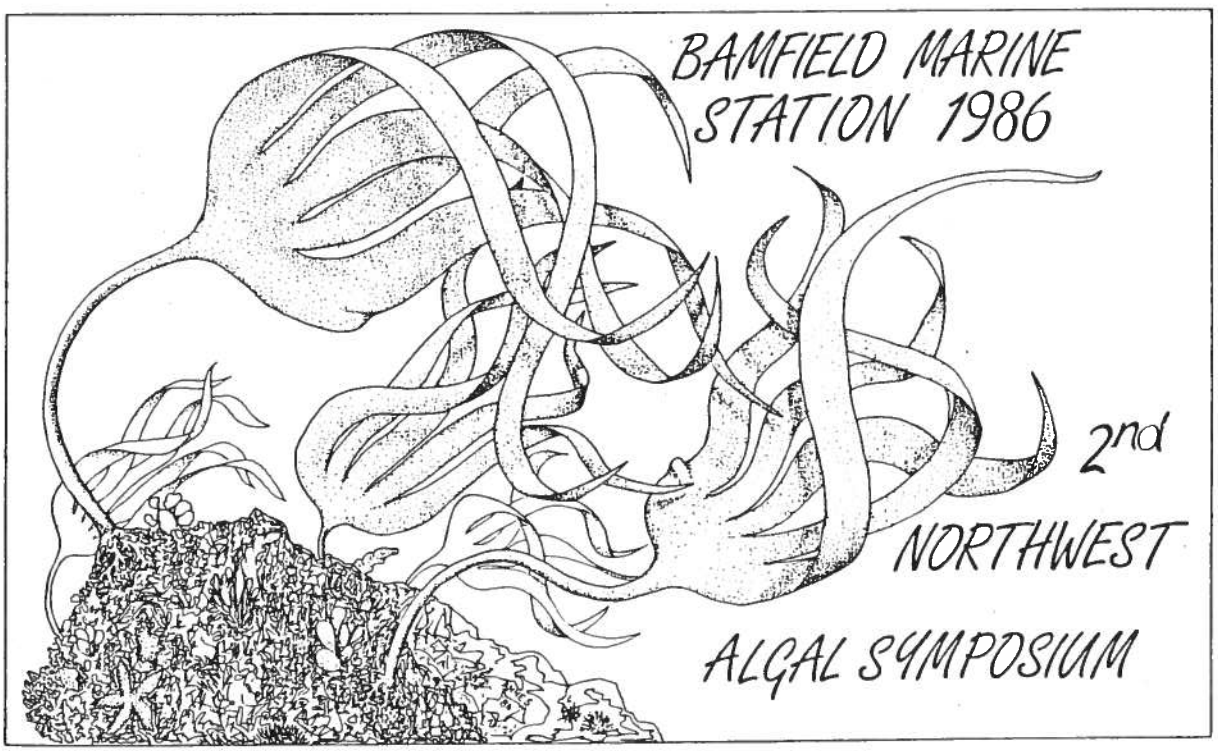
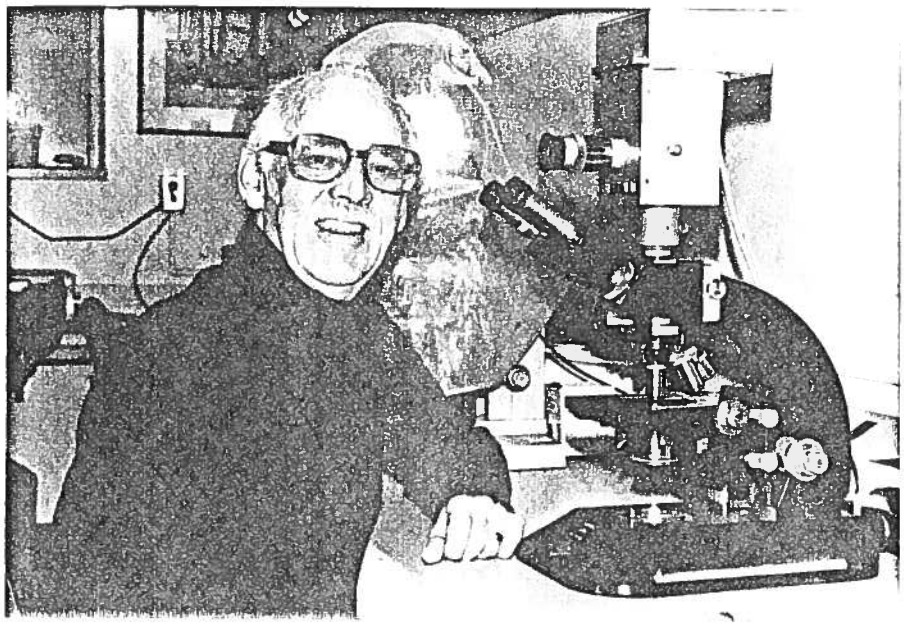
2nd NORTHWEST ALGAL SYMPOSIUM

