Eleventh NorthWest Algal Symposium

(NWAS)

Microcladia borealis
(from Scagel, 1967)

Program and Abstracts

University of Victoria
Victoria, B.C. Canada
May 9-11, 1997

Schedule

11th NorthWest Algal Symposium

University of Victoria, Victoria, B.C.
May 9-11, 1997

Friday, May 9:

1:00-5:00	Arrival, check-in and putting up posters
5:00-6:00	Dinner (own arrangements-can also eat at Social)
6:00-closing	**Social and Poster Session** in Antithesis Lounge (George & Ida Halpern Centre for Graduate Students) (cash bar & pub food)
7:30	**Dr. Gayle Hansen**. Hatfield Marine Science Center, Oregon **"Botanical Beach Revisited" -The History of Botanical Beach** Antithesis Lounge (George & Ida Halpern Centre for Graduate Students)

Posters

Diatoms as indicators of paleoclimatic shifts from an Alaskan Late Wisconsin Record. R. Gregory-Eaves and J.P. Smol. Paleoecological Environmental Assessment and Research Laboratory R. (PEARL), Dept. of Biology, Queen's University, Kingston, Ontario, K7L 3N6, Canada.

Phototrophic growth of *Laminaria saccharina* gametophyte suspension cultures in an illuminated tubular recycle bioreactor. R.K. Mullikin and G. L. Rorrer. Department of Chemical Engineering, Oregon State University, Corvallis, Oregon. 97331. USA.

Cultured *Lyngbya majuscula* as a source of bioactive natural products. N. Sittachitta, M.A. Roberts, J.V. Rossi, W.H. Gerwick. College of Pharmacy, Oregon State University.

Water quality- trophic interactions and human influence. P.C. Caron, S. Dingwall and P.D. Edmonds. Department of Biology. University of Victoria, Victoria B.C.

Title Unknown J. R. Hughey. Department of Biology. Coker Hall. University of North Carolina at Chapel Hill. North Carolina, USA

Database: Seaweeds of the Northeast Pacific (Cont.) T.B. Widdowson. Department of Biology, University of Victoria.

Saturday, May 10:

7:15-8:10 Breakfast (Cadboro Commons Cafeteria)

8:45 Opening Remarks (Human & Social Development Building Rm. 240)

9:00-10:15 Session I: Oral presentations (15 min. each) (HSD Rm. 240)

9:00 **A new look at chloroplasts of the rhodophyta using confocal laser scanning microscopy.** B.R. Oates, and K.M. Cole.

9:15 **Sea vegetables are not really vegetables: the origin of red algae based on RNA polymerase genes.** J.W. Stiller and B.D. Hall.

9:30 **Losing alleles from haplo-diploid seaweed populations.** T. Klinger.

9:45 **Title Unknown.** J. R. Hughey.

10:15-10:45 Coffee, Tea, Juice Break

10:45-12:00 Session II: Oral presentations (HSD Rm. 240)

10:45 **Habitat related biomechanical properties of *Udotea*.** R.E. Dewreede, L. Collado-Vides, L. Martinelli, and K.D. Milligan.

11:00 **Thallus shape and size effects on drag and dislodgement in *Hedophyllum sessile*.** K. Milligan.

11:15 **Algal symbiosis in the Pacific Northwest sea anemone *Anthopleura elegantissima*.** G. Muller-Parker and students.

11:30 **Growth characteristics for cell and tissue cultures of the macrophytic red alga *Agardhiella subulata*.** Bryan Huang, Gregory L. Rorrer., Sanjiv Mliakal and Donald P. Cheney.

12:00-2:00 Lunch (Cadboro Commons Cafeteria or anywhere you choose- see restaurant information at the desk in the foyer near HSD Rm. 240).

2:00-3:30 Session III: Oral presentations (HSD Rm. 240)

2:00 **Green tide algae in the Padilla Bay Estuary, Washington: a molecular approach to identification, distribution and phylogeny.** H.S. Hayden and J.R. Waaland.

2:30 **Increases in cell concentration of phytoplankton species suggest exponential growth rates in a turbulent marine environment.** L.A. Hobson and M.R. McQuoid.

