
SZN-IOC
Advanced Phytoplankton Course
on Taxonomy and Systematics

Marine Botany Laboratory
Stazione Zoologica “A. Dohrn” di Napoli
Vico Equense (Naples), Italy
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1. BACKGROUND, ORGANIZATION AND GOALS

1.1. BACKGROUND

Marine phytoplankton include about 5000 species belonging to seven different algal classes. Their classification and correct identification are the aim of an open and actively developing field of research, which is strongly rooted in light microscopy observations, coupled with modern and sophisticated techniques, such as TEM, SEM and molecular biology.

The knowledge of phytoplankton species from the taxonomic point of view is a tool that cannot be renounced for any ecological or ecophysiological work on marine phytoplankton. Due to its small scale response to environmental changes, phytoplankton community composition and its shifts represent an excellent tool to interpret the dynamics of the pelagic ecosystem and detect variations induced by river discharges, eutrophication and unusual climatic phenomena. In the last years, the importance of taxonomic work has also been stressed by the international scientific community, especially in the frame of the increasing interest in the assessment of natural community biodiversity, as demonstrated by the recommendations adopted by UNCED in Rio de Janeiro and by several relevant initiatives stemming from the AGENDA 21.

The SCOR-Working Group of Phytoplankton Methods (WG 33), established in 1969, suggested a tentative plan for a "Phytoplankton Course for Experienced Participants", along with a list of contents for a manual including methods and literature for the identification of marine phytoplankton. The Marine Botany Section of the University of Oslo was chosen to be responsible for the teaching programme of the Course, which was held for the first time in 1976 in Oslo. 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. Throndsen, K. Tangen, B. Heimdal and, from 1983, K.A. Steidinger). From 1985, three advanced Courses, still under the direction of G.R. Hasle, were organized at the Marine Botany Laboratory of the Stazione Zoologica "A. Dohrn" of Naples (SZN).

The teaching programme has not substantially varied over the year (annex I), but has always been open to integrate recent developments in the field and insights brought in by new technologies. A total number of 122 participants, representing 46 countries have so far attended the seven Advanced Phytoplankton Courses. This rather special community includes several well known scientists engaged, at times in leading positions, in the field of phytoplankton research all over the world (annex II). The handouts used by the students during the courses provided the ground for a multi-author manual for taxonomy and identification, with contribution from several teachers of the course. The manual was initially published in two parts (C.R. Tomas ed., 1993, 1996), but recently a unified, revised version has been published (C. R. Tomas ed., 1997).

1.2. ORGANIZATION

In the closure of the 1995 course, a new course was announced to be held in Naples in three years. The organization of this course started in late spring 1997, when the organizing committee was established (annex III) and the teachers (annex IV) were contacted for a first agreement on date, location and content of the course.

Due to severe space limitations at the SZN, the Course was held in a hotel (Hotel Villa Aequa) located in Vico Equense (Naples), which also hosted the faculty and the students. The classroom, secretary rooms, teacher office and laboratory were all located on the last floor of the hotel. The classroom held the students' benches, each equipped with a light microscope, the desk with three microscopes connected to a video camera, and slide and transparency projectors. A library was arranged which held the collection of about 3500 taxonomy reprints belonging to the Marine Botany Laboratory, as well as taxonomy textbooks lent by the SZN library. Laboratory equipment consisted of a small growth chamber for cultures, a centrifuge, and a number of laboratory devices and disposable material for culture maintenance and sample preparations. The secretary office was equipped with telephone, xerox-copy machine and two computers, one of which available to the students for e-mail and literature database.

The announcement of the course was delivered through the Web page of the SZN, and mailed to about 400 research institutions around the world and to the most relevant scientific journals of the field. The selection of 20 participants (annex V) out of 160 applications from 46 different countries, was performed based on the curriculum, the position held, the need and usefulness for training of the applicants.

Financial support for the Course was provided by the SZN, which covered living and travel expenses for teachers and the organizing committee, as well as funds for the organization and secretariat. The Provincial Administration of Napoli offered the rent of the classroom and the coffee-breaks during the Course. IOC contributed travel and subsistence expenses for 6 participants from developing countries. ONR and NOAA contributed travel and subsistence expenses for the 3 participants from USA. Carl Zeiss S.p.A. kindly lent 22 microscopes for the practical sessions.

1.3. GOALS

The Course was meant for already experienced researchers actively working in fields of research that require species identification such as phytoplankton ecology and physiology, and for experts in taxonomy and systematics who need to upgrade their expertise. The aim of the course was to increase and update the expertise of the students in the identification of diatoms, dinoflagellates, coccolithophorids and other flagellate species. Special attention was given to species implicated in the formation of exceptional or harmful blooms.

The objectives of the Course were:

- To provide an updated theoretical background for the morphology, taxonomy and classification of the most important phytoplankton groups.
- To teach, in the laboratory, methods and criteria for correct identification of species, with special emphasis on light microscopy techniques.
- To allow students to acquire updated information on specialized literature.
- To diffuse information and awareness on toxic and potentially toxic species.
- To create a forum for discussion of general and specific aspects of systematics, ecology and geographic distribution of phytoplankton species.

2. CONTENT

The Course included the following activities

- Lectures on general taxonomic features of marine diatoms, dinoflagellates (including cysts), coccolithophorids and other flagellates.
- Laboratory exercises the identification of selected species belonging to the different algal groups in the light microscope.
- Special techniques, such as acid frustule cleaning for diatoms, squashing and theca staining for dinoflagellates.
- Scanning (SEM) and Transmission Electron Microscope (TEM) techniques, with practical sessions devoted to the observation of selected species.
- Techniques for establishing and maintaining clonal cultures.
- Serial dilution technique to establish mixed flagellate cultures.
- Field cruise with demonstration of sampling techniques.
- Integrative seminars on specific taxonomic issues (nuisance species, marine cyanobacteria, epiphytic diatoms, etc.).

