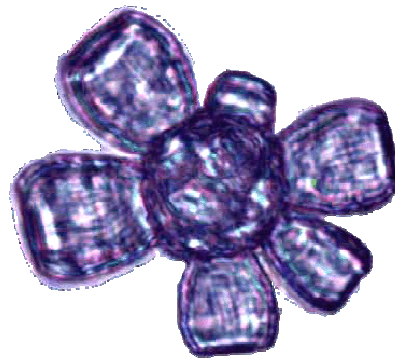
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9th Advanced Phytoplankton Course
Taxonomy and Systematics
APC9

Final report



*Laboratory of Ecology and Evolution of Plankton
Stazione Zoologica Anton Dohrn di Napoli*

5-26 April 2008

SUMMARY

The 9th Advanced Phytoplankton Course (APC9) was held in Naples, at the Stazione Zoologica Anton Dohrn, from 5 to 26 April 2008. This series of courses started in 1976 upon recommendation of the SCOR-WG on Phytoplankton Methods (WG 33), whose main goal is to train and upgrade qualified students in the identification of phytoplankton species. The organising committee of the 2008 course was formed by Marina Montresor, Diana Sarno and Adriana Zingone under the scientific responsibility of Adriana Zingone. The faculty included G.R. Hasle (Honorary Director, diatoms), Federica Cerino (cryptomonads), M.-J. Chrétiennot-Dinet (coccolithophores), C.B. Lange and D. Sarno (diatoms), J. Larsen (naked dinoflagellates and heterotrophic flagellates), M. Montresor (thecate dinoflagellates and resting stages), K.A. Steidinger (dinoflagellates), Raffaele Siano (naked dinoflagellates), C. R. Tomas (raphidophytes and cultivation), J. Throndsen (other flagellates), W. Kooistra (molecular taxonomy and phylogeny) and A. Zingone (coccolithophores and other flagellates).

Twenty-one students from 20 countries were selected out of 105 applicants from 43 countries. Eleven participants were European and six of them belonged to Institutions involved in MARBEF. The experience in taxonomy and the role of participants in monitoring and research projects were taken into account in the selection process, along with the potentiality to train other people and contribute to the diffusion of the information acquired during the course.

The Course consisted of both theoretical and practical sessions. Lectures on the taxonomy, morphology and phylogeny of the different phytoplankton groups were illustrated by power-point presentations. Practical sessions consisted of observations of a broad collection of fixed, live and slide material provided by the faculty. Relevant techniques aimed at displaying taxonomic characters essential for identification in light and electron microscopy and cultivating microalgal organisms were presented and demonstrated. Special sessions included TEM and SEM observations. The last week of the course consisted of exercise sessions based on mixed material provided by both the faculty and students. Serial dilution cultures set up at the beginning of the course with natural samples were also examined by the students, and the most probable number (MPN) method to estimate species abundance was demonstrated. Harmful or nuisance species received particular attention in both general and special sessions. Molecular methods for taxonomy and phylogeny were presented with theoretical lessons, seminars and practical demonstrations of the whole process from DNA extraction to phylogenetic trees.

The manual on phytoplankton identification (Tomas C.R. ed., 1997) was used as the main textbook. A comprehensive collection of reprints and relevant literature was available for consultation, with all titles included in a searchable database. Several old taxonomic papers were scanned and made available to the students. Handouts with methods illustrated and guides on specific groups of species were distributed. At the end of the course the students were given CD-ROMs with the ppt presentations and the relevant literature for each algal class. A collection of species pictures taken with the digital camera during the observation sessions has been delivered to the students via an ftp procedure.

Participants filled in an anonymous questionnaire with their evaluation of the course, which was also discussed during an open discussion in the closure session. All students declared their appreciation and acknowledged the faculty, the organisers and the secretary for their contribution to a successful Course.

Financial support for the Course was mainly provided by the SZN and by the University of Tromsø through the project MARBCENT and the EU- FP6 Network of Excellence MARBEF. Some students received support by MARBEF, the UNESCO-IOC through the Centre for HAB Science and Communication based in Vigo (Spain), and ISSHA (International Society for the Study of Harmful Algae). Carl Zeiss S.p.A. kindly lent 22 microscopes for the practical sessions.

Course information, report and pictures will be made available on the web within the SZN website, presently under re-construction.

