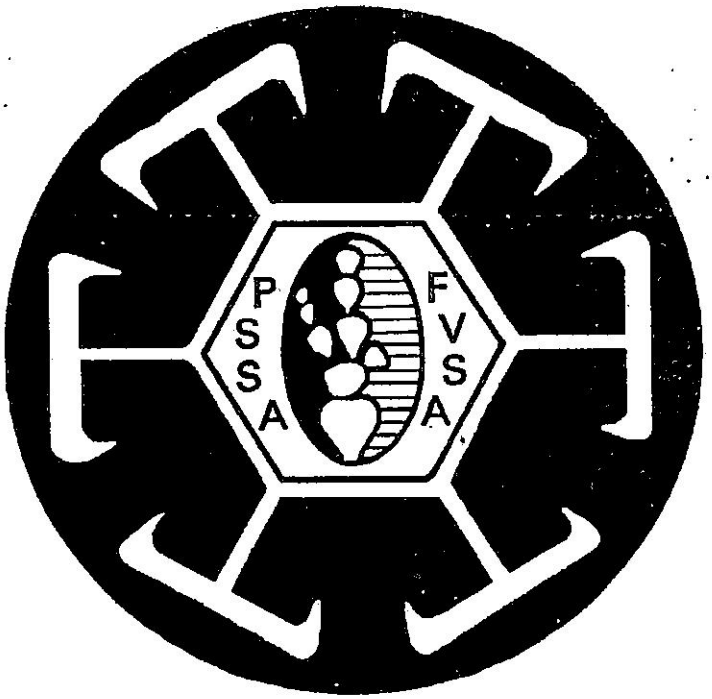


PHYCOLOGICAL SOCIETY OF SOUTHERN AFRICA

FIKOLOGIESE VERENIGING VAN SUIDELIKE AFRIKA

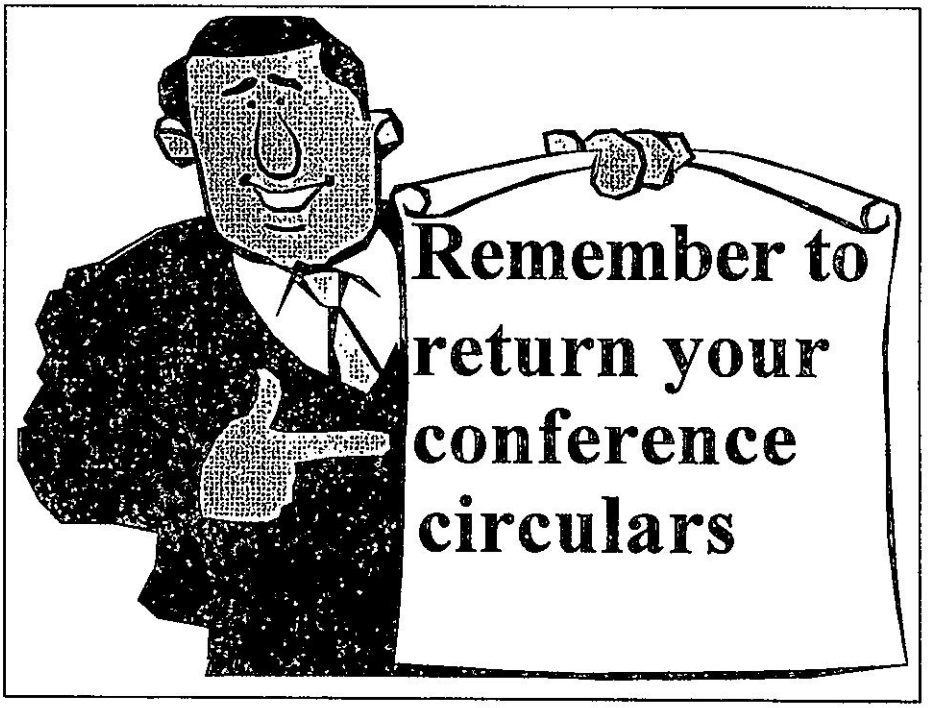
NEWSLETTER
NUUSBRIEF

No. 41
September 1996

THE BOARD OF THE PHYCOLOGICAL SOCIETY OF SOUTHERN AFRICA

TABLE OF CONTENTS

FROM THE EDITOR	i
HAB'S - DR. GRANT PITCHER	1
NEW MEMBERS	4
1ST EUROPEAN PHYCOLOGICAL CONGRESS REPORT BACK	5
MEMBERS ABSTRACTS FROM 1ST EUROPEAN PHYCOLOGICAL CONGRESS	5
FORTHCOMING CONFERENCES	6
STUDENT FOLLIES	7
ABSTRACTS FROM UPE HONOURS PROJECTS	7
APPLICATION FOR PSSA MEMBERSHIP	8