2.1. OPENING AND INTRODUCTION

Grethe R. Hasle, director, and Donato Marino, head of the Organizing Committee of the Course, opened the course. Grethe Hasle briefly presented the historical background of the Course. She showed the list of

participants in the previous Advanced Phytoplankton Courses and stressed the leading positions within the scientific community attained by a large number of them. Grethe Hasle concluded her welcome speech by presenting the financial budget and expressing, on behalf of the faculty, her thanks to the Institutions that generously supported the Course (annex VI).

D. Marino illustrated the programme (annex I) and provided practical information on the use of the laboratory facilities, the collection of reprints and identification literature.

2.2. MANUALS

The manuals "Marine Phytoplankton - A Guide of Naked Flagellates and Coccolithophorids" (1993) by J. Throndsen and B. Heimdal (C.R. Tomas ed.) and "Identifying Marine Phytoplankton - Diatoms and Dinoflagellates" (1996) by G. R. Hasle & E. Syvertsen, K. Steidinger & K. Tangen (C.R. Tomas ed.) were used as textbooks during the Course. The books developed from the handouts usually distributed during the previous courses, which were thoroughly re-elaborated and completed to include a detailed description of numerous planktonic genera and species, along with taxonomic keys, drawings and references.

2.3. LECTURES

General features of diatoms, dinoflagellates, coccolithophorids 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 using transparencies and slides. The use of identification keys was introduced when possible. For coccolithophorids and dinoflagellates having complex life-cycles, the morphology of different life-stages was illustrated. As a result of students' suggestions from previous courses, new classrooms were included concerning marine cyanobacteria, heterotrophic flagellates and benthic diatoms.

Throughout the lessons, the different sections of the manuals were referred to and commented, drawing attention to schemes and illustrations useful for species identification. Updated literature references were mentioned and additional handouts were distributed when needed.

2.4. LABORATORY EXERCISES

2.4.1. Species observation

A wide selection of fixed or living clonal cultures and permanent slides were distributed to each participant to be observed and identified in the light microscope. In some cases, permanent slides of selected species were shown through video camera connected to a microscope. The use of different light set-ups, fixatives and special staining or manipulation techniques were used whenever required. Slides and transparency showing ultrastructural features not visible in light microscopy were often displayed 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.

During the session on heterotrophic nanoflagellates, material was shown which was obtained from mud samples collected off Vico Equense and incubated in Petri dishes.

2.4.2. Techniques

Different techniques for collecting, culturing and handling phytoplankton were illustrated and their possible applications and limitations were highlighted. Practical demonstrations were provided and the opportunity was given to the participants to practice.

The following methods were included:

- Collection of phytoplankton samples with different tools: bucket samples, Niskin bottles, plankton nets. These methods were illustrated during the field trip (see paragraph 2.5).
- 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.
- Permanent jelly mounts for coccolithophorids and dinoflagellates.
- Squashing and thecal plate staining for thecate dinoflagellates.
- Dinoflagellate resting cyst collection and treatment of cyst samples for observation.
- Preparation of TEM grids and SEM stubs using both culture material and mixed samples.

2.4.3. Exercises

During the last days of the Course, fixed natural samples were distributed to identify species belonging to the different groups. These samples, mainly provided by the faculty, were chosen with the aim of covering different geographic areas and seasons. In the last days, special sessions were also devoted to the examination of natural samples provided by the students themselves.

For flagellates, each student was assigned a series of culture tubes from the serial dilution cultures established in the first day of the course. Students were guided in the identification of flagellates present in the tubes. Results were reported in forms and the Most Probable Number (MPN) was calculated for each species. Comparison exercises of similar species were also organized to stress distinctive features and improve identification capabilities.

A special session was devoted to the exercise of preparing models of *Pfiesteria piscicida*, a harmful dinoflagellate, using clay and 'play-doh'. The plate pattern of the species was reported from line drawings on the tri-dimensional models. Differences with closely related species were stressed and the complicate life-cycle and phylogeny of the species was recalled to the students.

2.5. FIELD TRIP

For logistical reasons, students were divided in two groups, which alternated over two days in the field trip and electron microscope sessions. Field trips took place on the research vessel 'Vettoria' of the SZN. Several stations were visited along the coast of the Surrentine Peninsula, from the oligotrophic waters off Punta Campanella, exposed to Tyrrhenian open waters, to the polluted area off Castellammare, close to the outlet of the Sarno River. During the trip, physiographic features of the Gulf of Naples were illustrated. Net and bottle samples were collected and observed in the afternoon of the same day. The use of different equipment was demonstrated, e.g. CTD probe and rosette sampler.

2.6. SCANNING (SEM) AND TRANSMISSION ELECTRON MICROSCOPE (TEM) DEMONSTRATIONS

The main goal of this course was to train students in light microscopy identification of phytoplankton species. However, a consistent number of phytoplankton species and genera belonging to different algal groups require electron microscopy to be correctly identified. Ultrastructural features underlying their classification were presented by slides and transparencies during the lessons and techniques required to observe these features were illustrated in practical sessions.

The electron microscopy session were held at the SZN in the same days of the field trip, to allow for the alternation of the students. This session was meant to show the potentiality of the EM technique more than train students on EM species identification, which would require a separate course. Students further divided into small subgroups alternated at the SEM and TEM to observe material under the guide of some of the teachers. For each algal group considered (diatoms, coccolithophorids, cryptophyceans, prasinophyceans, naked dinoflagellates), the specific morphological details visible in EM were illustrated through demonstrative samples. For comparison purpose, some of these samples were also examined in the light microscope.