1. BACKGROUND, ORGANIZATION AND GOALS

1.1. Background

Phytoplankton taxonomy is a very active field of research, which provides relevant information to other disciplines such as physiology, ecology, biogeography and molecular biology. Knowledge of phytoplankton species is also essential for practical issues, e.g. in biotechnology applications, monitoring and seafood control. It is therefore essential to keep a constant flux of information between taxonomists and taxonomy users in different fields. The series of Advanced Phytoplankton courses was initiated upon recommendation of the SCOR-Working Group of Phytoplankton Methods (WG 33), established in 1969 at the Marine Botany Section of the University of Oslo in 1976. After the first Course, two other advanced Courses were held at the Biological Station in Drøbak, in 1980 and 1983, with the teaching faculty basically including the same teachers (G.R. Hasle, J. Thronsen, K. Tangen, B. Heimdal and, from 1983, K.A. Steidinger). From 1985, four advanced Courses (1985, 1990, 1995, 1998, 2005), still under the direction of G.R. Hasle, were organized at the Stazione Zoologica Anton Dohrn of Naples (SZN).

The teaching programme (Annex IV) has always included an overview of all algal classes of marine eukaryotic phytoplankton, and has been integrated over the years with the advance of knowledge caused by new techniques.

A total number of 165 participants, representing 50 countries, have attended the nine Advanced Phytoplankton Courses so far organised. They constitute a rather special community, which includes well known scientists engaged, at times in leading positions, in the field of phytoplankton research all over the world. The handouts used by the students during the courses provided the ground for a multi-author manual for taxonomy and identification, edited by one of the Course teachers, Carmelo Tomas, with contribution from several teachers of the course (C. R. Tomas ed., 1997), which is widely used in all laboratories working with marine phytoplankton in the world.

1.2. Organization

The organising committee (Annex I) began the preparation for the 9th Advanced Phytoplankton Course - Taxonomy and Systematics 18 months before its start with a formal invitation to the Faculty (Annex II), which followed an agreement on the dates. The Course was announced in August 2007 on the Course web page opened at the Stazione Zoologica Website (www.szn.it/apc9). Before being included in the training programme of MarBEF, the Course underwent a selection process based on the interest declared by potential participants and hence it was announced in the MarBEF Website. The announcement was also posted to the main mailing lists attended by scientists in the field of marine phytoplankton (Algae-L, Marine Phycotoxins and Diatom-L), published in the bulletin 'Harmful algae news' and sent by e-mail to a list of marine institutions around the world, and to selected key scientists. A poster was sent as attached file for printing and displaying at the institute boards. The announcement, the poster and the website included all the relevant information concerning the Course venue, dates, aims and faculty. In addition, instructions and deadline for applications (15th October, postponed to 30th October, 2007), application forms and criteria for selection were also provided on the website.

We received a total number of 105 applications from 43 different world countries. After careful examination of the applications, 21 applicants from 20 countries were selected (Annex III) and a waiting list of 15 applicants was also prepared. Criteria for selection included previous experience with phytoplankton, relevance of the Course to the present position of the applicant and to its future involvement in monitoring and scientific projects, chances for participants to further spread information acquired during the course in their respective country. The country of provenance was also considered, and preference was given to applicants based in institutes where nobody had participated in an APC in recent years.

The Course was held at the Stazione Zoologica, in the seminar room and in the foyer. Students' benches were equipped each with a light microscope and the desk with microscopes connected to a digital camera projecting images on a screen, three computers, a video-projectors with another screen and a paper holder easel. A taxonomic library holding a wide book and reprint collection was also arranged in the classroom. A room adjacent to the foyer was used as secretary and equipped with telephone, xerox-copy machine and two computers. Material for preparation and culture maintenance was located in a laboratory on the first floor, equipped with a small growth chamber for cultures, a centrifuge, and a number of laboratory devices and disposable material.

Financial support for the organization of the Course was provided by the SZN, the University of Tromsø, project MARBCENT and the EU- FP6 Network of Excellence MarBEF. Two participants from MARBEF Institutes were fully supported with MarBEF funds, and the registration fee of another participant was also charged to the same funds. The UNESCO-IOC through the Centre for HAB Science and Communication based in Vigo (Spain) contributed travel and subsistence expenses for 2 participants from developing countries. The International Society for the Study of Harmful Algae (ISSHA) provided meals for two participants from developing countries active in the field of HAB monitoring. Carl Zeiss S.p.A. kindly lent 22 microscopes for the practical sessions.