FROM THE EDITOR

Dear PSSA members

It was great to see that our Society was well represented at the 1st European Phycological Congress. Congratulations to Gavin Maneveldt (University of Western Cape) for winning the best student poster award.

Once again I am looking for contributions from members for the next newsletter. In this issue I have included the abstracts from recently completed UPE honours research projects. Perhaps other supervisors can send in summaries from their student's projects.

Reminder

Votes for the new PSSA Council must be sent to Dr. Stuart Sym (Department of Botany, Wits) by 15 October 1996.

Thanks to Dr. Grant Pitcher for his article on his attendance to the NATO Advanced Study Institute on the physiological ecology of harmful algal blooms

Also a big hearty thanks to my sub-editor Brian. This newsletter would not have reached you without his help, as I am rushing off to an international conference on estuaries.

Regards
Janine

Report On: The Attendance Of The NATO Advanced Study Institute On The Physiological Ecology Of Harmful Algal Blooms

DR GRANT C. PITCHER
- Sea Fisheries Research Institute-

In 1992 I was invited to join the Scientific Committee on Oceanic Research (SCOR) Working Group (WG) on the topic of *The Physiological Ecology of Harmful Algal Blooms* (HABs). The terms of reference of this WG were to review and analyse data on the physiological ecology and biochemical aspects of HABs, especially those resulting in toxic episodes and to submit for publication a report, summarizing the state of knowledge and identifying areas of future research.

First Meeting 1993 - La Rochelle, France

It was decided that the best way to accomplish these terms of reference would be to convene a NATO Advanced Study Institute (ASI). The goal of the ASI was to summarise major advances in two theme areas:

1) The ecology of critical groups of toxic phytoplankton (autecology); and

2) The ecophysiological processes and mechanisms that affect toxic bloom formation and the production of phycotoxins (Ecophysiological Processes and Mechanisms).

ASI Meeting - Bermuda 27 May - 6 June 1996

The number of participants of the ASI was restricted to 85 and followed the format specified by NATO which required a 10-day meeting consisting of lectures, discussion sessions and demonstrations. The ASI provided the opportunity to assess our understanding of the fundamental physiological and ecological issues underlying HABs, to identify inadequacies, impediments, and promising areas for future research, and to advance and disseminate new approaches and technologies. During the ASI several major themes were identified as important to the physiological ecology of HABs. Justification of each theme and identification of research priorities are summarized below.

Small-Scale Physics, Behaviour, and Photosynthesis

Justification:

The conceptual model, often termed the Margalef mandala, provides a framework for describing how physiology, behaviour and hydrography interact to promote or maintain algal blooms. Furthermore, good descriptions of algal blooms in several well-studied regions exist.

Research Priorities:

- Incorporation of physics into all HAB initiatives to provide information on the environmental conditions that support bloom development, maintenance and decline.
- Development of effective methods to characterize organism behaviour under the influence of variable environmental factors.
- Development of appropriate methods to characterize photosynthesis and nutrition under relevant, natural hydrodynamic variability. Conventional culture techniques are not sufficient.
- Improved co-ordination among physiological/behavioral characterizations, biological-physical modelling, and quantitative descriptions of hydrography and natural communities.

Freshwater / Stratification

Justification:

Some degree of vertical stability is essential for the development of phytoplankton blooms. Such stability can be provided by density gradients caused by heat or by low salinity inputs.

Research Priorities:

- Elucidation of the mechanisms underlying blooms occurring within low salinity water masses vs those occurring at the boundaries of these water masses.
- Determination of the relative importance of physical effects and algal behaviour vs direct growth stimulation.
- Determination of *in situ* algal species growth rates and physiological status within and outside areas of freshwater influence as they relate to the chemical constituents of the water.
- Development of an understanding of the influence of the timing of freshwater inputs and stratification to bloom dynamics.

