Forum Phycologicum

Newsletter of the

Phycological Society of Southern Africa

Vol. 68

June/July 2008

FORUM PHYCOLOGICUM Volume 68 – June/July 2008

Newsletter of the Phycological Society of Southern Africa

Past President

John J. Bolton (John.Bolton@uct.ac.za)
Department of Botany
University of Cape Town
Private Bag
Rondebosch
7700

President

Eileen Campbell (eileen.campbell@nmmu.ac.za)
Department of Botany
Nelson Mandela Metropolitan University
PO Box 77000
Port Elizabeth
6031

Secretary-Treasurer

Mark Rothman (Mark.Rothman@uct.ac.za)
Seaweed Unit
Marine and Coastal Management
Private Bag X2
Rogge Bay
8012

Membership Secretary

A.J. Smit (smitaj@ukzn.ac.za)
School of Biological and Conservation Sciences
University of KwaZulu-Natal
Westville Campus
Private Bag X54001
Durban
4000

Newsletter Editor

Gavin W. Maneveldt (gmaneveldt@uwc.ac.za)
Dept. of Biodiversity and Conservation Biology
University of the Western Cape
Private Bag X17
Bellville
7535

Student Representative

Nuette Gordon (nuette.gordon@nmmu.ac.za)
Department of Botany
Nelson Mandela Metropolitan University
PO Box 77000
Port Elizabeth 6031

Table of Contents

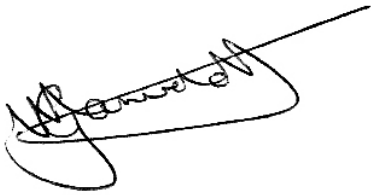
From the Editor

Welcome to another edition of *Forum Phycologicum*. Much has happened over the past few months, from phycological ramblings along the south coast to a number of conferences at which many of the PSSA members had attended. We hope to bring reports on these various activities to you in the next installment of the newsletter.

Planning for PSSA 2009 in well underway. We can certainly promise you some very hot, dry (and possibly windy) weather and very cold seas. There will also be the regular common denominators of cold refreshments and warm company. Registration will open on the 4th August so please keep an eye on the conference website.

The current hype in phycological and probably world science is the concept of using algae to generate bio-fuels. While this certainly is nothing new, increasingly there appears to be greater need to move towards this research direction for very obvious reasons. Both the *World Science* and the *Featured* articles have been devoted to this current interest in algae and there are a few PSSA members working in this very excited field of research. Perhaps we will get to hear some of their research endeavours around this interest at PSSA 2009.

Until the next issue.
Best wishes.
Sincerely



Gavin W. Maneveldt

Synarthrophyton patena
epiphytic on *Gelidium capense*

News and Reviews

1. SANBI aquaculture workshop

Following on various emails regarding aquaculture and invasives, the South African National Biodiversity Institute will be hosting a workshop on 13th August at the Kirstenbosch Research Centre in Cape Town to discuss how to deal with aquaculture species in the revised Invasive Alien Species regulations (see appendix). This invitation includes an invitation to join an online discussion group preceding the workshop.

As you may be aware, the Western Cape Provincial Development Council is organising a 3-day workshop dealing generally with aquaculture from 6-8 August and has IAS on the agenda. Although there may be some overlap between the two meetings, it will be necessary to continue with the meeting on 13 August as the IAS regulations is a national process and we need to include stakeholders from outside the province. It is envisaged that the outcomes of the WCPDC meeting will inform the discussions on 13 August.

Please feel free to pass on this invitation to anyone who you feel should be included in the process. Those of you who would like to be included on the email discussion list, please respond by emailing Mr. J. De Wet Bösenberg at bosenberg@sanbi.org.

Expected outcomes of workshop on aquaculture and invasive species regulations

Background
The NEMBA regulations for Invasive Alien Species are currently being revised after an initial draft was published in 2007. It has been accepted that listing in different categories is possible and the intention is to develop a draft set of regulations and the associated lists by end of September 2008. This is an ambitious task but it is very important to get an effective set of regulations enforced as soon as possible.

Certain groups of species and certain activities pose particular problems for the regulation of invasive species. Species used for aquaculture have been identified as one of these groups. The

objective of the workshop is to bring together experts in this field in order to develop a framework for dealing with aquaculture species in the regulations.

Outcomes

The framework will need to provide guidance on the following issues.

- Which species need to be listed, given the risk of invasion (including genetic implications for indigenous species)?
- Can some species be allowed in demarcated areas (i.e. be classified as invasive if they occur outside demarcated zones)?
- Are the proposed categories sufficient to deal with aquaculture species?
- Are there specific risk assessment requirements for aquaculture species?
- Are special regulations necessary for transport?

If these may not be resolved at the workshop, then an additional outcome of the meeting will need to be an agreed process to resolve the outstanding issues within the very tight deadline for the review of the regulations.

John Donaldson
Chief Director: Applied Biodiversity Research
Head: Kirstenbosch Research Centre
South African National Biodiversity Institute

Tel: +27 21 799-8672
Fax. +27 21 762-5834
Email: donaldson@sanbi.org

2. Mixed substrate shores research at Nelson Mandela Metropolitan University

The South African coastline comprises mainly rocky shores and sandy beaches, but there are also sections of shore where sand and rock occur together in particular configurations which have been termed mixed shores. Various estimates put the proportion of mixed intertidal zone at between a fifth and a third of the coastline (Bally *et al*. 1984, Campbell & Bate 1997, Lombard *et al.* 2004). The small number of studies that have been done on mixed substrate shores in South Africa concentrated on macrofaunal and macroalgal components only (see e.g. Bally *et al*. 1984, Dower 1989, McQuaid & Dower 1990, Brown *et al.* 1991).