A meeting among teachers and organizers was held in the mid of the Course, to review and discuss the whole organization, including positive and negative aspects and possible improvements. A discussion took place on the possibility to organise further sessions of the Course, taking into account the difficulties existing with the funding of such initiatives and the effort required by the organisers and the Faculty.

1.3. Goals

The Course was meant to upgrade and update the expertise of already experienced researchers actively working in fields that require species identification such as phytoplankton ecology and monitoring, as well as taxonomy and systematics. The groups considered were diatoms, dinoflagellates, coccolithophores and other flagellate species. Special attention was given to species responsible for the formation of exceptional or harmful blooms. Information and training was provided on basic methods used in molecular taxonomy and phylogeny.

The Course aimed at:

- teaching methods and criteria for species identification,
- updating information on specialized literature,
- spreading information and awareness on toxic and potentially toxic species,
- creating a forum for discussion of general and specific aspects of biodiversity and biogeography of phytoplankton species.

2. CONTENT

The Course included the following activities, detailed in the program (Annex IV):

- Theoretical classrooms on general taxonomic features of marine phytoplankton
- Practical classrooms on light microscopy (LM) identification
- Counting, biovolume estimates and special LM techniques
- Scanning (SEM) and Transmission Electron Microscope (TEM) techniques and observations
- Phytoplankton cultivation techniques
- Serial dilution technique

- Molecular phylogenetic methods
- Integrative seminars on specific taxonomic issues/taxa

2.1. Opening and Introduction

On Saturday 5 April the participants registered at the Course desk at the Stazione Zoologica. The course was officially opened on Sunday 6 April, in the seminar room of the Stazione Zoologica, by the Scientist Responsible for the Course Dr. Adriana Zingone. On behalf of the Organizing Committee, Adriana Zingone welcomed the students and introduced the course explaining the aims, illustrating the scientific and social program and introducing the faculty. A message from Karen Steideinger, who provided material and collaborated to the lesson preparation but could not be present at the Course, was read to the students. Adriana Zingone concluded her welcome speech by expressing, on behalf of the faculty, her thanks to the Institutions that generously supported the Course. The Honorary Director, Prof. Grethe Hasle expressed her appreciation for the continuation of these Courses, recalled their initial scope and noticed with appreciation the changes occurred over the years in the structure of the course as well as in the composition and needs of participants.

A historical overview of the Advanced Phytoplankton Course was presented by Jahn Thronsen, who took part in the faculty at all nine courses. Pictures of previous students and faculty members were presented, illustrating the past sessions of the course. The images showed many of the previous participants who are nowadays of primary importance in the field of phytoplankton research. Among the others, Barrie Dale, Trevor Platt, Gustaaf Hallegraeff, Victor Smetacek, Linda Medlin, Marta Estrada, Ojvind Moestrup and Malte Elbrachter. Also, almost all the members of the present faculty had been past students at the Phytoplankton Course.

2.2. Materials

Materials for the Course consisted of fixed samples and cultures provided by the faculty as well as from the students. Some cultures were bought or provided from culture collections.

The book 'Identifying Marine Diatoms and dinoflagellates', edited by C.R. Tomas, was used as general textbook for all taxa whose taxonomic status has not changed since the publication of the book. A collection of ca 2000 taxonomic papers and several books were available to the students and searchable through a reference manager program. This material included almost all published material needed for the identification of marine planktonic microalgae. For the methods and for selected groups of species, handouts on the techniques illustrated were distributed.

At the end of the course the participants were given CD-ROMs containing the complete set of ppt lessons and a compilation of literature for each algal class.

2.3. Theoretical Classrooms

The course included a total number of 140 hours of theoretical and practical classrooms, exercises and seminars (see Annex IV). Theoretical classrooms were given on the taxonomy of the different algal groups and on the characters that are important for species identification in light and electron microscopy. General features of diatoms, dinoflagellates, coccolithophores and other flagellates were illustrated during the different sessions. Morphological characters of taxonomic groups and species as seen in light and electron microscopy were presented and their distinctive features were stressed. For coccolithophores and dinoflagellates having complex life-cycles, special lectures illustrated the morphology of different life-stages. An introductory lesson to the use of molecular approaches in phytoplankton taxonomy was given.