2.7 HARMFUL ALGAE

During the theoretical and practical sessions, harmful and nuisance species were pointed out to students' attention whenever encountered. In addition, sessions devoted to harmful diatoms, dinoflagellates and phytoflagellates were held separately to stress problems caused by these species, along with their distinctive morphological characters and geographic distribution. Samples and culture of relevant species were observed in the light microscope and additional slide material was shown to illustrate other species not available as samples.

During the first of this session, Adriana Zingone (Chair of the IOC- Intergovernmental Panel on Harmful Algal Blooms, IPHAB) introduced the problem and illustrated the organization, activities and ongoing projects of the IOC Harmful Algal Bloom Programme.

2.8 INVITED LECTURES

Three invited lectures were held:

- | | |
|------------------|--|
| P. B. Albertano: | Marine cyanobacteria. |
| L. Edler: | Conversion of cell counts to biovolume and carbon. |
| L. Mazzella. | Epiphyte diatoms on marine Phanerogames. |

2.9 SEMINARS

The following seminars given by selected students were organized on both taxonomy and other aspects relevant to marine phytoplankton.

- | | |
|-------------------|--|
| M.C. Villac: | Distribution of <i>Pseudo-nitzschia</i> species. |
| J. B. Østergaard: | Haptophytes in the Andaman Sea - quantitative and qualitative perspectives. |
| N. Simon: | Eukaryotic Picoplankton Diversity. |
| A. M. Wood: | Evaluation of methods for quantification and species identification of marine phytoplankton. |
| M. Poulin: | Benthic diatoms in marine plankton. |

3. SOCIAL ACTIVITIES

A number of social events took place over the three weeks of the course, to allow for a better integration of students among them and with the teachers, as well as to interrupt the very intensive work programme and enjoy the nice location. These included a welcome party, a few organized tours, a concert, some dinners in different restaurants and, on the last night, a gala party, followed by a typical music show and a dancing party.

4. QUESTIONNAIRE AND CONCLUDING REMARKS

4.1 QUESTIONNAIRE

During the last days, participants were requested to express comments on the Course through a questionnaire (annex VII) which included questions on both logistic and scientific aspects.

All participants expressed their enthusiastic appreciation for the organization and the scientific content of the Course. Suggestions for improvements included the following comments:

- Some phytoplankton groups, that is cyanobacteria (3 participants) and pennate diatoms (2 participants) should be dealt in greater detail.

- Participants should have more time to try out some of the techniques included in the Course, that is TEM preparations (7 participants), culturing techniques (1 participant), counting methods (1 participant) and use of confocal microscope (1 participant).
- Time devoted to the examination of samples from different geographic areas and mixed diatom-dinoflagellate cultures should be increased (2 participants).
- Evening sessions should be devoted only to seminars (1 participant).

4.2 CONCLUDING REMARKS

G. R. Hasle and D. Marino introduced the final session of the course. They expressed their satisfaction for the whole course and commended the students for their constant and active participation to all the proposed activities. They remarked the pleasant and friendly atmosphere, which was established since the first day, and the open and frank communication during the lessons, which allowed a full exchange of knowledge between participants and teachers. Thanks were expressed to Gioacchino De Vivo for his continuous and invaluable assistance in the organization and during the whole course, and to the hotel personnel who offered a warm hospitality and were able to meet an array of unusual requirements posed by a quite special group of guests.

An open discussion followed during which students expressed enthusiastic comments on the course, stressing the broad range of topics covered, the impressive number of cultures and samples shown, the complete literature availability and the nice logistic arrangement. Some suggestions for further improvements were given concerning the usefulness of additional schematic handouts and comparative exercises. The possibility to expand the course to include a couple of days more was also discussed.

A meeting among teachers and organizers followed the conclusive session, to review the whole course, including positive aspects and possible improvements, and to start organizing the next course.

ANNEX I
PROGRAMME

Sunday, 10 May

Arrival of participants, course registration, ice breaking with welcome party in the evening

Monday 11 May

- 09:00-09:30 **Opening of the course**, general recommendations (how to use microscopes, literature, etc.).
Faculty: *Hasle, Marino*
- 09:30-11:00 **Methods** - Demonstration of procedure steps for preparation of diatom slides. Starting serial dilution cultures.
Faculty: *Lange, Marino, Zingone, Forlani*
- 11:30-13:00 **Methods** - Demonstration of procedure steps for preparation of diatom slides. Starting serial dilution cultures.
Faculty: *Lange, Marino, Zingone, Forlani*
- 15:00-17:00 **Diatoms** - Morphology, terminology, general systematics.
Faculty: *Hasle, Lange*
- 17:30-19:00 **Diatoms** - Observation of Thalassiosiraceae.
Faculty: *Hasle, Lange*

Tuesday 12 May

- 09:00-11:00 **Diatoms** - Observation of Coscinodiscaceae, Stellarimaceae. Demonstration of Hemidiscaceae, Asterolampraceae and Heliopeltaceae. Observation of Rhizosoleniaceae (1st part)
Faculty: *Lange, Hasle*
- 11.30-13:00 **Diatoms** - Observation of Coscinodiscaceae, Stellarimaceae. Demonstration of Hemidiscaceae, Asterolampraceae and Heliopeltaceae. Observation of Rhizosoleniaceae (1st part)
Faculty: *Lange, Hasle*
- 15:00-17:00 **Diatoms** - Observation of Rhizosoleniaceae (2nd part), Hemiaulaceae and Cymatosiraceae. Demonstration of Lithodesmiaceae and Eupodiscaceae.
Faculty: *Hasle, Lange*
- 17.30-19:00 **Diatoms** - Observation of Rhizosoleniaceae (2nd part), Hemiaulaceae and Cymatosiraceae. Demonstration of Lithodesmiaceae and Eupodiscaceae.
Faculty: *Hasle, Lange*
- 21:00-22:00 **Diatoms** - Demonstration of Melosiraceae and Leptocyliindraceae.
Faculty: *Lange, Hasle*