A new research project, recently initiated at Nelson Mandela Metropolitan University, aims to give a more complete record of biota at selected mixed substrate shores on the Eastern Cape coast. Study sites represent a wide range of rock-sand configurations and also differ in wave action regimes. The biotic component studies include organisms from both hard and soft substrates, ranging from benthic macroalgae and macrofauna, to benthic and phytal meiofauna, microphyto-benthos and the planktonic surf zone assemblage. Present classification of mixed substrate shores is based on physical attributes (Bally *et al*. 1984; Brown *et al*. 1991), macrobiota (McQuaid & Dower 1990) or wave exposure (Lombard *et al.* 2004). These ideas will be re-examined and

A mixed substrate shore community at Mpekweni

A mixed substrate shore community at Oyster Bay

interpreted in conjunction with information about system functionality to produce a multi-dimensional system of classification which, it is hoped, will be of use in future conservation planning for the coast.

References

Bally R, CD McQuaid & AC Brown. 1984. Shores of mixed sand and rock: an unexplored marine ecosystem. *S.A. J. Sci.* **80**: 500-503.

Brown AC, RP Wynberg & SA Harris. 1991. Ecology of shores of mixed rock and sand in False Bay. *Trans. Roy. Soc. S.Afr.* **47**: 563-573.

Campbell EE & GC Bate. 1997. Coastal features associated with diatom discoloration of surf-zones. *Bot. Mar*. **40**: 179-185.

Dower KM. 1989. Sand inundation on rocky shores: its effects on species richness and the structure of species assemblages. 187 pp. Unpublished M.Sc. Thesis. Rhodes University.

Lombard AT, T Strauss, J Harris, K Sink, C Attwood & L Hutchings. 2004. Technical Report: Marine Component. *South African National Spatial Biodiversity Assessment* Vol. **4.** 176 pp. SANBI.

McQuaid CD & KM Dower. 1990. Enhancement of habitat heterogeneity and species richness on rocky shores inundated by sand. *Oecologia* **84**: 142-144.

Nelia Garner and Eileen Campbell
Department of Botany
Nelson Mandela Metropolitan University
Email: Eileen.Campbell@nmmu.ac.za

3. New co-ordinator for the African Coelacanth Ecosystem Programme

Thomas (Tommy) Bornman, previously from the Nelson Mandela Metropolitan University (NMMU), has been appointed as the new co-ordinator of the multinational and multidisciplinary African Coelacanth Ecosystem Programme (ACEP), the flagship programme of the South African Institute for Aquatic Biodiversity (SAIAB). Tommy takes with him a wealth of knowledge in research and science and no doubt, the experience acquired at NMMU and the passion for what he loves doing, are the driving forces behind the confidence he projects. The PSSA family wishes Tommy everything of the best for his new endeavours and has no doubt that he will do us proud in his new role. Tommy's new email address is: t.bornman@ru.ac.za.

Tommy Bornman

4. Public Comment: Draft Guidelines for Marine Ranching

The Minister for Environmental Affairs and Tourism invites the public to comment on the draft Guidelines for Marine Ranching and Stock Assessment in South Africa and the draft Guidelines and Potential Areas for Ranching and Stock Enhancement of Abalone in South Africa in terms of the Marine Living Resources Act No. 18 of 1998.

Deadline: 29 August 2008 at 16h00

Post Comments to:
The Deputy Director-General:
Attention: Mrs Betsie Taylor
Environmental Affairs and Tourism
Marine and Coastal Management
Private Bag X2
Roggebaai 8012

Or Email: aquaculture@deat.gov.za
Fax: 021 402 3670

The Draft Guidelines are available at Participation Junction's website (http://www.participation.org.za/) in the Environment section.

World Science

1. Algae gene could make rice and wheat more tolerant

May 15, 2008
Courtesy: ABC News
Source: http://www.abc.net.au/

Scientists at the Australian National University (ANU) say new strains of rice and wheat adapted to the pressures of climate change could be ready in five to 10 years. Professor Murray Badger from the School of Biological Sciences says researchers have isolated genes in algae that could be inserted into grain plants to help them lose less water and be more productive in an environment with higher levels of carbon dioxide. Professor Badger says algae have a mechanism to improve their photosynthesis.

"The research could lead to improved photosynthesis of plants such as wheat and rice under conditions such as current day carbon dioxide and particularly under water limited conditions and elevated temperature, when these plants are challenged," he said. "So if you can take simple genes such as algae and put it into a plant like wheat, you could change the balance between how much CO_2 is fixed and how much water is lost ... to match how a maize plant operates."

Professor Badger says there is a lot of interest in the research from rice dependent countries. He says rice is starting to be a scarce commodity and prices are rising. "The International Rice Research Institute in the Philippines is particularly interested in using the same mechanisms of a maize plant and put those in the rice plant," he said. "But that takes a lot of genes and is very complicated. If you could do what algae do, it only takes a few genes and you could potentially achieve those outcomes, with a very simple transfer of genetic information."