Throughout the lessons, the different sections of the manuals were referred to and commented, drawing attention to schemes and illustrations useful for species identification.

Participants were informed on recent taxonomic changes not included in the manual. Updated literature references were illustrated and discussed. Members of the Faculty alternated in teaching over the days. Unfortunately, Karen Steidinger could not be present during the Course, but her help with material and lesson preparation was fundamental.

2.4. Practical Classrooms

2.4.1 Species observation

Species observations were made on material selected before the Course, including permanent slides, live unialgal cultures and fixed samples. The material was distributed to each participant for observation in the light microscope. The same material was also shown on a screen through a digital video camera connected to a microscope. At the same time, additional information and/or iconographic material were shown on a second screen and relevant literature was mentioned. The use of different light set-ups, fixatives and special stains or manipulation techniques was recalled whenever required. Ultrastructural features were often displayed from pictures projected on the screen during species observation. Bloom species and harmful species belonging to the different groups were given special attention and shown in comparison to related non-harmful species. Pictures were taken for most of the material shown during the practical classrooms. During the session on heterotrophic nanoflagellates, material was shown which was obtained from mud samples collected in the Gulf of Naples and incubated in Petri dishes.

2.4.2. Techniques

The course included a number of methodological lessons, spanning from special techniques for observations in light and electron microscopy to single cell isolation, serial dilution techniques, cultivation and molecular methods. Practical exercises were organised where the students themselves prepared the material for observation using their own samples.

Practical sessions focused on molecular methods – from DNA extraction to alignment and construction of phylogenetic trees- which were demonstrated to participants in small groups.

The following methods were included:

- Serial dilution cultures established from natural samples for flagellate identification and enumeration.
- Concentration of heterotrophic flagellates and benthic diatoms from mud samples.
- Single cell isolation by micropipetting and cultivation techniques. Different recipes for preparation of culture media were distributed to the participants and discussed.
- Frustule cleaning with different acid mixtures and permanent slide preparations for diatoms.
- Squashing and thecal plate staining for thecate dinoflagellates.
- Preparation of TEM grids and SEM stubs using both culture material and mixed samples.
- DNA extraction and PCR.
- Sequence downloading from GenBank and alignment.
- Reconstruction of phylogenetic trees.

2.4.3. Exercises

The last days were devoted to the observation of mixed natural samples from different geographic areas provided by the Faculty or by the students. Students worked together to compile species lists for each sample. Comparison exercises with the simultaneous observation of similar species were also organized to stress distinctive features and improve identification capabilities.

For the identification exercise of flagellates, the dilution cultures that had been demonstrated and prepared by the students during the first day were used. In the last days of the

course, each student was assigned one replicate consisting of a whole series of the five dilutions. Students observed their respective series, identified live flagellates as well as other microalgae growing in the culture tubes and filled a report form. The logs were unified and the concentration of the single species in the original sample was estimated as most probable number (MPN).

2.5. Scanning (SEM) and Transmission Electron Microscope (TEM) demonstrations

The electron microscopy session aimed at showing the potential of the EM techniques rather than training students on EM species identification, which would require a separate course. Students divided into subgroups alternated at the SEM and TEM to observe material under the guide of some of the teachers. For each algal group considered (diatoms, coccolithophores, cryptophyceans, prasinophyceans, naked dinoflagellates), the specific morphological details visible in EM were illustrated through demonstrative samples.

2.6. Special sessions and events

Harmful and nuisance species were pointed out to students' attention whenever encountered during the theoretical and practical sessions. In addition, a special session was devoted to Harmful Algae, their impact and problems caused in the students' countries.

Some seminars on specific topics were included in the program, which were given by members of the faculty and by fellows at the SZN. Posters prepared by the participants illustrating their scientific activity in relation with phytoplankton taxonomy were displayed in the classroom over the Course. A poster session was held to exchange information and discuss research activity of the participants.

3. SOCIAL EVENTS

A number of social events were organised to allow student and faculty to relax from the very intensive work programme and reach a better integration. These included an ice-breaking party, a closure party, guided tours to the ruins of Herculaneum and Villa Campolieto and a social dinner. In addition, seminars were given on the history of the Stazione Zoologica, and guided tours to the historical Archive and to the Fresco Room of SZN were organised.