BAMFIELD MARINE STATION

March 27 - 31, 1986





It is with great pleasure that we dedicate the 2nd Northwest Algal Symposium to Professor R. F. Scagel of the University of British Columbia during this, the year of his retirement from teaching.

Dr. Scagel has contributed greatly to phycology in the Northwest. After receiving his Ph.D. degree in Botany from the University of California, Berkeley, where he studied with Professor G.F. Papenfuss, Dr. Scagel joined the faculty of the University of British Columbia in 1952. At UBC he was instrumental in developing a strong center for phycological research and currently more than 7 tenured faculty members there are actively involved in research on algae. In his own laboratory, he supervised 9 Ph. D.'s in marine phycology and sponsored 14 postdoctoral fellows. In his capacity as curator of the algal herbarium, he increased the collections at UBC to a staggering 68,400 specimens which are now fully computerized. He has published numerous papers on marine algal morphology, systematics and biogeography, and he is well-known, along with his co-authors, for his four introductory texts in plant diversity. His museum handbook, *A Guide to the Common Seaweeds of British Columbia*, inspired many of us to begin our studies on marine algae.

Dr. Scagel's additional credits are numerous. He is a fellow of the Royal Society of Canada, the Linnean Society of London and the American Association for the Advancement of Science. He has been an editor of *Syesis* and *Phycologia* as well as an Associate Editor for these journals and for the *Canadian Journal of Botany*. He was awarded the prestigious Darbaker Prize in Phycology by the Botanical Society of America in 1964. At UBC, he served a 14 year term as Head of the Department of Botany and several terms as Assistant and Associate Dean for the Faculty of Science. Dr. Scagel was a major influence in establishing the Bamfield Marine Station and served several terms as the president of its' Management Council.

We are deeply indebted to Professor Scagel for his very generous, unfaltering support and encouragement of phycology -- and of those of us who study it in the Northwest. We wish him well in his retirement.

S C H E D U L E

2nd Northwest Algal Symposium
Bamfield Marine Station

Friday March 28	3:30-10:30	Arrival and check-in
	7:00- 8:00	Dinner
	8:00-	Social, poster set-up
Saturday March 29	7:00- 8:30	Breakfast
	8:30- 9:00	Welcome and introduction to the Bamfield Marine Station
	9:00-10:00	Tour of the facility
	10:00-11:40	*Session I*
	Noon- 1:20	Lunch
	1:20- 2:40	*Session II*
	2:40- 3:20	C/T Break
	3:20- 4:40	*Session III*
	5:30- 6:30	Social at the Director's house
	6:30- 8:00	Banquet
	8:00- 9:00	*Evening Lecture by Ralph Lewin*
	9:00-	Mixer
Sunday March 30	7:00- 8:30	Breakfast
	8:30- Noon	Free time: Church, field trips, etc.
	Noon- 1:20	Lunch
	1:20- 2:40	*Session IV*
	2:40- 3:20	C/T Break
	3:30- 5:00	*Session V*
	6:00- 7:30	Dinner
	7:30- 8:00	Business Meeting
	8:00-	Mixer
Monday March 31	7:00- 8:30	Breakfast
	8:00	Vans depart to Nanaimo & Victoria
	9:30	Check-out and departure

P R O G R A M

Friday March 28

3:30-10:30 Arrival and check-in

7:00- 8:00 Dinner

8:00- Social, Poster set-up

Saturday March 29

7:00- 8:30 Breakfast

8:30- 9:00 Welcome and Introduction to the Bamfield Marine Station - Ronald E. Foreman, Convener.