Professor Badger's team is the only group in the world currently known to be undertaking such research.

As carbon dioxide levels continue to rise, scientists at ANU are trying to develop new strains of wheat to cope with the changing climate (Image courtesy - ABC News).

2. Dutch consortium awarded algae research funding

May 30, 2008
Courtesy: Worldwide Algae News
Source: http://algaenews.blogspot.com/

A Dutch consortium has just received major funding to investigate the potential of converting algae into feedstock for the chemical industry. Having partnered with energy company Essent, algae producers Ingrepo and Wageningen University, the consortium has now received more than EUR1 million of government funding after successfully applying for a long-term energy research subsidy.

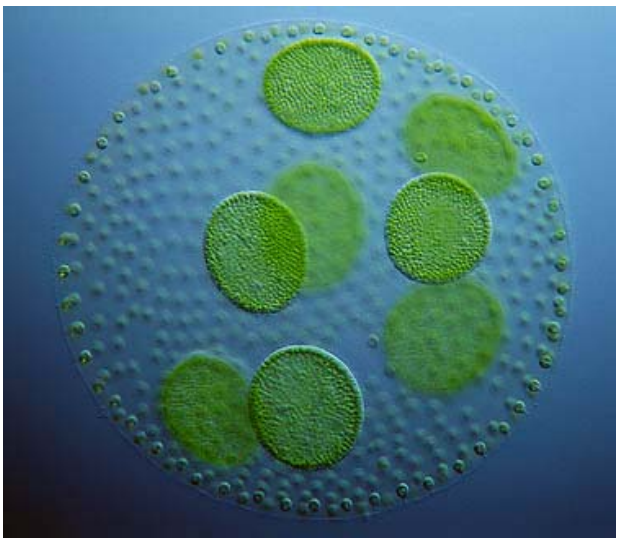
The four-year study will involve scientists at Wageningen conducting fundamental research into algal biology, growth parameter testing, separation and the subsequent upgrading of algae fractions. In addition, a pilot project will begin at AkzoNobel's (a member of the consortium) Delfzijl site in order to scale up the processes. Factors that influence the economics of algae-based chemical building blocks will also be investigated.

"With the Earth's natural resources running out it's becoming increasingly important to look for more sustainable alternatives," explains Hans Feenstra, who has been making preparations for the project since last year. "Algae offer the possibility for us to create value from renewable feedstock. It grows at a prodigious rate, can be used to rebate CO_2

emissions and has the potential to treat waste water streams. There are also no concerns regarding the food versus energy biomass debate."

He adds that the planned Delfzijl demonstration unit is expected to be up and running by September 2008. Consisting of two 1,000 square meter ponds linked to the site's cogeneration unit, it will be used to test conditions and methods for growing algae (there are more than 80,000 known types) on a larger scale in an industrial environment. "It will be a good opportunity for us to familiarize ourselves with bio-based processes," notes Feenstra.

The concept of creating value by obtaining certain fractions from renewable feedstock has been christened biorefinery. In the case of algae, it has been identified as having the potential to provide a rich source of unsaturated fatty acids, proteins and polysaccharides - all of which have important links to the chemical industry. Already creating enthusiasm because of what it can offer to the bio-fuel industry and power producers, algae could also have higher end value as a source of raw materials for coatings.



Microalgae have garnered considerable attention, since acre-by-acre microalgae can produce 30-100 times the oil yield of soybeans on marginal land and in brackish water. The biomass left-over from oil-pressing can either be fed to cattle as a protein supplement, or fermented into ethanol (image courtesy: Gas 2.0 – Biofuels - http://gas2.org/).

Featured Article

New wave in energy: Turning algae to oil

Algae, those simple aquatic plants, are composed of carbohydrates, proteins and plant oil. The algal oil can be processed into biodiesel or nonpetroleum gasoline, the carbohydrates into ethanol, and the protein into animal feed or human nutritional supplements. The whole biomass can generate methane, which can be combusted to produce electricity. Processors can extract chemicals to replace petrochemicals. As algae grow, they absorb carbon dioxide and they can be used to clean sewage or agricultural or industrial runoff.

Microalgae, the simplest and most primitive plants, are generally more efficient converters of solar energy than terrestrial plants and have a much higher energy potential. This possibility has lured entrepreneurs and venture capitalists into the research fray. Still, challenges loom large. Companies must grow algal biomass at a low enough cost to make it worth processing, find a cost-effective way to separate the algae from water, extract something of value from the algae and stabilize that product to make it market-ready, said Lissa Morgenthaler-Jones, chief executive of LiveFuels, an algae company based in Menlo Park, California.

Start-ups in the United States and elsewhere are investigating myriad processes and products derived from two basic models: closed or open systems. Closed systems use photobioreactors, clear containers that allow growers to carefully control the species and the environment. They have been expensive to build and can suffer from "'self-shading'" if the algae grow to the point that they block out the sunlight that they need to proliferate. Open systems grow algae in ponds, raceways, or even in the wild. While less expensive to build, they are susceptible to invasion by other species and vulnerable to environmental changes.

LiveFuels uses open ponds to grow algae that are indigenous to the local environment, hoping that this will avoid the invasion problem. Since algae

need nutrients to grow, including nitrogen and phosphorous, the company plans to feed agricultural runoff water - polluted with nitrogen and phosphorous fertilizers - into its ponds, combining energy production with water treatment.