Dr. Marta Estrada, of the Institut de Ciències del Mar, CMIMA (CSIC) in Barcelona (Spain), visited the Course while in Naples for another meeting. This was a good opportunity for the students to meet and exchange ideas a previous student of the Course who has much contributed to the knowledge of phytoplankton ecology and diversity in the Mediterranean area.

4. QUESTIONNAIRE AND CONCLUDING REMARKS

4.1 Questionnaire

During the last days, participants were requested to express comments on the Course through anonymous questionnaires which included questions on both logistic and scientific aspects. The comments were overall very positive. Several good suggestions emerged that in part reflected the specific needs of the single participants. All participants expressed very positive comments on the content of the course, on the organization and on the benefit for their professional career. Despite the different expertise, professional interests and duties of participants, apparently the APC8 format was a good compromise that offered everybody the possibility to gain more detailed knowledge in phytoplankton taxonomy.

4.2 Concluding remarks

The Course was closed on Saturday 26 April. On behalf of the Organising Committee, Adriana Zingone thanked the entire faculty, secretary and all people from the SZN who had collaborated towards a successful Course. Students also were thanked for their enthusiastic and warm participation, and commended for the deep interest and the capacity to work hard that they demonstrated over the three weeks. Adriana Zingone remarked the pleasant and friendly atmosphere of the Course, and the open communication during the lessons. Each student was distributed a participation certificate and the CD-roms with the material of the lessons. Thanks were expressed to the secretaries, Italia Canettieri and Margherita Groeben, for their continuous and invaluable assistance in the organization and during the whole course. Ivano Iennaco was thanked for his assistance with the scientific organization of the Course. In the course of an open discussion, students were given the possibility to comment on the Course, mainly along the lines emerging from the questionnaires, and provide suggestions for further improvements.

As also happened in other Courses a friendly atmosphere was established among students and with the Faculty since the beginning of the Course, also due to the logistic (almost all students were in the same B&B) which favoured free exchange of ideas and allowed to overcome problems posed by the very intensive activity for three entire weeks. The students presently are still in touch within a group (APC9) established on the web within Facebook.

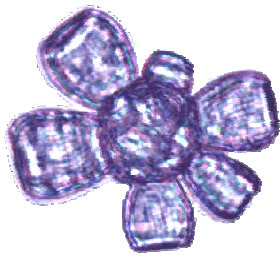
ANNEXES

I Organizing Committee

II Faculty

III List of participants

IV Programme



APC9 - ADVANCED PHYTOPLANKTON COURSE
TAXONOMY AND SYSTEMATICS

STAZIONE ZOOLOGICA "A. DOHRN"
5-26 April 2008

Annex I

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Technical support and collaborations

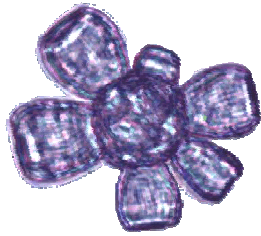
- Diego Castagna: network and classroom preparation
- Giuseppe Gargiulo and Giampiero Lanzotti: video and audio services
- Gennaro Iamunno and Franco Iamunno: electron microscopy
- Raffaele De Maio: technical service and logistic
- Salvatore Orfano & Paola di Girolamo: administration
- Ciro Zazo: sampling
- Gandi Forlani: EM preparations
- Carmen Minucci: cultures
- Ivano Iennaco, Isabella Percopo and Raffaele Siano: materials for the lessons
- Christiane Groeben: history and art of the Stazione Zoologica
- Carmen Minucci, Marco Borra and Nikos Andreakis: molecular methods

Secretary

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Light microscope assistance

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APC9 - ADVANCED PHYTOPLANKTON COURSE
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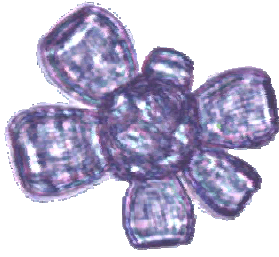
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STAZIONE ZOOLOGICA "A. DOHRN"
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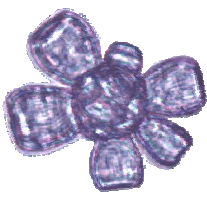
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APC9 - Advanced Phytoplankton Course
Taxonomy and Systematics
 Stazione Zoologica Anton Dohrn
 NAPLES, ITALY 5 - 26 APRIL 2008