9:00-10:00 Tour of the facilities

10:00-11:40 *Session I.* Gayle I. Hansen, moderator.

10:00-10:20 A RE-EVALUATION OF CALLOPHYLLIS CRISTATA (KALLYMENIACEAE, RHODOPHYTA). *Gayle I. Hansen, Bamfield Marine Station.*

10:20-10:40 AN EXAMINATION OF HOLE PRODUCTION IN THE SACCATE ALGA HYDROCLATHRUS CLATHRATUS (SCYTOSIPHONALES, PHAEOPHYTA). *Brian R. Oates, University of British Columbia.*

10:40-11:00 ULTRASTRUCTURE OF APLANOSPOROGENESIS IN VAUCHERIA. *Rob Fitch and Luis Oliveira, University of British Columbia.*

11:00-11:20 SYSTEMATICS AND SPINY CYST FORMATION IN DINOFLAGELLATES: GONYAULAX SPINIFERA. *Gregory Gaines and F.J.R. Taylor, University of British Columbia.*

11:20-11:40 RESOURCE MANAGEMENT BIOLOGY FOR THE EDIBLE KELP LAMINARIA GROENLANDICA. *W. G. Roland, B.C. Ministry of Environment.*

Noon - 1:20 Lunch

1:20- 2:40 *Session II.* Michael W. Hawkes, Moderator.

1:20- 1:40 APOMIXIS IN THE RHODYMENIALES FLORA OF BRITISH COLUMBIA. *Michael W. Hawkes, University of British Columbia.*

Saturday March 29 (continued)

1:40- 2:00 RELATIVE DOMINANCE OF LIFE-HISTORY PHASES OF IRIDAEA. *Robert E. DeWreede, University of British Columbia.*

2:00- 2:20 POPULATION GENETICS OF COSTARIA COSTATA TURNER. *D. Battacharya, Simon Fraser University.*

2:20- 2:40 SURVIVAL OF POPULATIONS OF THE EPIPHYTE MICROCLADIA COULTERI IN A PATCHY ENVIRONMENT. *Gary Kendrick, University of British Columbia.*

2:40- 3:20 C/T Break

3:20- 4:40 *Session III.* Scott Newman, Moderator.

3:20- 3:40 SYNTHESIS OF OLISTHODISCUS LUTEUS RIBULOSE-1, 5-BIPHOSPHATE CARBOXYLASE. *Scott Newman and Rose Ann Cattolico, University of Washington.*

3:40- 4:00 CHEMICAL CHARACTERIZATION OF FLORIDOSIDES FROM PHORPHYRA PERFORATA. *Jianxin Meng, Karl-Gunnar Rosell, and Lalit Srivastava, Simon Fraser University.*

4:00- 4:20 ORGANIZATION OF THE PHOTOSYNTHETIC APPARATUS IN MACROCYSTIS. *Barbara M. Smith, University of California, Berkeley.*

4:20- 4:40 PORPHYRA YEZOENSIS PHYCOBILISOMES: A MODEL DERIVED FROM PIGMENT MUTANT STUDIES. *John E. Merrill, University of Washington.*

5:30- 6:30 Social at the Director's House

6:30- 8:00 **BANQUET**

8:00- 9:00 *Evening Lecture.*
PARAPHYCOLOGY OF FRANZ MOEWUS. *Ralph A. Lewin, University of California, San Diego.*

9:00- Mixer

Sunday March 30

7:00- 8:30 Breakfast

8:30- Noon Free Time: Church, Field Trips, etc.

Noon- 1:20 Lunch

Sunday March 30 (continued)

1:20- 2:40 *Session IV.* Ralph Lewin, Moderator.