2:45 **Changes in diatom abundance and species composition in Saanich Inlet from frozen sediment cores and ODP169S hole 1034B.** M. R. McQuoid and L.A. Hobson.

3:00 **B.C. freshwater algal ecology research: a 20 year retrospective of work conducted by Professor A.P. Austin & his students.** W.P. Lucey.

3:30-4:30 Business meeting to select an organiser for the 12th NWAS

4:30-6:00 RELAX!- Visit Finnerty Rhododendron Gardens? Volleyball?

6:00-7:00 Happy Hour at Faculty Club (cash bar)

7:00-8:15 Banquet Dinner (Faculty Club)

8:15-9:15 Keynote address: **Dr. Asit Mazumder**. University of Montreal, Montreal, Quebec **"Managing algal biomass development in aquatic ecosystems: patterns, predictions and processes"**

Sunday, May 11:

7:00 Field trip to Botanical Beach**, Port Renfrew (low tide 10:00 0.5m) Depart from Housing Office (1 ½- 2 hour drive) (vans provided). Brown bag breakfast provided en route. Spinnakers Pub Lunch on way home?

7:15-8:15 Breakfast for those not on Botanical Beach field trip

8:30-4:00 Field trip to Greater Victoria Water District watersheds. (Victoria's drinking water supply- a 15,000 ha west coast forest). Depart from Housing Office (vans provided). Limit: 20 people.

2:00-3:00 Return from Botanical Beach
3:00-4:00 Depart for home.

** Reminder- Botanical Beach is now a Provincial Park- no collecting is permitted**

Abstracts of the 11th NorthWest Algal Symposium (NWAS)

University of Victoria

Victoria, British Columbia

May 9-11, 1997

The abstracts for all presentations and posters have been printed as received and are listed in alphabetical order by the first author's last name

Water quality - trophic interactions and human influence.

P.C. Caron, S. Dingwall, and P.D. Edmonds. University of Victoria, Department of Biology, Box 1700, Victoria, B.C. V8W 2Y2

Historically, watershed management has not sufficiently integrated biological, chemical, physical or ecological processes over adequate temporal and spatial scales. Traditional, single discipline studies have led to incorrect inferences about watershed health and frequently resulted in ill-informed land management practices. Recent watershed-scale investigations reveal aquatic biota respond to a suite of complex hierarchical variables, including climate and geology, hydrology and water quality, and anthropogenic landscape disturbances. The periphyton community, a major contributor to primary production, integrates changes in water quality and habitat which affects the trophic structure. Recent studies have shown that N/P ratio and concentration flux changes at the macro-scale can alter periphyton species composition and abundance or, at the micro-scale, modify species-specific lipid and protein pools, which alters their nutritional quality as a food source for higher trophic levels. Logging practices can significantly alter the biological, chemical, and physical parameters of aquatic habitat, thereby influencing water quality and periphyton community function and structure. Understanding how landscape practices affect the health and productivity of streams has important implications in developing restoration technologies, especially those affecting the salmonid fisheries.

Habitat Related Biomechanical Properties of *Udotea*.

R.E. DeWreede[1], L. Collado-Vides[2], L. Martinell[2], & K.D. Milligan[1].
[1]. Department of Botany, The University of British Columbia, Vancouver, B.C. Canada V6T 1Z4. [2]. Lab. Ficologia, Fac.-Ciencias, Universidad Nacional Autonoma De Mexico, D.F. Mexico.

Udotea flabellum (Halimediales, Chlorophyta) is a coenocytic algae, common in many tropical marine waters, either anchored in sand or attached to dead coral. In this paper we report the results of a biomechanical investigation on the forces required to detach this seaweed from its sandy habitat in lagoons, whether these forces exceed those required to break this algae, and what water velocities are necessary to either break or detach this organism. When pulled *in situ*, 94% of the thalli came out of the sand as entire plants; this required 8.6 N($\pm$ 0.81; X $\pm$ SE). In the laboratory 19.2 N $\pm$ 1.10 are required to break these individuals. Blades of *Udotea* generate a drag force dependent on their coefficient of drag (C_d), surface area, and water velocity. We calculated the C_d as 0.2 at water velocities of 1.5 m/s, quickly dropping to 0.2 at 3m/s. Calculations show that for a blade of average surface area (0.0025 m^2) a C_d of 0.20 requires a water velocity of 6m/s to remove this species; with a C_d of 0.02, water velocities of 15m/s are required. Thus changes in the C_d ensure that water generated forces sufficient to remove individuals of *Udotea* from the substratum are rarely encountered.