ANNEX IV

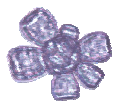
Program

Day	Morning 1 (8:30-10:30)	Morning 2 (11:00-12:30)	Afternoon 1 (14:30-16:30)	Afternoon 2 (17:00-19:00)	Evening: 20:30-21:30
05.04 Sat				Registration Foyer From 6:00 p.m.	Welcome party Fresco Room SZN
06.04 Sun	9:00- Opening, History of the Course, general instructions. <i>Zingone, Hasle, Throndsen</i>	Molecular methods in taxonomy <i>Kooistra</i>	Molecular methods in phylogeny. Phylogenies in phytoplankton taxonomy <i>Kooistra</i>	Dinoflagellates – Introduction to dinoflagellates, demonstration of LM methods <i>Montresor, Larsen, (Steidinger)</i>	
07.04 Mon	Dinoflagellates Dinophysiales: demonstration and observation of <i>Dinophysis</i> , <i>Ornithocercus</i> , <i>Amphisolenia</i> , <i>Oxyphysis</i> (Harmful <i>Dinophysis</i>) <i>Larsen, Siano(Steidinger)</i>	Dinoflagellates – Prorocentrales: demonstration and observation of <i>Prorocentrum</i> (Harmful <i>Prorocentrum</i>). <i>Larsen, Siano (Steidinger)</i>	Methods – Flagellates SDC and sand-dwelling flagellates preparation <i>Throndsen, Zingone, Larsen</i> Methods - Diatoms <i>Sarno, Forlani</i>	Dinoflagellates – LM techniques; Gonyaulacales demonstration and observation of <i>Pyrodinium</i> , <i>Alexandrium</i> (Harmful <i>Alexandrium</i>) <i>Larsen Montresor (Steidinger)</i>	
08.04 Tue	Dinoflagellates – Gonyaulacales: demonstration and observation of <i>Gonyaulax</i> , <i>Goniodoma</i> , <i>Protoceratium</i> , <i>Lingulodinium</i> . <i>Larsen Montresor (Steidinger)</i>	Dinoflagellates – Gonyaulacales: demonstration and observation of <i>Ceratium</i> <i>Montresor, Larsen (Steidinger)</i>	Christiane Groeben: History of SZN(14:30-15:00) Dinoflagellates –Additional genera <i>Larsen, Montresor, Siano (Steidinger)</i>	Dinoflagellates – Peridinales: observation and demonstration of <i>Scrippsiella</i> , <i>Ensiculifera</i> , <i>Pentapharsodinium</i> , <i>Heterocapsa</i> , <i>Kryptoperidinium</i> , <i>Peridinium</i> , <i>Montresor, Larsen, (Steidinger)</i>	LM selected species/problems <i>Faculty</i>
09.04 Wed	Dinoflagellates – Peridinales: demonstration and observation of ‘ <i>Diplopsalis</i> -group’ and <i>Protoperidinium</i> <i>Larsen, Montresor (Steidinger)</i>	Dinoflagellates – Peridinales: demonstration and observation of <i>Protoperidinium</i> and Pfiesteriaceae <i>Montresor, Larsen, (Steidinger)</i>	Free		
10.04 Thu	Raphidophyceans. General remarks. Morphology and taxonomy. <i>Tomas</i>	Raphidophyceans and other harmful flagellates <i>Tomas, Throndsen, Zingone</i>	14:00 Carmelo Tomas: Seminar Group 1: Cultivation. <i>Tomas</i> Group 2:EM techniques Dinoflagellates and flagellates <i>Montresor, Throndsen, Zingone, Forlani, Sarno</i>	Group 2: Cultivation. <i>Tomas</i> Group 1: EM techniques Dinoflagellates and flagellates <i>Montresor, Throndsen, Zingone, Forlani, Sarno</i>	Counting and biovolumes <i>Throndsen, Sarno</i>
11.04 Fri	Dinoflagellates unarmoured species – Introduction; observation and demonstration of <i>Karenia</i> , <i>Gymnodinium</i> , <i>Karlodinium</i> and related genera. <i>Siano, Larsen (Steidiger)</i>	Dinoflagellates unarmoured species – observation and demonstration of unarmoured species cont.. <i>Larsen, Siano (Steidiger)</i>	Dinoflagellates - Gonyaulacales: demo of benthic dinoflagellates: <i>Gambierdiscus</i> , <i>Coolia</i> , <i>Ostreopsis</i> <i>Larsen, Montresor, Siano (Steidinger)</i>	Dinoflagellates – Cysts <i>Montresor</i> Sand-dwelling flagellates and dinoflagellates <i>Larsen, Throndsen, Zingone</i>	
		12:00 Wiebe Kooistra SEMINAR			