Wednesday 13 May

- 09:00-11:00 **Diatoms** - Observation of Chaetocerotaceae.
Faculty: *Lange, Hasle*
- 11:30-13:00 **Diatoms** - Demonstration of Fragilariaceae and Rhaphoneidaceae. Observation of Thalassionemataceae. Demonstration of Naviculaceae. Observation of Bacillariaceae.
Faculty: *Lange, Hasle*
- 15:00-17:00 **Diatoms** - Demonstration of Fragilariaceae and Rhaphoneidaceae. Observation of Thalassionemataceae. Demonstration of Naviculaceae. Observation of Bacillariaceae.
Faculty: *Hasle, Lange*
- 17:30-19:00 **Diatoms** - Observation of *Pseudo-nitzschia* species.
Faculty: *Hasle, Lange*
- 21:00-22:00 **Seminar**: "Distribution of *Pseudo-nitzschia* species"
Lecturer: *Villac*

Thursday 14 May

- 09:00-11:00 **Coccolithophorids** - Morphology and terminology. Heterococcolithophorids. Observation of living material in culture (*Emiliana* and *Gephyrocapsa*).
Faculty: *Chrétiennot-Dinet, Zingone*
- 11:30-13:00 **Coccolithophorids** - Morphology and terminology. Heterococcolithophorids.
Faculty: *Chrétiennot-Dinet, Zingone*
- 15:00-17:00 **Coccolithophorids** - Holococcolithophorids. Collection and preservation techniques, preparation of permanent slides for light microscopy, preparation of stubs for SEM.
Faculty: *Chrétiennot-Dinet*.
- 17:30-19:00 **Coccolithophorids** - Observation of living material in cultures (*Pleurochrysis*, *Crucioplacolithus*, *Ochrosphaera*, *Hymenomonas*)
Faculty: *Chrétiennot-Dinet, Zingone*
- 21:00-22:00 **Coccolithophorids** - Observation of selected species and natural samples.

Faculty: *Chrétiennot-Dinet, Zingone*

Friday 15 May

- 09:00-11:00 **Coccolithophorids** - Reproduction and life cycles, synonyms and recent taxonomic changes.
Faculty: *Chrétiennot-Dinet*
- 11:30-13:00 **Coccolithophorids** - Observation of selected samples.
Faculty: *Chrétiennot-Dinet, Zingone*
- 15:00-17:00 **Flagellates** - Morphology, terminology, general systematics
Faculty: *Throndsen*
- 17:30-19:00 **Flagellates** - Raphidophyceae, Chrysophyceae, Dictyochophyceae. Observation of selected species.
Faculty: *Throndsen, Zingone, Chrétiennot-Dinet*
- 21:00-22:00 **Seminar:** "Haptophytes in the Andaman Sea - quantitative and qualitative perspectives"
Lecturer: *Østergaard*

Saturday 16 May

- 09:00-11:00 **Techniques** for SEM preparations of dinoflagellates and flagellates and TEM preparations of dinoflagellates.
Faculty: *Montresor, Throndsen.*
- 11:30-13:00 **Techniques** for TEM preparations of flagellates and coccolithophorids.
Faculty: *Throndsen, Chrétiennot-Dinet*

AFTERNOON FREE

Sunday 17 May

- 09:00-11:00 **Flagellates** - Prymnesiophyceae, Cryptophyceae. Observation of selected species.
Faculty: *Throndsen, Zingone, Chrétiennot-Dinet*
- 11:30-13:00 **Flagellates** - Prymnesiophyceae, Cryptophyceae. Observation of selected species.
Faculty: *Throndsen, Zingone, Chrétiennot-Dinet*
- 15:00- 17:00 **Flagellates** - Euglenophyceae and Chlorophyceae. Observation of selected species.
Faculty: *Throndsen, Zingone*
- 17:30-19:00 **Flagellates** - Euglenophyceae and Chlorophyceae. Observation of selected species.
Faculty: *Throndsen, Zingone*
- 19:30 Concert

Monday 18 May

- 09:00-11:00 **Flagellates** - Prasinophyceae. Observation of selected species.
Faculty: *Throndsen, Zingone*
- 11:30-13:00 **Flagellates** - Prasinophyceae. Observation of selected species.
Faculty: *Throndsen, Zingone*
- 15:00-19:00 **Invited lecture:** "Marine Cyanobacteria"
Lecturer: *Albertano*
- 21:00-22:00 **Seminar:** "Eukaryotic Picoplankton Diversity"
Lecturer: *Simon*

Tuesday 19 May

- All day **Excursion:** Vesuvio - Pompei

Wednesday 20 May

- 09:00-11:00 **Dinoflagellates** - Morphology, terminology, general systematics.
Faculty: *Steidinger*
- 11:30-13:00 **Dinoflagellates** - Demonstration and observation of *Prorocentrum*, *Dinophysis* and *Ornithocercus* species.
Faculty: *Steidinger, Montresor*
- 15:00-17:00 **Dinoflagellates** - Techniques (permanent slides, squashing, plate staining, etc.)
Faculty: *Steidinger, Montresor*
- 17:30-19:00 **Demonstration** and observation of *Protoperdinium*, *Scrippsiella* and *Ensiculifera* species.
Faculty: *Steidinger, Montresor*
- 21:00-22:00 **Seminar:** "Evaluation of methods for quantification and species identification of marine phytoplankton"
Lecturer: *Wood*