Another company, Bionavitas, of Redmond, Washington, also grows native algae, but in deep, narrow canals, with a special optical system to bring light to the algae beneath the surface. It too hopes to harness nutrients from polluted wastewater; and because intense carbon dioxide inputs can speed growth, it envisages setting up sites next to a factory that could funnel smokestack emissions directly into its canals. Michael Weaver, the chief executive, said that Bionavitas aimed to use "'the whole algae'" to produce biodiesel, ethanol, nutriceuticals and products currently derived from petroleum.

Biofuel plants such as these are going to become very common in the near future (Image by John MacNeill, commissioned by Solix Biofuels).

Vertigro, a U.S. company based in Vancouver, Canada, is testing single varieties of algae, grown in bioreactors that resemble hanging plastic bags, to see which grows best in a closed environment and produces the most oil. Its business plan is to sell its system to companies that would use it for commercial biofuel production, said Glen Kertz, chief executive of Valcent Products, a partner in Vertigro with Global Green Solutions, a sustainable energy development business.

In Seattle, Blue Marble Energy is putting algal biomass in anaerobic digesters to produce industrial chemicals and methane. The latter is combusted in a turbine to generate electricity and could also be used in fuel cells, said the chief executive, Kelly Ogilvie. Saleable byproducts include ammonia, anhydrous ammonia, and other industrial chemicals currently made with petroleum. Water cleanup is an important part of Blue Marble's business model. Its first demonstration plant, starting this year, will harvest nutrients from a Thai brewery's effluent pond using native algae. In the future it hopes to work with sewage treatment plants, mine sites or even the toxic marine algal blooms caused by agricultural runoff pollution. Harvesting these blooms, if possible, would help to repair the damaged ocean ecology.

All of these models will probably require inputs to adjust the balance of nutrients and carbon dioxide. "You're going to be adding something," Morgenthaler-Jones said. "The only question is, what do you have to add and how much is it going to cost?" Large-scale commercial production is at least five years away, according to most estimates, and it is still too early to say which methods, if any, will be economically viable, how much energy they may produce and what their effects on the environment might be. "They're so different that one really has to look at them one at a time to make sense of what they're promising," said Jeremy Martin, a senior analyst with the Union of Concerned Scientists, an independent scientific policy organization.

Although the industry is still taking shape, the concept is not completely new. The U.S. National Renewable Energy Laboratory researched algae from 1978 to 1996, before halting its work because of dwindling budgets. At that time researchers decided to focus on ethanol derived from cellulose, deemed to be more economically feasible at a time when oil cost about $20 a barrel, said Al Darzins, group manager of the laboratory's National Bioenergy Center. The laboratory recently restarted its algae program, thanks in part to interest from oil companies including Shell and Conoco Phillips and financing from Chevron. Darzins said he remained unsure which production route held the most promise. "It all comes down to how much it is going to cost to get a gallon of that oil," he said, noting that costs currently range from $6 to $100 a gallon, depending on the

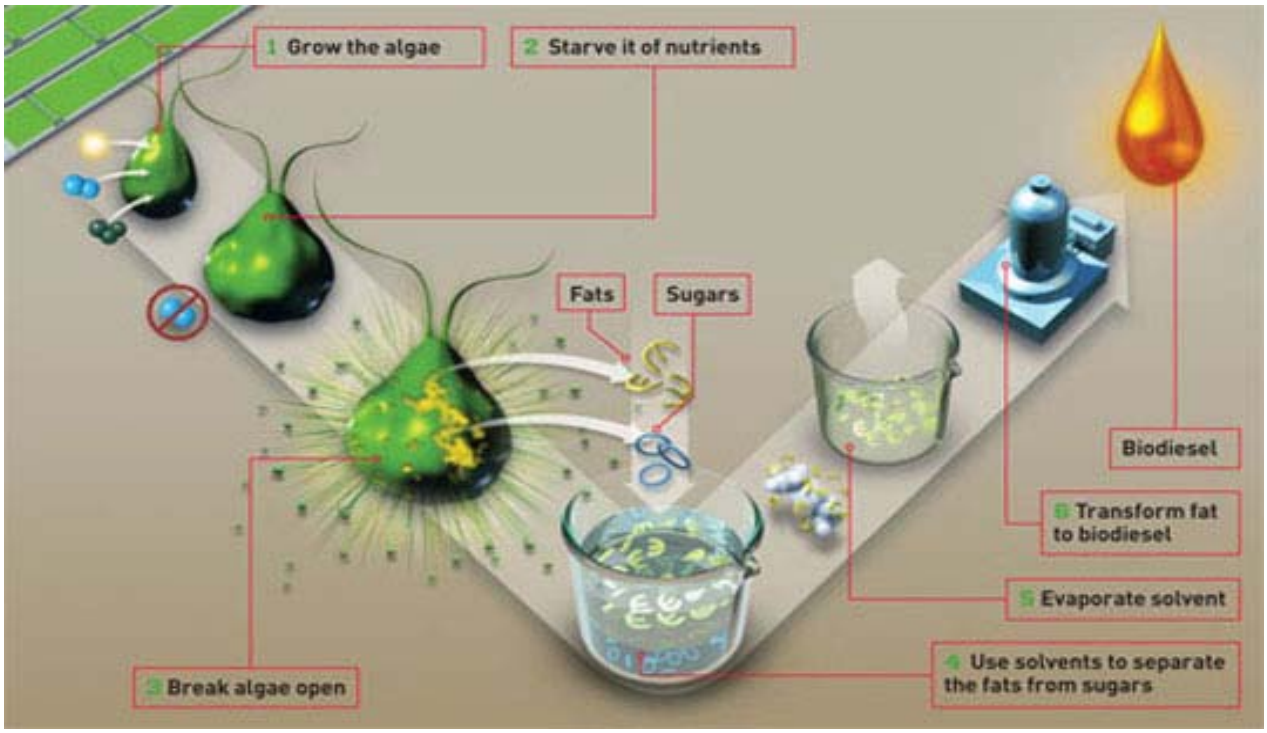
method. To reduce that cost the laboratory is focusing on the development of commercial co-products, like ethanol or animal feed, which could help to improve profitability.