Diatoms as indicators of paleoclimatic shifts from an Alaskan Late Wisconsin Record

Gregory-Eaves, R., and J.P. Smol

Paleoecological Environmental Assessment and Research Laboratory (PEARL), Dept. of Biology, Queen's University, Kingston, Ontario, K7L 3N6, Canada

Knowledge of the rate and magnitude of past climate change is critical for understanding the impacts of global warming. Because long term temperature record are sparse, paleolimnological techniques using diatoms (Class Bacillariophyceae) have been particularly useful for reconstructing climate. This project has been designed to quantitatively reconstruct the environmental dynamics of Birch Lake during a period abrupt climate change, the Late Wisconsin. Preliminary analysis of the Birch Lake diatom stratigraphy demonstrate three distinct zones of paleoenvironmental and climatic shifts. Using a diatom-based transfer function (currently in development), the changes in community composition from the Birch Lake sediment core will be used to quantitatively reconstruct a climatically-related environmental variable. The transfer function will be defined from a calibration set of 51 lakes distributed across a north-south transect in Alaska.

GREEN TIDE ALGAE IN THE PADILLA BAY ESTUARY, WASHINGTON: A MOLECULAR APPROACH TO IDENTIFICATION, DISTRIBUTION AND PHYLOGENY

Hillary S. Hayden and J. Robert Waaland, Department of Botany, Univ. of Washington

Large accumulations of macroalgae, particularly *Ulva* and *Enteromorpha* (Chlorophyta), are common in estuaries worldwide. These 'green tides' or 'blooms' are considered a natural ecological process, though eutrophication has been reported to magnify their occurrence. In 1989, a macroalgal bloom was observed in the Padilla Bay National Estuarine Research Reserve. The species responsible for the bloom and the cause of the bloom are unknown. This study aims to identify the green tide alga(e) and to determine if it is native and responding to environmental cues (e.g., stochastic or long-term changes in nutrients or temperature) or is a recent introduction. Initial macroalgal collections were made during two low-tide series in September 1996 and additional collections will be made in spring/summer 1997. Investigations based on morphological characters alone indicate ten Ulvacean taxa inhabit Padilla Bay; however, the simple morphology of these algae makes identification to species difficult. To confirm species identity and determine geographic origin, two molecular markers will be used -- the ITS regions of nuclear rDNA and a highly variable region of the second-largest subunit of nuclear RNA polymerase II. PCR products will be digested with restriction enzymes to develop species-specific banding patterns and will be sequenced for phylogenetic analysis.

SEQUENCE ANALYSIS OF THE rbcL AND ITS REGIONS ON SPECIES OF *CHONDRACANTHUS* (RHODOPHYTA, GIGARTINALES) FROM PACIFIC NORTH AMERICA.

Jeffery R. Hughey and Max H. Hommersand. Departement of Biology, University of North Carolina at Chapel Hill. Coker Hall, Chapel Hill, NC. 27599-3280.

Six species are currently recognized in *Chondracanthus* from Pacific North America: *C. canaliculatus*, *C. corymbiferus*, *C. exasperatus*, *C. harveyanus*, *C. spinosus*, and *C. tepidus*. Nine additional taxa have been described under *Gigartina*; however, these are traditionally treated as synonyms of the species listed above. The status of these taxa has been the subject of controversy due to the lack of diagnostic morphological characters. Molecular sequence analyses based on the rbcL gene (RUBISCO) and the ITS (Internally Transcribed Spacer) 1, 2, and 5.8S regions were employed to investigate phylogenetic relationships among the species of *Chondracanthus*. A total of forty taxa were sequenced from the rbcL and ITS regions, representing populations from Washington to Baja California. Two nearly congruent phylogenetic hypotheses resulted, varying only in the position of *C. tepidus*. A group containing *C. exasperatus* and *G. californica* was sister to another containing *G. armata*, *G. asperifolia*, *G. eatoniana*, and *C. spinosus*. The topological position of *C. corymbiferus* was strongly supported in both trees in a basal position. *Chondracanthus harveyanus* was sister to plants identified as *C. canaliculatus* and *G. serrata*. In summary, sequence data supports the continued recognition of the taxa listed above including the present placement of taxonomic synonyms.