Thursday 21 May

- 09:00-11:00 **Dinoflagellates** - Demonstration and observation of *Alexandrium*, *Goniodoma*, *Pyrodinium*, *Gambierdiscus*, *Coolia*, *Ostreopsis* species.
Faculty: *Steidinger, Montresor*
- 11:30-13:00 **Dinoflagellates** - Demonstration and observation of *Alexandrium*, *Goniodoma*, *Pyrodinium*, *Gambierdiscus*, *Coolia*, *Ostreopsis* species.
Faculty: *Steidinger, Montresor*
- 15:00-17:00 **Dinoflagellates** - Demonstration and observation of *Gonyaulax* and *Ceratium* species, and other armoured dinoflagellates.
Faculty: *Steidinger, Montresor*
- 17:30-19:00 **Dinoflagellates** - Demonstration and observation of *Gonyaulax* and *Ceratium* species, and other armored dinoflagellates.
Faculty: *Steidinger, Montresor*
- 20:30 **Social Dinner** - Belvedere restaurant (Massaquano)

Friday 22 May

- 09:00-11:00 **Dinoflagellates** - Demonstration and observation of naked species.
Faculty: *Larsen*
- 11:30-13:00 **Dinoflagellates** - Demonstration and observation of naked species.
Faculty: *Larsen*
- 15:00-17:00 **Dinoflagellate resting cysts** - Introduction, demonstration and observation of organic and calcareous cysts.
Faculty: *Montresor*
- 17:30-19:00 **Invited lecture**: "Conversion of cell counts to biovolume and carbon".
Lecturer: *Edler*
- 21:00-22:00 **Dinoflagellate resting cysts** - Observation of organic and calcareous cysts.
Faculty: *Montresor*

Saturday 23 May

- 09:00-11:00 **Heterotrophic flagellates.**
Faculty: *Larsen, Throndsen*
- 11:30-13:00 **Seminar:** Benthic diatoms in marine plankton.
Lecturer: *Poulin*
- 15:00-17:00 **Group 1: (10 students)**
Cultivation.
Faculty: *Tomas, Montresor, Larsen*
- Group 2: (10 students)**
Exercises - Examination of mixed samples from different areas.
Faculty: *Hasle, Lange, Steidinger, Throndsen*
- 17:30-19:00 **Group 2: (10 students)**
- Cultivation.**
Faculty: *Tomas, Montresor, Larsen.*
- Group 1: (10 students)**
- Exercises -** Examination of mixed samples from different areas.
Faculty: *Hasle, Lange, Steidinger, Throndsen*

Sunday 24 May

Free

Monday 25 May

Group 1 (10 students)

- 10:00-13:00 **SEM and TEM demonstrations** at the Stazione Zoologica.
Faculty: *Hasle, Montresor, Throndsen, Zingone*
- afternoon: **Visit to the historical center of Naples**

Group 2 (10 students)

- 09:00-13:00 **Field trip.**
Faculty: *Tomas, Marino*
- 15:00-17:00 **Examination of** samples from the Gulf of Naples.
Faculty: *Lange, Steidinger, Sarno, Marino, Tomas*
- 17:30-19:00 **Examination of** samples from the Gulf of Naples.
Faculty: *Hasle, Steidinger, Sarno, Marino, Tomas*

Tuesday 26 May

Group 1: (10 students)

- 09:00-13:00 **Field trip.**
Faculty: *Tomas, Marino*
- 15:00-17:00 **Examination of samples from the Gulf of Naples.**
Faculty: *Hasle, Steidinger, Sarno, Marino, Tomas*
- 17:30-19:00 **Examination of samples from the Gulf of Naples.**
Faculty: *Hasle, Steidinger, Sarno, Marino, Tomas*

Group 2 (10 students)

- 10:00-13:00 **SEM and TEM demonstrations at the Stazione Zoologica.**
Faculty: *Lange, Montresor, Throndsen, Larsen, Zingone*
- afternoon: **Visit to the historical center of Naples**

Wednesday 27 May

- 09:00-11:00 **Exercises - Examination of mixed samples from different areas.**
Faculty: *Hasle, Lange, Steidinger, Throndsen*
- 11:30-13:00 **Examination of serial dilution cultures.**
Faculty: *Throndsen, Zingone*
- 15:00-17:00 **Exercises - Re-observation of serial dilution cultures.**
Faculty: *Throndsen, Zingone*
- 17:30-19:00 **Examination of toxic and nuisance bloom species: Dinoflagellates.**
Faculty: *Tomas, Larsen, Steidinger, Zingone*
- 21:00-22:00 **Examination of toxic and nuisance bloom species: Dinoflagellates.**
Faculty: *Tomas, Larsen, Steidinger, Zingone*

Thursday 28 May

- 09:00-11:00 **Exercises - Examination of mixed samples from different areas.**
Faculty: *Lange, Steidinger, Throndsen, Zingone*
- 11:30-13:00 **Examination of toxic and nuisance bloom species: Naked flagellates.**
Faculty: *Throndsen, Zingone, Tomas*
- 15:00-17:00 **Examination of toxic and nuisance bloom species: Naked flagellates.**
Faculty: *Throndsen, Zingone, Tomas*
- 17:30-19:00 **Examination of toxic and nuisance bloom species: Diatoms.**
Faculty: *Hasle, Lange,*
- 21:00-22:00 **Discussion on the Serial Dilution Culture Techniques and MPM**
Faculty: *Throndsen, Zingone,*

Friday 29 May

- 09:00-11:00 **Exercises** - Comparison of selected species.
Faculty: *Throndsen, Zingone*
- 11:30-13:00 **Examination** of mixed dinoflagellate and diatom samples from different areas.
Faculty: *Steidinger, Lange, Hasle, Zingone*
- 15:00-17:00 **Examination** of mixed dinoflagellate and diatom samples from different areas.
Faculty: *Steidinger, Lange, Hasle, Zingone*
- 17:30-19:00 **Invited lecture:** "Epiphyte diatoms on marine Phanerogames".
Lecturer: *Mazzella*
- 20:00 **Gala Dinner** - Hotel Aequa

Saturday 30 May

- 09:00-11:00 **Summary and conclusions.**
Faculty: *Marino, Hasle*
- 11:30- 13:00 **Meeting of the faculty**