APC9 - Advanced Phytoplankton Course – 2nd week Program

Day	Morning 1 (8:30-10:30)	Morning 2 (11:00-12:30)	Afternoon 1 (14:30-16:30)	Afternoon 2 (17:00-19:00)	Evening: 20:30-21:30
12.04 Sat	Coccolithophorids Coccolithophorids. Morphology and terminology. Holococcolithophorids. Reproduction and life cycles. Synonyms and recent taxonomic changes. <u>Chrétiennot-Dinet</u>	Coccolithophorids Heterococcolithophorids. observations of cultures (<i>Emiliana</i> , <i>Gephyrocapsa</i>) <u>Chrétiennot-Dinet, Zingone</u>	Coccolithophorids – Observations of cultures (<i>Pleurochrysis</i> , <i>Ochrosphaera</i> , <i>Oolithotus</i> , <i>Umbilicosphaera</i>) <u>Chrétiennot-Dinet, Zingone</u>	Coccolithophorids – Observation of samples/cultures: <u>Chrétiennot-Dinet, Zingone</u>	
13.04 Sun	Coccolithophorids – Observation of samples/cultures: <u>Chrétiennot-Dinet, Zingone</u>	Coccolithophorids – Methods : Collection and preservation techniques, permanent slides.	Free		
14.04 Mon	Molecular phylogeny: from sequences to trees. - Protocols and sequences. Practice and demonstrations - division into 4 groups <u>Kooistra</u>	Molecular phylogeny: . Practice and demos. Group 1: Lab Demo Group 2: GenbankAlign Group 3: GenbankAlign Group 4: PAUP	Molecular phylogeny: Practice and demos Group 1: GenbankAlign Group 2: PAUP Group 3: PAUP Group 4 : Lab Demo	Molecular phylogeny Group 1: PAUP Group 2: Lab Demo Group 3: : Lab Demo Group 4: GenbankAlign 16:30 Discussion	
15.04 Tue	EXCURSION: Herculaneum/Ercolano & Villa Campolieto				
16.04 Wed	Diatoms – Introduction: terminology, morphology, general systematics - Demonstration and observation of Family Thalassiosiraceae (1st part) <u>Lange, Sarno</u>	Diatoms. Family Thalassiosiraceae (2nd part) <u>Lange, Sarno</u>	Diatoms - Demonstration of Family Melosiraceae, Demo of Family Leptocylindraceae, Demo of Family Coscinodiscaceae <u>Lange, Sarno</u>	Diatoms - Observation of Family Coscinodiscaceae, Demonstration and Observation of Family Stellarimaceae <u>Lange, Sarno</u>	LM selected species/problems <u>Faculty</u>
17.04 Thu	Diatoms - Demonstration of Family Chaetocerotaceae <u>Sarno, Lange</u> 10:00. Visit to the Historical Archive Christiane Groeben	Diatoms - Observation of Family Chaetocerotaceae - Mixed samples from the Gulf of Naples <u>Lange., Sarno, Zingone,</u>	Diatoms - Demo of Family Hemidiscaceae, Demonstration of Family Asterolampraceae, Demonstration of Family Heliopeltaceae <u>Lange, Sarno</u>	Diatoms - Demonstration and Observation of Family Hemiaulaceae, Demonstration of Family Cymatosiraceae <u>Lange, Sarno</u>	
18.04 Fri	Diatoms - Demonstration and Observation of Family Rhizosoleniaceae (1st part) <u>Lange, Sarno</u>	Diatoms - (cont.) Family Rhizosoleniaceae (2nd part) <u>Lange, Sarno</u>	Diatoms - Demonstration of Family Lithodesmiaceae, Demonstration of Family Eupodiscaceae <u>Lange, Sarno</u>	Diatoms - Introduction to Pennate diatoms, morphology, terminology, Demo of Family Fragilariaceae, Demo of Rhapsoneidaceae, Demo of Family Thalassionemataceae <u>Lange, Sarno</u>	\Poster session