1:20- 1:40 THE PHYLOGENETIC POSITION OF PROCHLORON. *Ralph A. Lewin, University of California, San Diego.*

1:40- 2:00 BIOGEOGRAPHY: AN OLD TOOL IN A NEW METHODOLOGY *Paul W. Gabrielson, Department of Botany, University of British Columbia, Vancouver, B.C.*

2:00- 2:20 CHLOROPLAST RIBOSOMAL RNA AS AN INDICATOR OF PLASMID EVOLUTION. *Terry Delaney and Rose Ann Cattolico, University of Washington.*

2:20- 2:40 CHARACTERIZATION OF THE CHLOROPLAST AND MITOCHONDRIAL GENOMES IN THE RED ALGA GRIFFITHSIA PACIFICA. *Ning Li and Rose Ann Cattolico, University of Washington.*

2:40- 3:20 C/T Break

3:20- 5:00 *Session V.* Gregory Gaines, Moderator.

3:20- 3:40 PATTERNS OF FEEDING IN HETEROTROPHIC DINOFLAGELLATES: OXYRRHIS MARINA AND POLYKRIKOS KOFOIDII. *Gregory Gaines and F.J.R. Taylor, University of British Columbia.*

3:40- 4:00 ARE NUTRIENTS AT BAMFIELD LIMITING TO ALGAL GROWTH? *Karl-Gunnar Rosell, B.C. Research, Vancouver.*

4:00- 4:20 UPTAKE AND INCORPORATION OF SELENIUM: FURTHER EVIDENCE OF A SPECIFIC REQUIREMENT FOR SELENIUM IN THE MARINE DIATOM THALASSIOSIRA PSEUDONANA (CLONE 3H). *N. M. Price and P. J. Harrison, University of British Columbia.*

4:20- 4:40 EFFECTS OF SELENIUM DEPLETION ON THE ULTRASTRUCTURE OF THE MARINE DIATOM THALASSIOSIRA PSEUDONANA (CLONE 3H). *G. J. Doucette, N. M. Price and P. J. Harrison, University of British Columbia.*

4:40- 5:00 FACTORS AFFECTING THE METAL TOLERANCE OF AMPHORA COFFEAEFORMIS AGARDH. *Terry E. Thomas and Maurice G. Robinson, Royal Roads Military College.*

6:00- 7:30 Dinner

7:30- 8:00 Business Meeting

8:00- Mixer

Monday March 31

7:00- 8:30 Breakfast

8:00 Vans depart to Nanaimo and Victoria

9:30 Check-out and departure.

P O S T E R S

THE PHYTOPLANKTON COMMUNITY AT ST. P IN MAY AND AUGUST.
Beatrice C. Booth, University of Washington.

A MODEL FOR THE PASSIVE DISPERSAL OF RED ALGAL SPORES.
John Carrier, University of Washington.

ENVIRONMENTAL REGULATION OF REPRODUCTION IN CONCHOCELIS OF SOME PACIFIC NORTHWEST *PORPHYRA* SPECIES.
J. Robert Waaland, Leal G. Dickson and Ellen C.S. Duffield, University of Washington.

ABSTRACTS

A RE-EVALUATION OF *CALLOPHYLLIS CRISTATA* (KALLYMENIACEAE, RHODOPHYTA)

Gayle I. Hansen, Bamfield Marine Station, Bamfield, B.C. V0R 1B0

Callophyllis cristata is a small, branching red alga that is wide-spread in north temperate regions of the Pacific and Atlantic Oceans and in the Bering and Arctic Seas. The species is one of the narrowest members of the genus *Callophyllis* and until 1974 was considered to be a distinct genus with separate species described for the North Pacific and Atlantic Oceans.