The Union of Concerned Scientists is interested in algae innovation but cautious about hype. Like anything that is promoted as a green energy source, algae will have to prove its credentials. "You have to add up all the pieces that it takes to make this into a fuel and do lifecycle accounting," Martin said. He dismissed, for example, the notion that harvesting carbon dioxide from smokestacks would offer an additional environmental benefit. "Any plant used to make fuel uses recycled carbon dioxide," he said. "Whether you recycle it on its way out of a smokestack or straight from the atmosphere, like a plant growing in a field somewhere, it's still the same carbon recycling." Martin also questioned whether companies could find the ingredients they would need - water, sunlight, nutrients, carbon dioxide - in close proximity and in quantities large enough to generate a meaningful amount of fuel. But Darzins, of the National Renewable Energy Laboratory, said, "whenever you try to harness biology, it's never an easy thing." He added that the laboratory was "'bullish" on algae. So, too, was Morgenthaler-Jones of LiveFuels. "Our team looked at hydrogen, solar power, wind power, ethanol, biodiesel, cellulosic ethanol," she said. "It's only when we got to algae that we said, 'this one is going to be really hard, but it could work. **And if it works, it has the potential to change the world**.'"

The Union of Concerned Scientists counsels say no single material is likely to meet global fuel needs without having an effect on the environment. Reducing pollution from transportation fuels, moreover, is only part of the puzzle, which also includes improving energy efficiency and reducing the number of miles that people drive. "As exciting as these developments are," Martin said, "we don't see any likelihood that there'll be so much algae that it will reduce the need to do these other things."

Erica Gies
Freelance environmental reporter
Courtesy: The International Herald Tribune

First published in *The International Herald Tribune* via LN Publisher. 30.06.08.



A simplified view of the way biofuel in generated. By depriving the algae of nutrients and in particular sulfur and oxygen, this causes the algae to produce fats and hydrogen. Hydrogen is used by fuel cells to generate electricity without generating those nasty greenhouse gases (image courtesy of Inhabitat - http://www.inhabitat.com/).

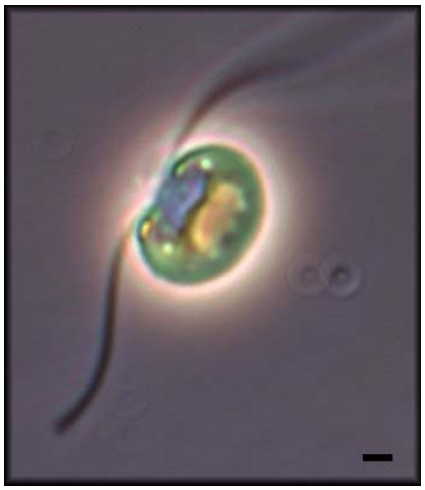
Popular Student Article

The Class Prasinophyceae

Trevor G. Bell

School of Animal, Plant & Environmental Sciences
University of the Witwatersrand, Johannesburg

The kingdom Viridiplantae *sensu* Cavalier-Smith (1981) is a monophyletic lineage of eukaryotes, consisting of the phyla Streptophyta (the true land plants – embryophytes, the non-vascular bryo-phytes, and the vascular pteridophytes and spermatophytes – and several green algal lines which were previously considered part of the Charophyceae) and Chlorophyta (the "green algae") (Nayakama *et al.* 1998, Marin & Melkonian 1999). Synapomorphic characters of the Viridiplantae include a chloroplast with a double membrane, containing chloro-phyll *a* and *b*, stacked thylakoids, interplastidial starch and "stellate structure"-type flagellar transition region (Melkonian 1984, Nayakama *et al.* 1998). The Chlorophyta – photosynthetic aquatic flagellates, most of which are unicellular – comprise four classes: the Chlorophyceae, the Prasinophyceae, the Trebouxiophyceae and the Ulvophyceae.



A phase-contrast light microscope image of a recently described Prasinophyte, *Nephroselmis spinosa* Suda. The cup-shaped chloroplast is clearly visible, with a starch grain present in the center of the cell. The single eyespot can be seen under the short flagellum.

Scale bar = 1 micron.