APC9 - Advanced Phytoplankton Course – 3rd week Program

Day	Morning 1 (8:30-10:30)	Morning 2 (11:00-12:30)	Afternoon 1 (14:30-16:30)	Afternoon 2 (17:00-19:00)	Evening: 20:30-21:30
19.04 Sat	Diatoms - Observation of Family Thalassionemataceae, Naviculaceae <i>Lange, Sarno</i>	Diatoms - Demonstration and Observation of Bacillariaceae <i>Lange, Sarno</i>	Diatoms <i>Lange, Sarno</i>	Diatoms <i>Lange, Sarno</i>	
20.04 Sun	Flagellates Morphology, terminology, general systematics <i>Thronsdén</i> Observation techniques. (<i>Telonema</i> , <i>Olisthodiscus</i>) <i>Thronsdén, Zingone</i>	HAPTOPHYTA. Morphology, taxonomy and diversity. <i>Imantonia, Chrysochromulina, Thronsdén, Zingone.</i> <i>Chrétiennot-Dinet</i>	HAPTOPHYTA. Observations of <i>Prymnesium, Phaeocystis Pavlova</i> , EUGLENOPHYTA Morphology and diversity. <i>Eutreptiella.</i> <i>Thronsdén, Zingone</i>	CHLOROPHYTA Morphology and taxonomy. Life cycles Observations of <i>Halosphaera</i>). Chlorophyceae ; Observations of <i>Dunaliella, Brachiomonas</i> <i>Thronsdén, Zingone</i>	
21.04 Mon	CHLOROPHYTA. Prasinophyceae ; Observations of <i>Bathycoccus, Micromonas, Mantoniella, Nephroselmis, Pseudoscourfieldia.</i> <i>Thronsdén, Zingone</i>	CRYPTOPHYTA. Morphology and diversity <i>Hemiselmis, Proteomonas, Storeatula Cerino, Zingone, Thronsdén</i>	HETEROKONTOPHYTA Chrysophyceae: Ochromonas, Dictyochophyceae Morphology and diversity DICTYOCHELES AND PEDINELLALES. <i>Dictyocha, Apedinella</i> and <i>Pseudopedinella,</i> <i>Thronsdén, Zingone</i>	HETEROKONTOPHYTA Pinguiphyceae, Pelagophyceae Observations of <i>Pelagomonas Zingone, Thronsdén,</i> Exercises - Comparison of selected flagellate species <i>Pseudoscourfieldia/Nephroselmis, Bathycoccus/Micromonas, Ochromonas/Pavlova) Thronsdén, Zingone</i>	HARMFUL SPECIES, Observations and discussion <i>Faculty</i>
22.04 Tue	FREE				
23.04 Wed	LM Mixed samples from the Gulf of Naples EM <i>Faculty</i>	LM Mixed samples from the Gulf of Naples EM <i>Faculty</i>	Group 1: (10 students) Serial dilution cultures. <i>Thronsdén, Zingone,</i>	Group 2: (10 students) Serial dilution cultures. <i>Thronsdén, Zingone</i>	LM selected species/problems <i>Faculty</i>
			Group 2: (10 students) Coccolithophorids SEM Observation of cultures/natural samples	Group 2: (10 students) Coccolithophorids SEM Observation of cultures/natural samples	
24.04 Thu	LM Mixed samples from different areas <i>Faculty</i>	Group 1: (10 students) LM Mixed samples from different areas <i>Faculty</i> Group 2: (10 students) EM Observations samples/cultures of other areas	Group 1: (10 students) LM Mixed samples from different areas <i>Faculty</i> Group 2: (10 students) EM Observations samples/cultures of other areas	LM Mixed samples from different areas <i>Faculty</i>	Gala Dinner
25.04 Fri	Serial dilution cultures. <i>Thronsdén, Zingone</i>	Serial Dilution Cultures <i>Discussion, Thronsdén, Zingone</i>	LM Mixed samples from different areas <i>Faculty</i>	LM Mixed samples from different areas <i>Faculty</i>	
26.04 SAT	General discussion All faculty	Summary and conclusions			