PRELIMINARY MOLECULAR SEQUENCE ANALYSIS OF *MAZZAELLA* (RHODOPHYTA, GIGARTINALES) FROM THE PACIFIC COAST OF NORTH AND SOUTH AMERICA

Jeffery R. Hughey and Max H. Hommersand. Department of Biology. University of North Carolina at Chapel Hill. Coker Hall, Chapel Hill, NC. 27599-3280.

The number of taxa currently recognized for *Mazzaella* from Pacific North America is debatable, stemming from observations that the morphological characters used to delineate some of the species are often continuous. Characters traditionally used to separate these taxa are: blade size, number of blades per clump, and color and shape of the blade. To address the relationships among the species, thirty-six samples were sequenced from the ITS (Internally Transcribed Spacer) 1, 2, and 5.8S regions and eight new sequences for the rbcL gene (RUBISCO). Inferred phylogenetic hypotheses from both data sets are nearly congruent. The rbcL and ITS data support the recognition of five major groups: 1) Splendens group- *M. splendens*, *M. linearis*, *M. flaccida*, *M. sanguinea*; 2) Californica group- *M. californica*, *M. affinis*, *M. leptorynchos*, *M. volans*; 3) Laminarioides group- *M. laminarioides* and *M. membranacea*; 4) Coriaceum group- *Rhodoglossum coriaceum*, *M. cobinae*, *M. rosea*; 5) Cornucopiae group- *M. cornucopiae* and *M. heterocarpa*.

Increases in cell concentrations of phytoplankton species often suggest exponential growth rates in a turbulent marine environment. L.A. Hobson & M.R. McQuoid, Department of Biology/Centre for Earth & Ocean Research, University of Victoria, Victoria, B.C.

The metabolic state of individual species in assemblages of protistan plankton is not well known because most extant techniques integrate over all metabolic states of co-existing cells and species. Recently, indirect techniques have been employed by Carpenter and colleagues to estimate cellular division rates of species, and by detailed temporal sampling, we observed exponential increases of cell concentrations of individual species. We calculated rates of increase for 31 diatom species, 2 pyrrophyte species and 1 ciliate (tintinnid) species in a turbulent marine environment. The range of rates (log base 2 transform) was 0.05-1.6 day^{-1}, similar to values for division rates of wild and cultured cells, but most varied between 0.1 and 0.4 day^{-1}. Variations in species-specific rates most often were correlated to temperature, although other significant ($p \leq 0.05$) correlations to irradiance, daylength, salinity and tidal range (a proxy for turbulence) were computed. We cannot claim that our reported rates equal those for cellular division because of uncertainty about impacts of dissipative processes such as turbulence and grazing on increases in cell concentrations. Nevertheless, the occurrence of exponential increases and the similarity between their rate constants and those in the literature for cell division were striking, leading us to conclude that, at times, dissipative processes may have little effect on accumulation of cells, even in a relatively turbulent environment.

Growth Characteristics for Cell and Tissue Cultures of the Macrophytic Red Alga *Agardhiella subulata*

Bryan Huang and Gregory L. Rorrer, Department of Chemical Engineering, Oregon State University, Corvallis, OR 97331. Sanjiv Maliakal and Donald P. Cheney, Marine Science Center, Northeastern University, Nahant, MA 01908.