The name Prasinophyceae [originally termed "Prasinophycinées" by Chadefaud (1960)] is derived from "prasinos", the Greek word for "green", rather than from the genus *Prasinocladus* as Mattox & Stewart (1984) incorrectly suspected. The class Prasinophyceae can very loosely be defined as "green flagellates with scales". The group is considered to be the most primitive of the green algae and to have given rise to all other classes of green algae and the true land plants (Sym & Pienaar 1993). That is, they are considered ancestral to the Streptophyta and the rest of the Chlorophyta (Nayakama *et al.* 1998, Marin & Melkonian 1999). Scaly green flagellates are located in a basal position within the Chlorophyta [Norris (1980), Steinkötter *et al.* (1994)]. The prasinophytes, represented by *Tetraselmis*, did not appear in a basal position in a ribosomal study of eukaryotes (Lipscomb *et al.* 1998). However, as only one genus from the prasinophytes was included in this study, the results may not be very robust. Additionally, *Tetraselmis* is an atypical prasinophyte in that it produces a theca and appears only distantly related to the prasinophytes (Steinkötter *et al.* 1994).

Cladistic analyses of nuclear-encoded small-subunit (SSU) 18S and 26S ribosomal RNA (rRNA) sequence data have shown that the class Prasinophyceae is not monophyletic (Kantz *et al.* 1990, Steinkötter *et al.* 1994). This was confirmed by Nayakama *et al.* (1998) who reported that the prasinophytes are paraphyletic or even polyphyletic. Phylogenetic analyses of 18S rRNA sequences from other scaly green flagellates are needed in order to determine whether the origin of this class is polyphyletic or paraphyletic. The class may even deserve phylum (Prasinophyta) status (Moestrup 1991).

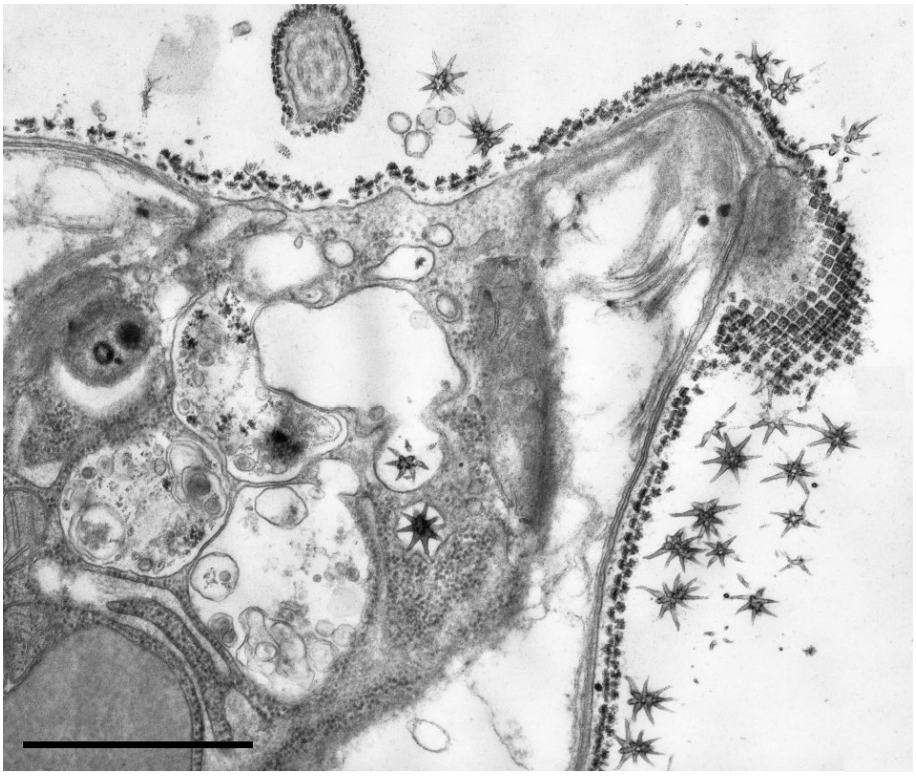
The class Prasinophyceae is diverse, exhibiting a wide variety of forms. All members are unicellular, with the cell body and flagella covered by non-mineralized organic scales (Melkonian 1990). No characters have yet been discovered which unite all prasinophytes and at the same time exclude other green algae and other algal classes (Steinkötter *et al.* 1994, Nayakama *et al.* 1998). This is not surprising, as the group is not monophyletic.

Moestrup & Throndsen (1988) defined the class by the presence of hair scales on the flagella and very long basal bodies, although they noted that *Mesostigma* lacks hair scales. The presence of scales has also been suggested as a feature

supporting delineation at the class level (Manton & Parke 1960), but naked flagellates such as *Micromonas* and *Scourfieldia* have subsequently been placed into the Prasinophyceae as a result of pigment studies or very long basal bodies being present (Moestrup 1991). Other exceptions exist, such as the flagella of the genus *Prasinopapilla* (gen. ined.) arising from an anterior papilla rather than from a flagellar pit (Sym & Pienaar, 1993; Daugbjerg *et al.* 1995). Further exceptions are *Tetraselmis* and *Scherffelia*, the only genera in the class to possess theca (compact cells walls) which are formed by the fusing of body scales. Detailed exceptions are provided by Sym & Pienaar (1993). Many of the features previously considered as diagnostic of the class Prasinophyceae (such as scales, flagella pits, long basal bodies and parallel basal bodies) are now considered to be symplesiomorphic, as they are found in other green algal groups (Steinkötter *et al.* 1994).