Anatomical investigations of specimens of this plant from both coasts of North America have revealed that *Callophyllis cristata* is a single morphologically variable species that is distinct both vegetatively and reproductively from the genus *Callophyllis*. Unlike the other species referred to this genus, *C. cristata* is uniaxial and monoecious. Although the carpogonial branch system is similar to that of the monocarpogonial species in *Callophyllis*, the ontogeny of the cystocarp is completely different. After fertilization, a fusion cell forms which involves all of the cells of the carpogonial branch, including CB 2 (which is normally excluded in *Callophyllis*). As the fusion cell develops, densely staining nutritive cells form in the surrounding vegetative tissue and expand toward the fusion cell, becoming clavate in shape. These cells join through wall dissolution with the central fusion cell, and outwardly radiating gonimoblast filaments begin to form. As the spore-bearing filaments continue to develop, the fusion cell fragments as its contents are exhausted by their production. The mature cystocarp is symmetrical with the central fragmented fusion cell surrounded by chains of carposporangia sectored occasionally by inwardly directed nutritive filaments.

These features distinguish *Callophyllis cristata* sufficiently from the genus *Callophyllis* to warrant the resurrection of the genus *Euthora* J. Agardh to which the species was previously assigned.

Notes

AN EXAMINATION OF HOLE PRODUCTION IN THE SACCATE ALGA *HYDROCLATHRUS CLATHRATUS* (SCYTHOSIPHONALES, PHAEOPHYTA)

Brian R. Oates, Department of Botany, University of British Columbia, Vancouver, B.C. V6T 2B1

An ultrastructural examination of the saccate alga *Hydroclathrus clathratus* was made to determine how holes penetrating the thallus wall are produced. Holes were found to be formed from surface pits through a process that digests the cells at the bases of hair filaments found in the pits. Examinations showed that cells within the filaments are metabolically very active and contain unusual bodies that are involved in digesting the subtending cells. Membrane bound vesicles are produced by the bodies and are moved into cells found at the base of the filaments where their digestive contents are released. Movement between cells is through plasmodesmata. The bodies are derived from chloroplasts that are found only in the basal cells of young filaments. While the bodies do not resemble chloroplasts, they do contain the major features of brown algal chloroplasts. These features include: 1) ring genophore, 2) double membrane bound organelle, 3) chloroplast endoplasmic reticulum, 4) thylakoid stacking arrangement that originated from stacks of three. The bodies are considered functional organelles and have been named *Plastosomes*. Plastosomes are not unique to *Hydroclathrus* since they have been found in two species of the closely related (phyllogenetically and morphologically) genus *Colpomenia*.

Notes:

ULTRASTRUCTURE OF APLANOSPOROGENESIS IN *VAUCHERIA*

Rob Fitch & Luis Oliveira, Department of Botany, University of British Columbia, Vancouver, B.C. V6T 2B1

Aplanospores are formed at vegetative filament apices in *Vaucheria longicaulis* var. *macounii*. At the onset of aplanosporogenesis, the vegetative tip expands and the large central vacuole is displaced by an accumulation of cytoplasm in the tip. An inner wall is secreted within the existing cell wall. Centripetal infurrowing of the newly secreted inner wall isolates the aplanospore from the vegetative filament. Each filament produces a single, multi-nucleated, walled aplanospore which is subsequently released.

Notes:

SYSTEMATICS AND SPINY CYST FORMATION IN DINOFLAGELLATES: *GONYAULAX SPINIFERA*.

Gregory Gaines and F.J.R. Taylor, Department of Oceanography, University of British Columbia, Vancouver, B.C. V6T 1W5

Gonyaulax spinifera is the type species of the genus *Gonyaulax*. It exemplifies the problem of intra- versus inter-species morphological variation in dinoflagellate systematics and ecology; and because of its definitive systematic position, the problem is particularly acute. Both the motile form and the resting cyst exhibit considerable variation; cyst specialists have even assigned the cysts to several different genera. The present light and electron microscope study of cultured specimens indicates that differences in both motile cells and cysts are due to developmental variability.

Notes:

RESOURCE MANAGEMENT BIOLOGY FOR THE EDIBLE KELP *LAMINARIA GROENLANDICA*.