Thin Layers and Microphysics of the Pycnocline

Justification:

Different strategies lead some species, amongst which are a large proportion of the harmful species, to accumulate into thin layers associated with the pycnocline for long periods of time. Spatial scales in these features have not yet been investigated but

there is evidence that they can extend, at least, to the 10 km scale.

Research Priorities:

- Characterization of the microphysics and chemistry at the viscous and intermediate sub-ranges in order to quantify the various processes influencing the development of HABs.
- Characterization of the processes leading to the formation and the erosion of thin-layers.
- Development of models of mesoscale advection in thin layers in relation to cyclic forcing, weather events and biologically mediated reduction of turbulent viscosity (through turbulence suppression, e.g. by differential solar heating of phytoplankton layers, and/or by viscoelastic polymer secretion).
- In order to understand 3D-movements of these features, development of appropriate instruments is necessary (density-adjusting floats, fine-scale profilers, particle analyzers, video systems, *in situ* rheometers).

Macronutrients

Justification:

There has been an increase in anthropogenic nutrient inputs to many coastal areas. Correlative evidence indicates that HABs have increased in response to elevated nutrient loading in localized regions (e.g. North Sea, Baltic Sea, Seto Inland Sea, Tolo Harbour). Some HABs have also been related to natural nutrient dynamics (e.g. upwellings) in coastal areas.

Research Priorities:

- Determination of the nutrient utilization capabilities and strategies of selected HAB species in comparison with co-occurring phytoplankton. Interactive field and laboratory studies are essential.
- Establishment of the influence of nutrient concentration, composition, ratios, and cycling on the occurrence of HABs. Retrospective analysis of long-term data available in some regions or evidence preserved in cores can provide information about the past occurrence of HABs in areas where nutrient inputs have increased. Process-oriented field studies of current HABs, especially recurrent, predictable blooms where all phases of the bloom dynamics can be studied, are essential.

Evaluation of the role of dissolved organic matter as either a direct source of nutrients which HAB species can utilise or as an indirect stimulant of HABs through interaction with bacteria and the microbial loop.

Trace Metals and Chelator Interactions

Justification:

Trace metals including iron, manganese, cobalt and selenium have been hypothesized to limit the production of HABs. Examples include limitation of *Alexandrium tamarense* (Gulf of Maine), *Aureococcus anophagefferens* (Peconic Bay), *Heterosigma sp.* (Osaka Bay) *and Chattonella antiqua* (Seto Inland Sea) by iron, the limitation of *Chrysochromulina sp.* (Kattegat) by cobalt and the inhibition of *A. tamarense*, and *C. antiqua* by copper.

Research Priorities:

- Determination of trace metal concentrations and speciation in coastal waters. Establishment of techniques to estimate the bioavailability of trace metals to HAB species.
- Examination of the mechanisms of uptake of trace metals.
- Examination of the effects of multiple nutrient limitation.
- Determination of the minimum cell quotas for trace metals.
- Examination of the effects of trace metal limitation on cellular biochemistry including toxin biosynthesis.
- Determination of the importance of bacteria trace metal interactions.

Mixotrophy

Justification:

It is now clear that many HAB species have the potential for mixotrophic nutrition. The ability to utilize both photosynthetic and heterotrophic pathways may give species of mixotrophic HABs a competitive advantage over strictly autotrophic members of the phytoplankton. An understanding of bloom dynamics, the effects of eutrophication on plankton communities and the importance of life cycle strategies of key HAB taxa cannot be obtained without thorough understanding of the forces driving mixotrophy and the extent to which autotrophic processes are supplemented by heterotrophy.

Research Priorities:

- Development of reliable methods to detect and quantify mixotrophic nutrition.
- Determination of the mixotrophic potential of key HAB species.
- Identification of the factors that induce or enhance phagotrophy in photosynthetic organisms.
- Investigation of the effects of natural and anthropogenic eutrophication on HAB mixotrophy.
- Evaluation of the effects of mixotrophic nutrition on the toxicity of HAB species.

- Assessment of the significance of mixotrophic HABs on the structure and function of marine food webs.

Population Genetics/Biogeography

Justification:

Morphological features and life histories are the primary criteria used to distinguish phytoplankton species. However, a single group of organisms defined in this way a species may include multiple genetic variants or strains. Definition of species and their associated infraspecific variants is critical for understanding the basis of biodiversity, toxin production, physiological optima and tolerances and origins of HABs on local and global scales.