AFTERNOON FREE

Sunday 31 May

Departure of the participants

ANNEX II

PARTICIPANTS TO THE SIX PREVIOUS COURSES

Judy C. Acreman Canada, 1976	Svein Rune Erga Norway, 1985	Michael A. Hoban USA, 1985
Jean Marie Adamson USA, 1995	Marta M. Estrada Spain, 1976	Giorgio Honsell Italy, 1985
Emelia R. Anang Ghana, 1976	Maria A. Faust USA, 1983	Nobuhito Hosaka Japan, 1985
David Hernandez-Becerril Mexico, 1985	Martha E. Ferrario Argentina, 1985	Maja Huttunen Finland, 1983
Lyse Bérard-Therriault Canada, 1983	Santiago Fraga Spain, 1983	Lydia Ignatiades Greece, 1985
Pensri Boonruang Thailand, 1983	Jaqueline Fresnel France, 1990	Pablo R. Intriago Equador, 1985
Susan A. Brady USA, 1985	Greta A. Fryxell USA, 1976	Ian R. Jenkinson Ireland, 1976
Ian Bryceson Tanzania, 1983	Ken Furuya Japan, 1980	Roberto S. Jiménez Equador, 1976
Marina Cabrini Italy, 1995	Julie K. Garrett USA, 1990	Lakshmanan Kannan India, 1983
Jeng Chang USA, 1990	David L. Garrison USA, 1983	Marie Kat Nederland, 1976
Marie-J. Chrétiennot-Dinet France, 1983	Gisele Gaumer Algerie, 1980	Maureen Keller USA, 1995
Einar Dahl Norway, 1980	Ana Maria Gayoso Argentina, 1990	Tufan Koray Turkey, 1990
Maximino Delgado Spain, 1995	Giovanni E. Giuffré Italy, 1990	Miryam Kutner Brasil, 1980
Elvira de Reyes Venezuela, 1980	Jeanette Göbel Germany, 1995	Jan H. Landsberg USA, 1995
Quay Dortch USA, 1995	Gustaaf M. Hallegraeff Australia, 1983	Carina B. Lange Argentina, 1983
Lars Edler Sweden, 1995	Regina Hansen Germany, 1990	Jacob Larsen Denmark, 1985
Wenche Eikrem Norway, 1995	Derek S. Harbour United Kingdon, 1976	Pauline Lawrence Canada, 1980
Malte Elbrächter Germany, 1976	David R. A. Hill Australia, 1990	Joon-Baek Lee Republic of Korea, 1995

Jin-Hwan Lee Republic of Korea, 1983	Jacqueline H.T. O'Mahony United Kingdom, 1995	Helene M. Sørensen Denmark, 1990
Georgina S. Lembeye Chile, 1990	Frederick I. Opute Nigeria, 1990	Sylvia M. Susini Ribeiro Brasil, 1995
Jane Mary Lewis United Kingdom, 1995	Trevor Platt Canada, 1976	Jens Petter Taasen Norway, 1976
Sérgio Licea-Durá Mexico, 1976	Akshinthala Prasad India, 1990	Thórunn Thórdardóttir Iceland, 1990
Connie Vincent Lovejoy Canada, 1995	Freda M.H. Reid USA, 1976	Lena C. Tinnberg Sweden, 1976
Douding Lu Popular Republic of China	Cilian Roden Ireland, 1980	Carmelo R. Tomas USA, 1983
A. Noemi Ochoa Lopez Peru, 1985	Elisabeth Sahlsten Sweden, 1980	Cecilia Totti Italy, 1995
Ivona Marasovic Yugoslavia, 1983	Leila Samson Algerie, 1980	Juan Carlos Uribe Paredes Chile, 1995
Donato Marino Italy, 1980	Francisco Sanchez Spain, 1980	Elizabeth L. Venrick USA, 1976
Esther Meave Del Castillo Mexico, 1995	Diana Sarno Italy, 1995	Damir Vilicic Croatia, 1985
Linda Medlin USA, 1980	Victor Smetacek Germany, 1976	Virginia Villafañe Argentina, 1995
Øjvind Moestrup Denmark, 1983	Giorgio Socal Italy, 1985	Tracy A. Villareal USA, 1985
Maria Teresa Moita Garnel Portugal, 1985	Sylvia M. Susini Ribeiro Brasil, 1995	Cecilie H. von Quillfeldt Norway, 1995
Caterina Nuccio Italy, 1990	Filipina B. Sotto Philippines, 1983	Karin Wandschneider Germany, 1980
Clarisse Odebrecht Brasil, 1990	Alain Sournia France, 1980	Ladda Wongrat Thailand, 1976
Yuri Borisovich Okolodkov Russia, 1995	Bo Sundström Sweden, 1990	Adriana Zingone Italy, 1985

ANNEX III

ORGANIZING COMMITTEE

COMMITTEE

Dr. Donato Marino
Responsible for the organization
Stazione Zoologica 'A. Dohrn'
Villa Comunale
80121 Naples, Italy
Tel.: ++39 815833271
Fax: ++39 817641355
E-mail: marino@alpha.szn.it

Dr. Diana Sarno
Marine Botany Laboratory
Stazione Zoologica 'A. Dohrn'
Villa Comunale
80121 Naples, Italy
Tel.: ++39 815833295
Fax: ++39 817641355
E-mail: diana@alpha.szn.it

Dr. Marina Montresor
Marine Botany Laboratory
Stazione Zoologica 'A. Dohrn'
Villa Comunale
80121 Naples, Italy
Tel.: ++39 815833259
Fax ++39 817641355
E-mail: mmontr@alpha.szn.it

Dr. Adriana Zingone
Stazione Zoologica 'A. Dohrn'
Marine Botany Laboratory
Villa Comunale
80121 Naples, Italy
Tel.: ++39 815833295
Fax: ++39 817641355
E-mail: zingone@alpha.szn.it