The macrophytic marine red alga *Agardhiella subulata* produces two novel eicosanoids deriving from arachidonic acid metabolism, including 8S-hydroxy-5,11,13,15-eicosatetraenoic acid (8-HETE) and its derivative agardhilactone. Cultivation of cell or tissue suspensions of *Agardhiella subulata* in bioreactor systems can provide for the controlled production of cellular biomass and its bioactive natural products. Toward this end, a clumped cell culture and a regenerated plantlet culture were established for *Agardhiella subulata*. The clumped cell culture was established by a callus induction technique. Cell clumps could be subcultured and maintained in culture wells without agitation. Hydrodynamic stress, either as mixing or bubble aeration, promoted the formation of shoot tissues from the cell clumps. The shoot tissue developed into branched microplantlets which could be readily cultured as a liquid suspension and subcultured by simply dicing up the shoot tissue into smaller pieces. The specific growth rate of the undifferentiated cell clumps was 0.03 1/day whereas the specific growth rate of the regenerated microplantlets was 0.08 1/day at 24 °C and 10 $\mu E/m^2$-sec (10:14 photoperiod) in ASP12 artificial seawater medium (pH 8.5-9.0). The photolithotrophic growth parameters determined by photosynthetic oxygen evolution rate vs. incident light intensity measurements showed that the cell clump culture had higher respiration requirements and lower photosynthetic growth capacity relative to the regenerated microplantlet culture.

LOSING ALLELES FROM HAPLO-DIPLOID SEAWEED POPULATIONS

Terrie Klinger, Friday Harbor Labs, Friday Harbor, WA 98250

The probabilities of losing alleles from the haploid versus diploid phases of a typical biphasic seaweed life history were determined analytically for the case of a single Mendelian locus with two alleles under conditions of very high non-selective mortality. Results indicated that alleles are more likely to be lost during the haploid phase of the life history, especially when populations are small and when one allele occurs at low frequency. The number of haploids in a population must be twice as large as the number of diploids in order for the probability of losing alleles to be equivalent between the two phases. These results imply that the haploid component of the population is more vulnerable to loss of alleles than is the diploid component, and this finding has consequences for the maintenance of genetic diversity in seaweed populations under conditions of catastrophic mortality.

B.C. Freshwater Algal Ecology Research: a 16 year retrospective of work conducted by Professor A.P. Austin and his students.

Wm. P. Lucey, Departments of Biology & Environmental Studies, University of Victoria and Aqua-Tex Scientific Consulting Ltd. 3861 Bedford Road, Victoria, B.C. V8N 5T6.

Throughout the past two decades, Professor Alan Austin and his students have conducted research on freshwater algal ecology, primarily in coastal streams, lakes and reservoirs. The focus of this work was to further our understanding of how specific environmental parameters effect alterations in algal community structure. Lake and reservoir studies sought to follow long term, temporal phytoplankton community changes, especially in drinking water reservoirs. Periphyton studies focused on developing semi-natural surrogate stream facilities within which contained communities could be subjected to alterations in physical (stream flow and velocity) and chemical (nutrient flux, nutrient ratios, toxins) parameters. Long term, water quality monitoring programs were established to form the basis of watershed management models to provide local communities and professional resource managers with the ecological information essential to make appropriate landuse decisions. An integral component of the research programs was the presentation of basic scientific knowledge to the non-scientific community, especially children. This paper is presented in honour of Dr. Austin's upcoming retirement from the University of Victoria.

Changes in diatom abundance and species composition in Saanich Inlet from frozen sediment cores and ODP169S hole 1034B.

Melissa R. McQuoid, Centre for Earth and Ocean Research, and
Louis A. Hobson, Department of Biology, University of Victoria.

Diatom history in Saanich Inlet can be studied in great detail over a long period of time because the laminated sediments are easily sampled at annual and sub-annual levels. Frozen sediment cores provide a record of seasonal diatom changes over the last 100 years, a record which is similar to species successions observed in the inlet today. Population blooms of individual species (*Thalassiosira gravida, Skeletonema costatum, Rhizosolenia sp.*) helped identify when the light and dark laminae were deposited during the year. In addition to seasonal variations in diatom species composition, we have found interannual variations in the abundance of several species. *Thalassiosira gravida* and *Chaetoceros diadema* are both found in lower numbers in recent decades of this century. *Ditylum brightwellii* and *Paralia sulcata* show low abundance in the 1940's-70's but higher than average abundance from 1920's-40's, a trend also found in fish catch records and sea surface properties in other areas of the northeast Pacific. Longer timescale variations are being examined from ODP169S cores. Preliminary results suggest that species composition and abundance is similar in samples from 15-25 m to samples from the frozen cores. Material from 60-65 m appears to be slightly enriched in *Thalassionema nitzschioides* and depleted in *Paralia sulcata* cells, however other species are found in similar proportions throughout all samples examined to date.