Research Priorities:

- Development of molecular tools, particularly those that bridge the critical gap between laboratory investigations and natural populations.
- Renewed effort in morphotaxonomy to provide a platform for species identification and genetic comparisons.
- Continue support for the establishment and maintenance of culture collections. A primary requirement for the study of genetic variation among HAB organisms is the availability of multiple isolates of the same species from different geographic areas.
- Multidisciplinary investigations that examine HAB species from both morphological and subcellular perspectives should be encouraged.
- There is provocative evidence that anthropogenic dispersal of HAB species has occurred. The introduction of harmful organisms may be accompanied by the introduction of harmful genes that may be incorporated into native populations. Assessment of the extent of human-assisted dispersals and their occurrence in the past is required.

Life Cycles

Justification:

Knowledge of life cycles and cell cycles is fundamental to the understanding of formation, maintenance, and decline of HABs. The water column or benthic origins of bloom inocula, cell growth, bloom termination and long-term species are mediated by poorly understood or largely unknown life cycle events.

Research Priorities:

Full elucidation of life histories for all HAB species (including asexual and sexual reproduction).

- Development of rapid and reliable molecular/immunological probes for detection of life cycle stages, leading to improved and/or automated recognition.
- Description of cell cycle morphologies (e.g. division stages) facilitating calculation of *in situ* growth rates.
- Determination of endogenous cell cycles, for example, the gating of cell division on a diurnal basis and annual cycle of excystment.
- Identification of the specific nutritional and environmental triggers as well as genetic controls involved in stage transformation, and the conditions required for successful transformation.
- Determination of the survival and metabolic activity of benthic stages.
- Understanding the physics of water column - sediment transport and subsurface sediment mixing and burial in deep sediment and their influence on life history.

Ecophysiology of Toxin Production

Justification:

Toxic secondary metabolites associated with HABs in aquatic ecosystems are produced by several groups of photosynthetic eukaryotic and prokaryotic microorganisms, including non-photosynthetic bacteria.

Bacterial-Algal Interactions in HAB Population Dynamics, Cellular Growth and Toxicity

Justification:

Co-existing with algal communities containing HAB species are microbial assemblages which, like the algae, undergo changes in species composition, exhibit nutrient competition, and produce bio-active compounds, including toxins. These and other microbial processes are influenced by the algal community and, in turn, can potentially influence the population dynamics, cellular growth, and toxin characteristics of the algae.

Research Priorities:

- Determination of the kinetics of growth, toxin biosynthesis, and interconversions.
- Identification of the cellular location of the toxins and the timing of their production in the cell cycle.
- Characterization of the components of the toxin biosynthetic pathways.
- Determination of the role of toxins in predator-prey interactions.
- Determination of the allelopathic function of algal toxins against other algae, bacteria or fungi, including the role of other compounds in stimulating or inhibiting the effect of the toxins.
- Determination of the critical interactions between extrinsic environmental factors and the genome in regulating toxin biosynthesis, catabolism and sequestration (phenotypic vs genotypic variation in HAB species).

- Modelling the production of toxins for extrapolation to natural populations.
- Determination of the evolutionary origin of the toxin biosynthetic genes.
- Development and maintenance of international sources for toxin standards and reference materials.

Emerging Techniques and Technology

Justification:

An understanding of HAB phenomena requires the detection of causative species and the toxins they may produce. Analogous problems exist in biomedical diagnostics, and many techniques and technologies used for those purposes are applicable to HAB research. For example flow cytometry, antibody and DNA probes, and phycotoxin-specific receptor binding assays have been transferred and used successfully in the laboratory and, to varying degrees, in field studies.

Research Priorities:

- Development of probes for species identification. DNA and antibody probes have been developed and tested in the laboratory for a limited number of HAB species. These probes must now been tested in the field.
- Toxin detection. Receptor assays for toxins in HAB species have been demonstrated in the laboratory. These assays now need to be tested for utility in natural populations.

Measurement of *in situ* growth rates. Methods for determining *in situ* growth rates are needed in order to understand the mechanisms driving HABs. Flow and imaging cytometric methods have been demonstrated to be useful in the field and show promise for HAB species.