W. G. Roland, Marine Resources Section, Ministry of Environment, Parliament Buildings, Victoria, B.C. V8V 1X5

Standing crop, density of plants, plant weight and lamina length/width were greatest July-September in a bed of *Laminaria groenlandica* in Queen Charlotte Strait, B.C. Moisture content of laminae decreased while lamina thickness and weight per area increased May-December. Sori were first observed in September and 79% of plants had sori by December. Presence of sori was positively related to plant weight. New sporophytes were observed May-July. Standing crop or cover of plants in two non-harvested plots varied dramatically over a 4 year period. Three large harvest plots (reduced to approximately 0.01% of former standing crop levels) had variable recovery rates. July and August harvest plots did not recover to control levels in four years, while a September harvest recovered in three years. Evidence is presented that lack of spores for colonization due to removal of large plants, and post-harvest succession, greatly affect recovery. Management in terms of resource stability, yield, plant quality and recovery after harvest are discussed.

Notes:

APOMIXIS IN THE RHODYMENIALES FLORA OF BRITISH COLUMBIA

Michael W. Hawkes, Department of Botany, University of British Columbia, Vancouver, B.C. V6T 2B1

A recent floristic survey of Rhodymeniales occuring in British Columbia recorded twelve species in nine genera. All of these species are reported (or assumed) to have a sexual, *Polysiphonia*-type life history. In British Columbia, however, only three of them: *Rhodymenia pertusa, Minium parvum*, and *Fauchea laciniata* possessed gametophyte (male and female), carposporophyte and tetrasporophyte stages typical of a complete sexual cycle. In the case of *F. laciniata* sexuality is probably not the only reproductive mode. Despite an abundance of female gametophytes (cystocarpic) and tetrasporophytes in several populations of this species, monitored over a two year period, male gametophytes were never encountered. This observation suggests either a sexually dimorphic male gametophyte (as yet unknown) or an asexual life history. Similarly, B.C. populations of the nine other rhodymenialean species appear to be maintaining themselves asexually by apomixis (both apogamy and apomeiosis) as well as vegetative propagation. Investigation of apomixis and other types of breeding system in the red algae may provide insights into population structure and species problems.

RELATIVE DOMINANCE OF LIFE-HISTORY PHASES OF *IRIDAEA*

Robert E. DeWreede, Department of Botany, University of British Columbia, Vancouver, B.C. V6T 2B1

In situ studies have shown that algal-life history phases do not always alternate in a predictable manner. Tetrasporophytes may predominate at one site, gametophytes at an adjacent one. For some red algae, tetrasporophytes are dominant at the northern extreme of the organisms' range. The recognition of such predominance, and its theoretical interpretation, has necessarily been based on the enumeration of reproductively mature thalli in isomorphic species. Nothing is known of the life-history stage ratio at recruitment, nor how this may change with age.

A simplified resorcinol test has been developed which can identify colourimetrically the gametophyte and tetrasporophyte of some red algae. The colour reaction occurs with kappa-carrageenan. Using this test, populations of *Iridaea* have been examined. Significant differences in life-history stage dominance were found between study sites, and over time. Size related life-history stage ratios are now being studied.

POPULATION GENETICS OF *COSTARIA COSTATA* TURNER

D. Bhattacharya, Department of Biological Sciences, Simon Fraser University, Burnaby, B.C. V5A 1S6

The seaweed, *Costaria costata* Turner, exhibits clinal polymorphism within its low intertidal distribution. Environmental factors have been thought responsible for this phenomenon. Plants from two disjunct, strongly heteromorphic populations are being studied and compared. The extent of morphological variation between the two populations is being quantified through multivariate statistical techniques. As well, the environmental and genotypic components of phenotypic variance of selected traits and their heritabilities are being estimated by quantitative genetic analysis.

Notes:

SURVIVAL OF POPULATIONS OF THE EPIPHYTE *MICROCLADIA COULTERI* IN A PATCHY ENVIRONMENT

Gary Kendrick, Department of Botany, University of British Columbia, Vancouver, B.C. V6T 2B1

At Beaver Point, Saltspring Island, British Columbia the population structure of the epiphyte, *Microcladia coulteri* and the host species, *Prionitis lanceolata, Iridaea cordata* and *Odonthalia floccosa* were studied over a 13 month period.