Milligan, Kristen and DeWreede, Robert E., Botany Department, University of British Columbia, Vancouver B.C.

THALLUS SHAPE AND SIZE EFFECTS ON DRAG AND DISLODGMENT IN *HEDOPHYLLUM SESSILE*

The relative importance of shape and size on hydrodynamic drag and dislodgment in the perennial kelp, *Hedophyllum sessile*, was examined using biomechanical approaches. *H. sessile* inhabits a range of wave exposures and thallus shape and size vary throughout this wave exposure gradient. In exposed sites, streamlined shapes and seasonal tattering (resulting in smaller sizes) occur. Drag forces on thalli with morphologies representative of extremely sheltered and exposed sites and of tattered thalli were measured in flow velocities ranging from 0.5 - 4.0 m/s. Drag coefficients (C_d) were calculated from these data and used to assess shape effects on drag forces. At 0.5 m/s more streamlined shapes had lower average C_d 's, but all shapes reconfigured and final C_d 's at 4.0 m/s were similar. Shape effects on drag forces were minimal when compared to those of thallus size. Ecological implications of these patterns are illustrated by a biomechanical model example. Within sizes naturally found, shape variation does not affect the chances of dislodgment at peak velocities in exposed sites, demonstrating that thallus size rather than shape is the primary drag reducing mechanism important to survivorship in exposed sites.

Algal symbiosis in the Pacific Northwest sea anemone *Anthopleura elegantissima*. By Gisèle Muller-Parker and students. Dept. of Biology and Shannon Point Marine Center, Western Washington University, Bellingham WA 98225-9160.

Symbiotic zooxanthellae (dinoflagellate; *Symbiodinium* sp.) provide tropical anemone and coral hosts substantial amounts of reduced carbon and conserve nutrients within the association. The advantage of symbiotic algae to temperate anemone hosts is less obvious, as light is seasonally limiting for photosynthesis and plankton prey abundant during high-light seasons. However, strong environmental gradients in temperate regions provide the framework for assessing the role of the host and of the algae in the anemone symbiosis. Studies with the abundant intertidal temperate anemone *Anthopleura elegantissima* that contains mixed populations of algal symbionts (zooxanthellae and zoochlorellae) reveal that physical factors (light and temperature) appear to be more important than host control in determining the distribution of algal symbionts in anemones. These anemone hosts do not appear to depend on photosynthesis of the algae to meet their nutritional requirements. Our research continues to explore other benefits of the symbiosis to *A. elegantissima* within the context of current research on tropical coral symbioses.

PHOTOTROPHIC GROWTH OF *Laminaria saccharina* GAMETOPHYTE SUSPENSION CULTURES IN AN ILLUMINATED TUBULAR RECYCLE BIOREACTOR. Ronald K. Mullikin and Gregory L. Rorrer, Department of Chemical Engineering, Oregon State University, Corvallis, Oregon 97331 USA.

A liquid suspension of *Laminaria saccharina* female gametophytes were cultivated in a novel tubular recycle bioreactor. The cultivation system consisted of a helical coil of silicone tubing connected to an aeration tank. The tubing was 39 m in length with an inner diameter of 0.8 cm and a total volume of 2 L. The tubing was helically wrapped around a cylindrical frame 29 cm in diameter and 54 cm in height. The suspension culture was recycled between the aeration tank and the biocoil by a peristaltic pump at 123 ml/min. The aeration tank was continuously bubbled with air at a rate of 1 L/min. Every 90 minutes air was also injected into the biocoil at 2 L/min for 90 seconds to remove cell mass attached to the tubing wall. The biocoil was radially illuminated by two 20-watt fluorescent lamps positioned at the center of the coil. The incident light intensity of the coil was 17 $\mu E/m^2$-sec. The aeration tank was not directly illuminated, but received 1 $\mu E/m^2$-sec diffuse light. Specific growth rates of 0.12 day^{-1} and final biomass concentration of 1,200 mg DCW/L were achieved under these conditions after 27 days. The efficient delivery of light to the suspension culture make this system an attractive alternative to the stirred tank bioreactor for the production of photosynthetic biomass.