- Development of probes for the determination of physiological status. Many fluorescent probes for measuring intracellular conditions have been developed for mammalian systems. Application of these tools to algal physiology may yield new understanding of the regulation of phytoplankton population dynamics.
- Since the choice of reference taxa is critical due to potential genetic variability, culture repositories should be supported and expanded internationally.

e above article was shortened and further information can be obtained from Grant Pitcher or the proceedings of the ASI workshop to be published as part of the NATO ASI series.

New Members.

The following new members are welcomed to PSSA

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1st European Phycological Congress - Cologne

Summary from seminar report back by Prof. Bruce Robertson, University of Port Elizabeth

The congress was held at University of Cologne on 11-18 August, a number of European countries have their own phycological societies. The objective of this meeting was to bring these societies together to form a new European Phycoclogical Society.

Approximately 570 delegates attended the conference with representatives from most European countries as well as 16 other countries. PSSA was well represented and the abstracts of our members are given below.

One of the most noticeable trends was the move to molecular biology particularly as a taxonomic tool. The lack of papers on the ecology of marcoalgae was disappointing.

- Abstracts of members -

The components of seaweed species diversity: controlling factors at different spatial scales

John J. Bolton, H. Engeldow, J.J. Jackelman

Botany Department, University of Cape Town, South Africa

At the global scale, polar regions have low numbers of seaweed species, whereas rich and poor floras occur in both temperate and tropical regions. Controlling factors on gamma diversity have been speculated to include a variety of current ecological or historical factors, which will be summarized and critically assessed. Beta diversity (species turnover) on a sub-continental scale is overwhelmingly controlled by gradients of seawater temperature regime. There is evidence that some rich floras are rich because of high alpha (point) diversity. Environmental gradients such as depth or wave action superimpose patterns of beta diversity at a local scale. In intertidal and subtidal regions of southern Africa local alpha diversity correlates with several ecological factors including presence of grazers and space competitors, sand action, and aspects of the substratum.

Unpicking the knot: the *Porphyra capensis* Kützing species complex

Neil J. Griffin[1] John J. Bolton[1], Robert J. Anderson[2]

[1]*Botany Department, University of Cape Town, Cape Town, South Africa*

[2]*Seaweed Unit, Sea Fisheries Research Institute, Roggebaai, South Africa*

Porphyra capensis was described in 1843 in Kützing's *Polycologia generalis* from a collection made at the Cape of Good Hope. At the same time, Kützing also described *P. augustinae*. Forty-seven years later, J. Agardh fused the two as *P. capensis*. More than one hundred years after Agardh's modification, Stegena, Bolton & Anderson (in press) are making the next change to the classification of southern African *Porphyra* species in describing two new species.

During a study of the harvest biology of South African *Porphyra* species it became clear that still more species may be present, based on morphological and ecological criteria. Some of these are described in this paper, and evidence supporting their status as species discussed.

Cladophora glomerata in South African irrigation canals: possible causes, current control and future options

Margaret A. P. Joska, John J. Bolton

Botany Department, University of Cape Town, South Africa.

Two irrigation systems fed by Kalkfontein and Van Der Kloof dams in the Free State in South Africa are being investigated with regard to the nuisance growth of *Cladophora glomerata*. Irregular rainfall events in the dam catchment areas result in raised nitrogen and reduced conductivity and pH conditions in the irrigation water.

The relationship between dominant growth of *C glomerata* in the two systems and water quality parameters is compared with other localities. Presently, dosage with copper sulphate and manual cleaning methods are used to control this alga. The continued usage of this chemical is problematic. An *in situ* investigation of the actual growth patterns over a two-year period combined with *in vitro* experiments has been undertaken. The information obtained to date will be presented. It is hoped that the results of this investigation will be help in the formulation of a control strategy for *C. glomerata*

leading to a diminished use of chemicals and costs of manual removal.

Grazing as a positive force in the ecology of an encrusting coralline alga: a geographyc survey

C.W. Maneveldt, D.W. Keats

Botany Department, University of the Western Cape, P.Bag X17, Belville, 7535 South Africa

The pear limpet, *Patella cochlear*, occurs along the South and southern West Coast of South Africa, while many of the encrusting coralline algae upon which it grazes occur much further north along the West coast. This limpet appears to be the primary and only significant grazer of the encrusting coralline alga *Spongites yendoi.* The presence and absence, and varying degrees of abundance of the limpet have various implications for the morphology and ecology of the coralline alga and have presented the ideal situation to develop and test hypotheses concerning the importance of grazing in the ecology of encrusting coralline algae along a geographic gradient. In this paper I will be discussing the positive effects of the association between the limpet and the coralline which I consider to be facultative mutualism.