Since its creation (Chadefaud 1960, Christensen, 1962), the class Prasinophyceae has undergone several revisions (see e.g. Chadefaud 1977). Two extensive reviews of the class have been published (Norris 1980, Sym & Pienaar 1993) and various classification systems for the class have been provided. Sym & Pienaar (1993) reviewed the two main alternative classification systems: that of Moestrup & Throndsen (1988) as modified by Moestrup (1991) and Guillard *et al.* (1991), and that of Melkonian (1990), and elected to follow the latter system. Within this system, the 16 genera belonging to the Prasinophyceae are divided across the following four orders: Mamiellales (5 genera), Pseudoscourfieldiales (2 genera), Chlorodendrales (2 genera) and Pyraminonadales (7 genera, including *Prasinopapilla* gen. ined.). The order Pseudoscourfieldiales consists of two families, Pseudoscour-fieldiaceae (which contains only *Pseudoscourfieldia*) and Nephroselmidaceae (which contains only *Nephroselmis*).

Members of the Prasinophyceae are found in symbiotic relationships with a wide variety of other organisms. The marine flatworm *Convoluta roscoffensis* provides the specific name for its symbiont, *Tetraselmis convolutae* (Parke & Manton 1967), as is the case with the dinoflagellate *Noctiluca miliaris* and its symbiont *Pedinomonas noctilucae* (Sweeney 1976). The radiolarian *Thallassolampe margarodes* and *Pedinomonas symbiotica* share a symbiotic relationship (Cachon & Caram 1979). An



Stained transmission elec-tron microscope ultra-thin section of *Nephroselmis astigmatica* Inouye and Pienaar, showing the square underlayer body scales (seen from the "side" next to the plasmalemma and from the "top" in the upper-right of the image) and the "temple" or "fir tree" third layer body scales in various orientations. Scales can be seen in Golgi cisternae within the cell.

Scale bar = 1 micron.

unidentified strain of *Nephroselmis* has recently been shown to be a symbiont of the new katablepharid genus and species *Hatena arenicola* (Okamoto & Inouye 2005, 2006). *Hatena* appears to be highly selective, only forming a symbiotic relationship with a particular strain of *Nephroselmis* (Okamoto & Inouye 2006). Like most modern accounts, the study of the Prasinophyceae is posing more questions than it is providing answers.

References

Cachon M & Caram B. 1979. A symbiotic green alga, *Pedinomonas symbiotica* sp. nov. (Prasinophyceae), in the radiolarian *Thalassolampe margarodes*. *Phycologia* **18**: 177–184.

Cavalier-Smith T. 1981. Eukaryote kingdoms: seven or nine? *BioSystems* **14**: 461–481.

Chadefaud M. 1960. Les végétaux non vasculaires (Cryptogamie). In: Chadefaud M & Emberger L (Eds.), *Traité de Botanique Systématique, Tome I*. Masson, Paris.

Chadefaud M. 1977. Les Prasinophyceés. Remarques historiques, critiques et phylogénétiques. *Bulletin de la Société phycologique de France* **22**: 1–18.

Christensen T. 1962. Alger. In: Böcher TW, Lange M. & Sørensen T (Eds.), *Botanik 2 (Systematik Botanik) 2*, pp. 1–178. Munksgaard, Copenhagen.

Daugbjerg N, Moestrup Ø & Arctander P. 1995. Phylogeny of genera of Prasinophyceae and Pedinophyceae (Chlorophyta) deduced from molecular analysis of the *rbc*L gene. *Phycological Research* **43**: 203–213.

Guillard RRL, Keller M D, O'Kelly CJ & Floyd GL. 1991. *Pycnococcus provasolii* gen. et sp. nov., a coccoid prasinoxanthin-containing phytoplankter from the western North Atlantic and Gulf of Mexico. *Journal of Phycology* **27**: 39–47.

Kantz TS, Theriot EC, Zimmer EA. & Chapman RL. 1990. The Pleurastrophyceae and Micromonado-phyceae: a cladistics analysis of nuclear rRNA sequence data. *Journal of Phycology* **26**: 711–721.

Lipscomb DL, Farris JS, Källersjö M & Tehler A. 1998. Support, ribosomal sequences and the phylogeny of the Eukaryotes. *Cladistics* **14**: 303–338.

Manton I & Parke M. 1960. Further observations on small green flagellates with special reference to possible relatives of *Chromulina pusilla* Butcher. *Journal of the Marine and Biological Association of the UK* **39**: 275–298.

Marin B & Melkonian M. 1999. Mesostigmatophyceae, a new class of streptophyte green algae revealed by SSU rRNA sequence comparisons. *Protist* **150**: 399–417.

Mattox KR & Stewart KD. 1984. Classification of the green algae: a concept based on comparative cytology. In: Irvine DEG & John DM (Eds.), *Systematics of the Green Algae*, pp. 29–72. Academic Press, London.

Melkonian M. 1984. Flagellar apparatus ultrastructure in relation to green algal classification. In: Irvine DEG & John DM (Eds.), *Systematics of the green algae*, pp. 73–120. Academic Press, London.

Melkonian M. 1990. Phylum Chlorophyta, Class Prasinophyceae. In: Margulis L, Corliss JO, Melkonian M & Chapman DJ (Eds.), *Handbook of Protoctista*, pp. 600–607. Jones and Bartlett Publishers, Boston.

Moestrup Ø. 1991. Further studies of presumedly primitive green algae, including the description of Pedinophyceae class. nov. and *Resultor* gen. nov. *Journal of Phycology* **27**: 119–133.