A NEW LOOK AT CHLOROPLASTS OF THE RHODOPHYTA USING CONFOCAL LASER SCANNING MICROSCOPY. Oates, B. R. and Cole, K. M. University of British Columbia, Department of Botany, Vancouver, British Columbia V6T 1Z4

We have recently applied confocal laser scanning microscopy (CLSM) to determine 3-dimensional relationships between organelles within living cells of the red alga *Ceramium*, noting that each cell contained a single multi-lobed chloroplast. Since it is generally accepted that, with the exception of apical cells, vegetative cells of higher florideophytes, including Ceramium, contain numerous dicoid chloroplasts, we commenced a survey using CLSM to re-examine chloroplast number and morphology in cells of species in 16 orders of the Rhodophyta. This new technology, combined with a reexamination of light and electron microscope observations, has revealed the presence of a single chloroplast is common in cells of higher florideophytes. These results may call into question the use of chloroplast number in systematics of certain red algal groups.

Cultured *Lyngbya majuscula* as a Source of Bioactive Natural Products

N. Sittachitta, M. A. Roberts, J. V. Rossi, W. H. Gerwick
College of Pharmacy, Oregon State University

The marine environment is a rich and underdeveloped source for novel pharmaceuticals. Many of the compounds isolated from marine organisms possess unique structures not seen in terrestrial or fresh water counterparts. Resupply through recollection of the organisms can be problematic due to limited numbers or habitat loss. Culturing those organisms having important bioactive natural products is a possible means to guarantee a reliable source of research material. Our studies with a cultured Curaçao collected *Lyngbya majuscula* are yielding not only answers about mass production of curacin A, but also is allowing further studies on the elucidation of the biosynthetic pathway of barbamide, a molluscicidal natural product. Our presentation will discuss current findings on the biosynthetic pathways of curacin A and barbamide.

SEA VEGETABLES ARE NOT REALLY VEGETABLES: THE ORIGIN OF RED ALGAE BASED ON RNA POLYMERASE GENES.

John W. Stiller and Benjamin D. Hall

We report the results of phylogenetic analyses based on sequences of the largest subunit of RNA polymerase II (rpb1) which provide the first robust statistical rejection of a sister relationship between red algae and plants. The separate evolutionary origins of rhodophytes and chlorophytes has a major impact on current theories of plastid evolution. Comparative analyses of gene sequences, genome content and gene order provide compelling evidence that all extant plastids are derived from a common cyanobacterial ancestor. While it is most parsimonious to assume a single endosymbiotic origin of primary plastids and a monophyletic relationship among their host cells, evidence from rpb1 and other nuclear genes indicates that rhodophytes, glaucocystophytes and green plants are not closely related. The different evolutionary histories implied by nuclear versus plastid genes can be explained by a polyphyletic origin of primary plastids or by wholesale loss of plastids from a number of different eukaryotic lineages. We propose a third possibility, that some plastids which are now characterized as primary, i.e., descended directly from a cyanobacterial endosymbiont, may in reality be highly reduced secondary plastids descended from a eukaryotic algal endosymbiont.

Database: Seaweeds of the Northeast Pacific (cont.)

Thomas B. Widdowson

As demonstrated previously, this database contains distribution and other data from the holdings of the UBC Phycological Herbarium up to accession no. 67726 in Microsoft *Access*, together with illustrations of many species from the literature, linked to Microsoft *Paintbrush*. Recently, I have added records up to UBC No. 82922 and from the literature. I have added another field containing photos of representative specimens in the UBC herbarium (linked to Corel *Photopaint)*, a field containing photos of living specimens or populations (also linked to *Photopaint*) and a few keys to species (linked to Microsoft *Word*).

Rita Horner
UW Oceanography

11th NWAS
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