Inhibition of epiphytic *Ectocarpus siliculosus* infestations with copper chloride in tank cultures of *Gracilaria gracilis*

P.D.R. van Heerden, B.L. Robertson

Botany Department, University of Port Elizabeth, P.O. Box 1600, Port Elizabeth, 6000, South Africa

The use of copper chloride for the control of *Ectocarpus siliculosus* infestation in *Glacilaria gracilis* cultures was studied.

Gracilaria gracilis was grown in outdoor tanks with continuous water flow and aeration. Two copper chloride concentrations (400 and 800 $\mu g.l^{-1}$) used. Each was administered as a single treatment (experiment A) and as two consecutive treatments (experiment B). Growth rates of the cultures were determined weekly for one month after treatment.

Both levels of the Cu-treatment inhibited *Ectocarpus* infestation in both experiments but also resulted in a reduction in the *Gracilaria* growth rates. The *Gracilaria* recovered completely within three weeks (experiment A) while no recovery occurred after the high copper concentration in experiment B. Inhibition of *Ectocarpus* was most effective at the higher concentration in experiment A. Three weeks after treatment with the low concentration (experiment A) the growth rate of the *Gracilaria* cultures was higher than that of the control.

Forthcoming Conferences

- SIXTH INTERNATIONAL PHYCOLOGICAL CONGRESS - ALGAE IN A CHANGING ENVIRONMENT

The Sixth International Phycological Congress will be held on August 9-16 1997 in Leiden, the Netherlands. The venue for the Congress is the historical centre of the city. The scientific programme will make use of the lecture halls of Leiden University, while plenary lectures, poster sessions and social events will take place in the Pieterskerk.

Tel. +31 71 5148203 fax +31 71 5128095 or Email co-conveners for circulars (First circular was mailed in May 1996):

Prudhomme@rulrhb.leidenuniv.nl

C.van.den.Hoek@biol.rug.nl

Registration Fees: Regular approx. Dfl. 550. Students approx. Dfl. 275.

Accommodation: Hotel rooms have been reserved with prices ranging from Dfl. 80. to Dfl. 185. - per person/night. A limited number of cheaper places will be available in student houses.

CONFERENCE REMINDERS:

THE SCOTTISH ASSOCIATION FOR MARINE SCIENCE: ALGAL BLOOMS AND TOXINS IN ESTUARINE AND COASTAL WATERS. UNIVERSITY OF DUNDEE, SCOTLAND.

SEPTEMBER 16-18, 1996

CONTACT: Dr. S. G. Bell

Email: s.g.bell@dundee.ac.uk

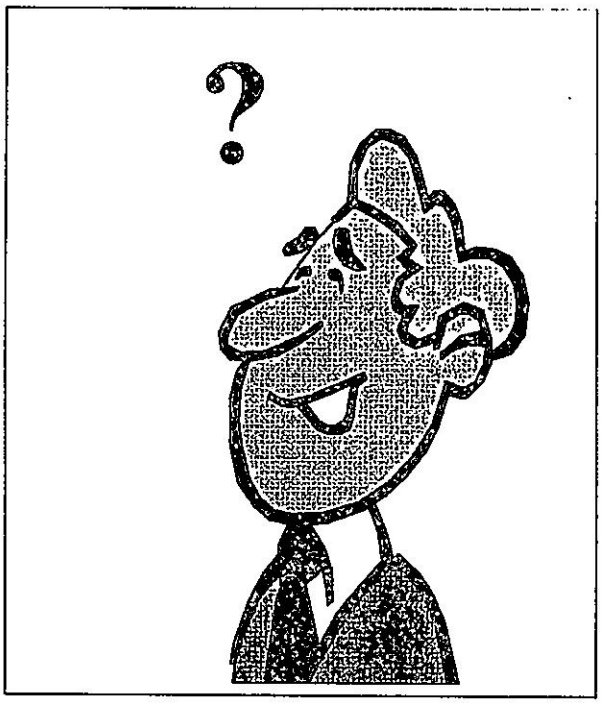
VIII INTERNATIONAL CONFERENCE ON HARMFUL ALGAE, VIGO, SPAIN.