Moestrup Ø & Throndsen J. 1988. Light and electron microscopical studies on *Pseudoscourfieldia marina*, a primitive scaly green flagellate (Prasinophyceae) with posterior flagella. *Canadian Journal of Botany* **66**: 1415–1434.

Nayakama T, Marin B, Kranz HD, Surek B, Huss VAR, Inouye I & Melkonian M. 1998. The basal position of scaly green flagellates among the green algae (Chlorophyta) is revealed by analyses of nuclear-encoded SSU rRNA sequences. *Protist* **149**: 367–380.

Norris RE. 1980. Prasinophytes. In: Cox ER (Ed.), *Phytoflagellates: developments in marine biology 2*, pp. 85–145. Elsevier/North, Holland.

Okamoto N & Inouye I. 2005. A secondary symbiosis in progress? *Science* **310**: 287.

Okamoto N & Inouye I. 2006. *Hatena arenicola* gen. et sp. nov., a Katablepharid undergoing probable plastid acquisition. *Protist* **157**: 401–419.

Parke M & Manton I. 1967. The specific identity of the algal symbiont in *Convoluta roscoffensis*. *Journal of the Marine and Biological Association of the UK* **47**: 445–464.

Steinkötter J, Bhattacharya D, Semmelroth I, Bibeau C & Melkonian M. 1994. Prasinophytes form independent lineages within the Chlorophyta: evidence from ribosomal RNA sequence comparisons. *Journal of Phycology* **30**: 340–345.

Sweeney BM. 1976. *Pedinomonas noctilucae* (Prasinophyceae), the flagellate symbiont in *Noctiluca* (Dinophyceae) in Southeast Asia. *Journal of Phycology* **12**: 460–464.

Sym SD & Pienaar RN. 1993. The class Prasino-phyceae. In: Round FE & Chapman DJ (Eds.), *Progress in phycological research, volume 9*, pp. 281–376. Biopress Ltd, Bristol.

Conference Countdown

PSSA 2009 will be hosted by the University of the Western Cape and is planned for the 19-23 January 2009 at the Paternoster Lodge, Paternoster along the South African west coast. Registration will open from 4th August 2008.

What to do now?

- ✓ Keep these dates free in your diary.
- ✓ Make sure you have funding for your group to attend.
- ✓ Start making your travel arrangements.

Website: http://www.bcb.uwc.ac.za/pssa/conf2009/.

Convenor: Gavin W. Maneveldt (gmaneveldt@uwc.ac.za)

Calendar of Events

Upcoming Conferences

1. 20th International Diatom Symposium, Dubrovnik, Croatia, 7-13 September 2008. http://www.imp-du.com/ids2008
2. 5th Asian Pacific Phycological Forum (APPF). Wellington, New Zealand, 10-14 November 2008. http://www.appf2008.com
3. 6th International Multi-Purpose Reef Conference (IMPR 2009), Jeffrey's Bay, South Africa, 18-21 May 2009. http://www.multi-purposereef.com/
4. International Phycological Congress (IPC) 2009. Tokyo, Japan, 2-8 August 2009. http://www.intphycsoc.org/

Invitation to participate in an online discussion and a one day workshop (13 August 2008) on aquaculture in relation to the invasive species regulations

SANBI is co-ordinating the revision of categories, and the listing process, for the revised Invasive & Alien Species (IAS) regulations. Several interested and affected parties have expressed the need for specific discussions regarding aquaculture species and how these should be dealt with in the regulations. SANBI is convening a one-day workshop at the Kirstenbosch Research Centre in Cape Town on 13 August to discuss this topic. The meeting will be preceded by a structured on-line discussion of the main issues that will be regarded as part of the process.

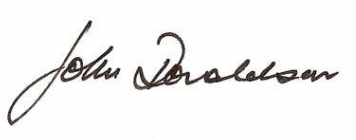
The agenda for the meeting will be circulated at a later date (based on the outcomes of the online discussion) but the key issues that need be discussed include:

- How do we deal with aquaculture species in the regulations?
- Which species need to be pohibited?
- Which species need to be listed?
- Regulations for imported species/ indigenous species
- Regulation through zoning (i.e. allowing farms only in demarcated areas)
- Risk assessment
- Management of species already in the country (e.g. transport)
- Development of guidelines / norms & standards

To participate

1) **Online discussion**. The online discussion will be managed as a Yahoo discussion group. You will receive an invitation from aquaculture_invasives@yahoogroups.com. Please respond as requested in the email. The invite will give you the options of either receiving all emails (individually) or a daily digest that will allow you you follow the discussions more easily. If you have not received an invite to join this group, please email DeWet Bosenberg (bosenberg@sanbi.org) who will add your name to the discussion group.
2) **Meeting in Cape Town**. The meeting will be held at the Kirstenbosch Research Centre on 13 August 2008 (09h00 – 17h00). We have scheduled only one day because the intention is to deal with several issues via the online discussions. It is essential that participants from outside Cape Town make provision for an early start. Please RSVP to Ms Gail van Aswegen (vanAswegen@sanbi.org; 021 799-8771) by 7 August 2008.

Yours



Prof John Donaldson
Chief Director: Applied Biodiversity Research Division

Office of the Chief Director: Applied Biodiversity Research Division
Kirstenbosch Research Centre, P/ Bag X7, Claremont 7735
Rhodes Drive, Newlands, Cape Town
vanAswegen@sanbi.org; 021 799-8771