Comparison of population structures of *Microcladia coulteri* and its hosts was made using ANOVA. The partitioning of variation in epiphyte population structure with the seasons, between host species, within host species variations in size of thalli, reproductive status and spatial distribution was determined. The analysis indicated: less than 5% of the overall variation in epiphyte population structure was accounted for by seasonal variation in the epiphyte population; 7% to variations in epiphyte population structure between host species; 18% to within host species variation in size and reproductive status, and 10% due to spatial variation in availability of host substrata for colonization.

Both temporally and spatially stable epiphyte populations were the result of the differential use of available host substrata.

Notes:

SYNTHESIS OF *OLISTHODISCUS LUTEUS* RIBULOSE-1,5-BISPHOSPHATE CARBOXYLASE

Scott Newman and Rose Ann Cattolico, Botany Department, University of Washington, Seattle, Washington 98195

Ribulose-1,5-bisphosphate carboxylase (RuBPCase) catalyses the initial CO_2 fixing reaction of photosynthesis in prokaryotes and eukaryotes. The active holoenzyme consists of 8 large subunits (LS) and 8 small subunits (SS), both of which are required for activity. In chlorophytic plants (chlorophyll a,b), the LS gene is chloroplast DNA encoded while the SS gene is in the nucleus. However in the chromophytic (chl a,c) alga *Olisthodiscus luteus*, both subunits are coded for by chloroplast DNA (ctDNA). The proximity and arrangement of these genes (5'-LS-SS-3') are identical to that seen in blue-green algae and on the cyanelle genome from *Cyanophora*. In order to study the mechanism of synthesis of RuBPCase, we attempted to express active *O. luteus* holoenzyme in *E. coli*. Polyclonal antibodies were raised against *O. luteus* RuBPCase as well as the individual subunits. Using these antibodies, large and small subunits can be detected in *E. coli* containing *O. luteus* ctDNA. Although subunits of native size are present, most of the immunoreactive material remains insoluble under conditions where the native holoenzyme is soluble. The soluble subunits aggregate to form a complex that is easily dissociated upon density gradient centrifugation and is of higher molecular weight than the native holoenzyme. These data suggest that the constituent subunits of the *O. luteus* RuBPCase holoenzyme do not assemble spontaneously in *E. coli* (unlike the enzyme from several species of blue-green algae). The possibility and ramifications that an assembly or binding protein is required for holoenzyme synthesis will be discussed.

Notes:

CHEMICAL CHARACTERIZATION OF FLORIDOSIDES FROM *PORPHYRA PERFORATA*

Jianxin Meng, Karl-Gunnar Rosell and Lalit Srivastava, Department of Biological Sciences, Simon Fraser University, Burnaby, B.C. V5A 1S6

The chemical structures and configurations of floridoside and isofloridoside, obtained by extraction of the red alga *P. perforata*, were studied using nuclear magnetic resonance spectroscopy and gas-liquid chromatography-mass spectroscopy. Assignments of the signals in the nmr spectra were made by consideration of the previously assigned signals of related compounds and proton decoupling experiments. Both D- and L-forms of isofloridoside were found in *P. perforata*. Separation of D- and L-forms of isofloridoside was achieved on glc, this provides a simple way to quantify the three floridosides present in red algae. ^{1}H-nmr and ^{13}C-nmr can also be utilized for quantitative purposes. The ratio of D- to L-forms of isofloridoside varied in the samples analyzed.

Notes:

ORGANIZATION OF THE PHOTOSYNTHETIC APPARATUS IN *MACROCYSTIS*

Barbara M. Smith, University of California, Berkeley, California

Measurements of various structural-functional components of the photosynthetic apparatus of *Macrocystis* surface blades have been performed using isolated thylakoid membranes. The Chla/Chlc ratios of these preparations are in the range of 5 to 7. The Chl(a+c)/P700 ratios is 750+/-70 (n=14); the Chl/Cytf ratio is 315+/-50 (n=6) and the Chl/Q ratio is 360+/-70 (n=14). The apparent PSII/PSI ratio is 2.1. Detergent fractionation of the membranes has resulted in a pattern (in contrast to that of vascular plants) in which P700, hypothesized to be located in the stroma-exposed regions of the stacked thylakoid bands of brown algae, is comparatively resistant to detergent solubilization.