JUNE 25-29, 1997

CONTACT:Tim Wyatt

Email: twyatt@iim.csic.e

Student Follies



"Courtesy of Dr. Derek Du Preez - University of Port Elizabeth"

In the recent botany second year practical exam a number of interesting answers were submitted for the following questions.

(a) What does HPLC stand for ?

Answers

~ High Pigment Level Concentration

~ Hydro Photometer Light Coefficient

~ Harvesting Light Pigment Computer

~ High Pigment Liquid Concentration

~ High Power Thin Chromatography

(b) What instrument would you use to measure light absorption by a solution?

Answers

~ A stenographer

~ Refractometer

The required answers were (a) High Performance Liquid Chromatography and (b) Spectrophotometer.

Abstracts From Upe Honours Research Projects

Investigating techniques for studying the effects of Ultra Violet -B radiation on microalgae.

- Henry Fougstedt -

A direct effect of the depletion of natural ozone in the atmosphere, is an increase in the short-wave radiation (280-400 nm), or ultraviolet radiation, striking the earth's surface. This directly influences the marine microalgae. These organisms are the primary producers of the trophic system. The aims of this study were to examine the effects of ultraviolet radiation on marine microalgal cultures, grown under laboratory conditions, and to determine the methodology used to study the effects of ultraviolet radiation on these organisms.

The laboratory-grown cultures that were exposed to ultraviolet radiation for 10 minutes showed decreased photosynthetic rates (from 0.608 mol O^2.g chl-*a*.h^{-1} to between 0 mol O^2.g chl-*a*.hr^{-1} and 0.323 mol O^2.g chl-*a*.h^{-1}) and decreased chl-*a* contents (from 438.15 µg chl.l^{-1} to between 388.47 µg chl.l^{-1} and 409.63 µg chl.l^{-1}). This varied with the intensity of the radiation. The effects of the radiation appear to be of a deleterious nature. This shows that environmental conditions, e.g. the ozone layer, need to be monitored, in order to ensure the survival of natural systems. Problems were encountered in the methodology of the study especially the establishment of successful mono-algal diatom cultures.