SECRETARIAT

Gioacchino De Vivo
Vico Equense (Naples), Italy
Tel.: ++39 818024059

ANNEX IV

FACULTY AND INVITED LECTURERS

FACULTY

Prof. Grethe R. Hasle
Director of the course
University of Oslo
Department of Biology, Marine Botany
P.O. Box 1069, Blindern
N-0316 Oslo, Norway
Tel: ++47 22854533
Fax: ++47 22854438
E-mail: g.r.hasle@bio.uio.no

Dr. Marie-Josèphe Chrétiennot-Dinet
Observatoire Oceanologique de Banyuls
Université Pierre et Marie Curie
I.N.S.U. - C.N.R.S, Laboratoire Arago
66650 Banyuls-sur-Mer
France
Tel.: ++33 468887307
Fax : ++33 468 887395
E-mail: mjdinet@arago.obs-banyuls.fr

Dr. Carina B. Lange
University of California
Scripps Institution of Oceanography
Geological Research Division
La Jolla, California 92093-0215 , USA
Tel: ++1 6195344605
Fax: ++1 6195340784
E-mail: clange@ucsd.edu

Dr. Jacob Larsen
IOC Science and Communication Centre
on Harmful Algae, Botanical Institute
Øster Farimagsgade 2D
DK-1353 Copenhagen K, Denmark
Tel: ++45 33134446
Fax: ++45 33134447
E-mail: jacobl@bot.ku.dk

Dr. Marina Montresor
Marine Botany Laboratory
Stazione Zoologica 'A. Dohrn'
Villa Comunale
80121 Naples, Italy
Tel.: ++39 815833259
Fax ++39 817641355
E-mail: mmontr@alpha.szn.it

Dr. Karen A. Steidinger
Department of Environmental Protection
Florida Marine Research Institute
100 Eighth Avenue S.E.
St. Petersburg, Florida 33701
USA
Tel: ++1 8138968626
Fax: ++1 8138230166
E-mail: Steidinger_k@epic7.dep.state.fl.us

Dr. Carmelo R. Tomas
Department of Environmental Protection
Florida Marine Research Institute
100 Eighth Avenue S.E.
St. Petersburg, Florida 33701
USA
Tel: ++1 8138968626
Fax ++1 8138230166
E-mail: tomas_c@epic7.dep.state.fl.us

Prof. Jahn Throndsen
University of Oslo
Department of Biology, Marine Botany
P.O. Box 1069, Blindern
N-0316 Oslo, Norway
Tel: ++47 22854526
Fax ++47 22854438
E-mail: jahn.throndsen@bio.uio.no

Dr. Adriana Zingone
Stazione Zoologica 'A. Dohrn'
Villa Comunale
80121 Naples
Italy
Tel.: ++39 815833295
Fax: ++39 817641355
E-mail: zingone@alpha.szn.it

INVITED LECTURERS

Prof. Patrizia B. Albertano
Dipartimento di Biologia
Universita' di Roma "Tor Vergata"
Via della Ricerca scientifica, I-00133 Roma
Italy
Tel. +39 672594345, Fax +39 62023500
E-mail: albertano@utovrm.it

Dr. Lucia Mazzella
Stazione Zoologica 'A. Dohrn'
Punta S. Pietro, Ischia (Naples)
Italy
Tel.: ++39 815833305
Fax: ++39 817641355
E-mail: mazzella@alpha.szn.it

Dr. Lars Edler
Swedish Meteorological and Hydrological
Institute
Oceanographic Laboratory
Doktorsgatan 9D
S-262 52 Ängelholm
Sweden
Tel.: ++46 31696500
Fax: ++46 43183167
E-mail: Lars.Edler@smhi.se

ANNEX V

LIST OF PARTICIPANTS

Congestri Roberta
Dipartimento di Biologia
Universita' di Roma "Tor Vergata"
Via della Ricerca scientifica, I-00133
Roma Italy
tel. ++39 6 72594345, Fax ++39 6 2023500
e-mail: albertano@tovvx1.ccd.utovrm.it

Diaz-Ramos José Rafael
Dept of Marine Science
Univ. of South Florida
140 Seventh Avenue South
St. Petersburg, Florida USA
tel ++813 5531130, fax ++813 5531189
e-mail: jrdiaz@carbon.marine.usf.edu

Egge Jorun K.
Department of Fisheries and Marine Biology
University of Bergen
Bergen High Technology Center
N-5020 Bergen, Norway
tel ++47 55584484, fax: ++47 55584450
e-mail: jorun.egge@ifm.uib.no

Ferreira Amorim Ana
Instituto de Oceanografia
Faculdade de Ciencias de Lisboa
R. Ernesto Vasconcelos, Campo Geande
1700 Lisboa, Portugal
tel ++351 1750 0156, fax ++351 1750 0009
e-mail: ajamorim@fc.ul.pt

Haywood Allison J.
Cawthron Institute,
98 Halifax St EAST,
Private Bag 2,
Nelson, New Zealand
tel ++64 3 5482319, fax ++64 3 5469464
e-mail: allison@environment.cawthron.org.nz

Kang Sung-Ho
Polar Research Center, KORDI
Ansan PO Box 29
Seoul 425-600
Korea
tel ++82 3454006429, fax: ++823454085825
e-mail: shkang@sari.kordi.re.kr

Karentz Deneb
Department of Biology HRN342
University of San Francisco
San Francisco, CA 94117-1080
USA
tel ++1 4154222831, fax ++1 4154226363
e-mail: karentzd@usfca.edu

LeRoi Jeannie-Marie
CSIRO Division of Marine Research
GPO Box 1538, Hobart
Tasmania, 7001
Australia
tel ++61 362325316, fax ++61 362325000
e-mail: jeannie-marie.leroi@marine.csiro.au