Optimisation of the tank cultivation of *Gelidium pristoides* (Turner) Kuetzing

- Sharon Hampson-

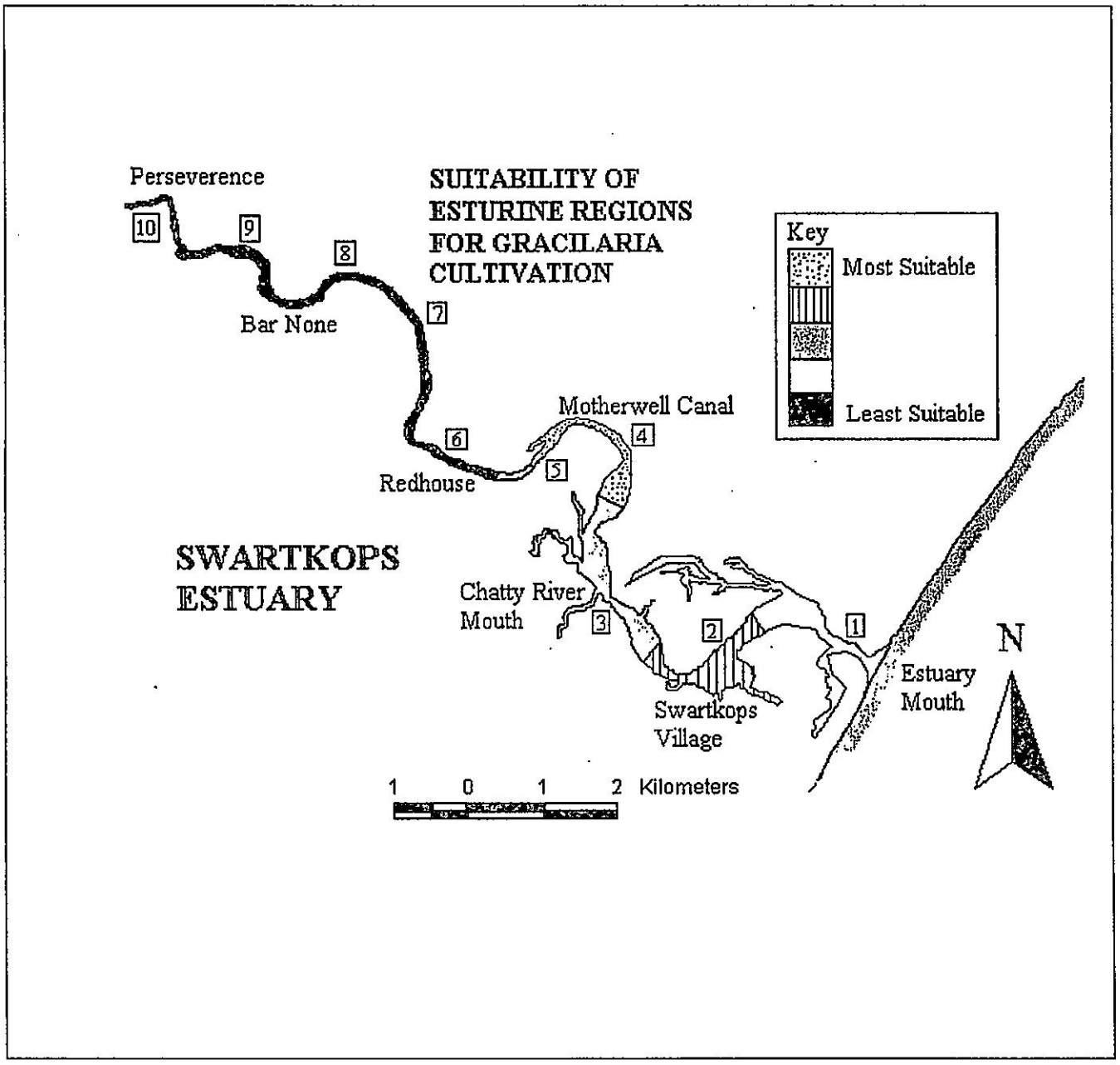
The economically important agarophyte *Gelidium pristoides* was cultivated in an outdoor cultivation tank-system with a continual flow of seawater. Two sets of experiments were conducted. The first included growth of *G. pristoides* at two different stocking densities viz. 1 kg.m^{-2} and 2 kg.m^{-2}, for a duration of five weeks. The second set of experiments included an investigation into the freshwater treatment of the *Gelidium* fronds, as a method to remove the epifauna and to determine if such action would result in an increased growth rate. Nutrients were added on a weekly basis for 3 hours at

night, according to a modified pulse-feeding strategy devised for *Gracilaria* cultivation. Specific growth rates were measured on a weekly basis as a percentage of wet mass increase. *Gelidium* yield was also measured on a weekly basis as an indication of the production of material at the different stocking densities. Maximum growth was obtained by the 1 $kg.m^{-2}$ treatment viz. 1.128 +/- 1.216 % per week and with a yield of 0.011 +/- 0.012 $kg.m^{-2}.week^{-1}$. No growth was obtained in the 2 $kg.m^{-2}$ treatment.

<u>An investigation into the possible culture of *Gracilaria* in the Swartkops River Estuary, South Africa</u>

<u>- Ian Home -</u>

The world-wide requirement for agar has exceeded the supply that can be obtained from seaweeds harvested from natural populations. This has resulted in the development of cultivation systems to supplement the increasing demand of raw material required. In South Africa, the only areas that at present appear suitable for the culture of *Gracilaria* are estuaries. The environmental variables that prevail in the Swartkops Estuary were compared to the optimal growth conditions required for growth by the alga and the most suitable sites selected using map overlay techniques. The Motherwell Canal region is the most suitable followed by the area downstream of the Swartkops Village. Pond culture in salt ponds appears the most viable culture method at the Motherwell site while raft culture appears most practical at the Swartkops Village site.



Application for PSSA membership.

Name:.....

Address:.....

.....

Tel:.....

Fax:.....

E-mail:.....

The Phycological Society of Southern Africa aims to promote an interest in phycology and establish and maintain communication between persons interested in the algae of Southern Africa and, by way of the newsletter, to collate and disseminate information concerning the Society, it's members and matters of mutual interest.

Signature:.....

Date:.....

Indicate category of membership required (fees in SA Rand):

Student membership	R 20
Ordinary membership	R 30
Ordinary membership (overseas)	R 40
Corporate membership	R 240
Life membership	R 300

Please send to:

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