Lu Songhui
Department of Ecology & Biodiversity,
The University of Hong Kong
Pokfulam Road, Hong Kong
Popular Republic of China
tel. ++852 28598914, fax ++852 25176082
e-mail: shlu@hkusua.hku.hk

Mozetic Patricija
Marine Biological Station
Fornace 41
6330 Piran
Slovenia
tel ++386 6673073, fax ++386 66746367
e-mail: patricija.mozetic@uni-lj.si

Østergaard Jette Buch
Department of Phycology
Botanical Institute, University of Copenhagen,
Øster Farimagsgade 2D
DK-1353 Copenhagen K, Denmark
tel ++45 35322302 fax: ++45 35322321
e-mail: jetteb@bot.ku.dk

Pholpunthin Pornsilp
Department of Biology, Faculty of Science
Prince of Songkla University
Hat-Yai, Songkla 90112
Thailand
tel ++66 74211030, fax 6674212917
e-mail: ppornsil@ratree.psu.ac.th

Potapova Marina
Department of Botany, Biological Faculty
St. Petersburg State University Emb 7/9
St. Petersburg, Russia
fax ++7-812-2423045
e-mail: MARINA@EP1539spB.edu
marina@bear.zin.ras.spb.ru

Poulin Michel
Research Division
Canadian Museum of Nature
P.O. Box 3443, Station D
Ottawa K1P 6P4, Ontario, Canada
tel ++613 5664788, fax ++613 3644027
e-mail: mpoulin@mus-nature.ca

Romero Oscar
FB Geowissenschaften
Universität Bremen
Postfach 33 04 40
28334 Bremen, Germany
tel ++49 4212187766, fax ++49 4212183116
e-mail: oromero@allgeo.uni-bremen.de

Scharek Renate H.
Institut De Ciencies Del Mar
Passeig Joan De Borbo, S/N
08039 Barcelona
Spain
tel ++ 34 32216416, fax ++ 34 32217340
e-mail: rscharek@icm.csic.es

Sexton Julianne Patricia
CCMP
Bigelow Laboratory for Ocean Sciences
McKown Point Road
West Boothbay Harbor, ME 04556, USA
tel ++1 2076339630, fax: ++1 2076339715
e-mail: Jsexton@bigelow.org

Simon Nathalie
CNRS
Station Biologique, BP 74
29682 Roscoff
France
tel ++33 298292372, fax: ++33 298292372
e-mail: simon@sb-roscoff.fr

Villac Maria Celia
Departamento de Biologia Marinha
Universidade Federal do Rio de Janeiro
Cidade Universitaria, CCS - bloco A
Rio de Janeiro, RJ Brazil 21944-970
tel/fax: ++55 212802394
e-mail: mcvillac@acd.ufrj.br

Wood Michelle A.
Department of Biology
University of Oregon
Eugene, Oregon 97403
USA
tel ++1 5413460454, fax ++1 5413462364
email: miche@darkwing.uoregon.edu

ANNEX VI

FINANCIAL STATEMENT

Total Income:	Lit
Funds provided by Stazione Zoologica	46,172,270
Funds provided by the Marine Botany Laboratory of Stazione Zoologica	4,539,470
Funds provided by Amministrazione Provinciale di Napoli	16,000,000
IOC UNESCO grant (10.000 US\$) ⁽¹⁾	17,500,000
Registration fee (Lit 500,000x18 ⁽²⁾)	9,000,000
ONR - Office of Naval Research Subsistence costs for two USA students	
NOAA - National Oceanic and Atmospheric Administration (USA) Subsistence costs for one USA student	
ZEISS s.r.l Free renting of 22 light microscopes	
	<hr/>
TOTAL	Lit 93,211,740

(1) Ratio US \$/Lit was calculated as 1/1750

(2) The registration fee was not charged to two of the participants, partially supported by IOC, to meet their financial difficulties.

Total costs

Travel refunds for selected students (IOC)	6,777,000
Subsistence costs for selected students (IOC)	10,535,000
Bank expenses (IOC)	188,000
Rent for course rooms and necessary equipment	12,000,000
Travel refunds for invited teachers and lecturers	9,573,970
Transfer from/to the airport of invited teachers and lecturers	1,900,000
Subsistence costs for invited teachers and lecturers	14,230,400
Subsistence costs for SZN teachers and organizers (Marino, Montresor, Sarno, Zingone)	4,539,470
Transfer from/to Stazione Zoologica for EM sessions	400,000
Excursion to Pompei and Vesuvio	775,000
Coffee break (Lit 4000 x 20 days x 25 persons)	4,000,000
Ice breaking dinner	729,000
Social dinner	1,550,000
Transfer for social dinner	1,072,785
Gala dinner	1,500,000
Manuals	2,443,365
Postal expenses	1,157,100
Announcement brochure (1000 copies)	3,404,200
Rent for xerox-copier during the Course	2,200,000
Internet connection	500,000
Telephone of the secretary	638,000
Technicians' meals during the Course	450,000
Consumables, copies and administrative costs	9,943,600
Other costs	2,704,850

TOTAL Lit 93,211,740

ANNEX VII
QUESTIONNAIRE

1. Considering where you are in your professional development, do you feel that this course was an important experience to have? Could you have received the same training elsewhere?
2. Course content: with a limited period of time (three weeks) do you feel each group of phytoplankton species was covered adequately? If not, what would you suggest be included in future offerings?
3. Techniques: are there other techniques you would have liked to have seen or of the ones presented to have greater detail?
4. What general suggestions would you make to improve the course?
5. Do you feel that each student was given equal instruction?
6. Were laboratory facilities adequate?
7. Were housing and meal arrangements adequate?
8. When you return to your home institution, do you believe you will be given sufficient time and facilities to do more detailed taxonomic work?
9. Please feel free to make additional comments you may wish regarding the course experience.