Notes:

PHORPHYRA YEZOENSIS PHYCOBILISOMES: A MODEL DERIVED FROM PIGMENT MUTANT STUDIES

John E. Merrill, Botany Department, University of Washington, Seattle, Washington 98195

Phycobilisomes (light harvesting pigment-protein complexes in red and blue-green algae) were isolated and compared from the wild-type and four color-variant strains of *Porphyra yezoensis* Ueda. Differences in pigmentation between strains were correlated with PBS particle sizes as measured by sedimentation rate studies and by electron microscopy. The sedimentation velocity for PBS from green-type C-32 (50% phycoerythrin [PE] loss) was slower than for intact wild-type PBS, but was equivalent to those wild-type PBS which were partially dissociated. Electron microscopic images of negatively stained PBS from low-PE strains were 15-16 nm smaller in dimension than the wild-type. Polypeptide composition of the PBS, as studied by SDS polyacrylamide gel electrophoresis, indicates a normal complement of phycobiliprotein subunits but possible alteration of "linker" polypeptides. These data are consistent with a PBS model for the wild-type consisting of a core surrounded by rods composed of 4 phyucobiliprotein disks, 2 each of hexameric phycocyanin (PC) (proximal to the core) and PE (distal to the core). Low-PE strains appear to lack the outermost PE disk due to a possible "linker" polypeptide disfunction. Continued investigation of *P. yezoensis* PBS will yield useful information concerning PBS substructure and "linker" polypeptide function in red algae.

THE PHYLOGENETIC POSITION OF *PROCHLORON*

Ralph A. Lewin, Scripps Institution of Oceanography, University of California, San Diego, La Jolla, CA 92093

No abstract.

Notes:

BIOGEOGRAPHY: AN OLD TOOL IN A NEW METHODOLOGY

Paul W. Gabrielson, Department of Botany, University of British Columbia, Vancouver, B.C. V6T 1W5

The importance of biogeography for resolving phylogenetic relationships among bentic marine red algae largely has been ignored. Historically, biogeographic studies of marine macroalgae have been floristic in scope, a comparison of the similarities and differences among lists of taxa from various localities. Whereas this has led to the recognition of broad biogeographic provinces, it has obscured patterns of distribution among related species, genera and families. The emergence of cladistics as an important methodology in systematic research has enabled us to use biogeographic patterns to independently assess proposed phylogenetic relationships based on the evolution of morphological characters. The application of this methodology will be domonstrated using genera in the red algal family Solieriaceae.

Notes:

CHLOROPLAST RIBOSOMAL RNA AS AN INDICATOR OF PLASTID EVOLUTION

Terry Delaney & Rose Ann Cattolico, Department of Botany, University of Washington, Seattle, Washington 98195

Chloroplasts are thought to have arisen from the endosymbiotic acquisition of photosynthetic organisms. The identity of these symbionts is uncertain, although cyanobacteria are likely the source of some chromophytic (chlorophyll a,c) and rhodophytic algal chloroplasts. Other chromophytic algae and the chlorophytes (chlorophyll a,b) have plastids that suggest a non-cyanobacterial origin for these organelles. Through the analysis of the appropriate macromolecular sequences one can obtain a measure of evolutionary distance between different algal plastids and their putative ancestors. Ribosomal RNAs are the macromolecules of choice for such an analysis due to their universal distribution, constancy of function, information content, and slow rate of change.

We have isolated the chloroplast rRNA genes from the chromophytic alga *Olisthodiscus luteus* and are currently determining the sequence of the 16s gene. We have already found that these genes are present on the inverted repeat region of the plastid DNA and are thus present at two copies per genome. The orientation is similar to that in higher plants where the direction of transcription is toward the small single-copy region of the genome. However, the gene complement of the genome is markedly different from that in higher plants (Reith & Cattolico, PNAS, in press). Through the sequencing of 16s rRNA genes from a variety of algal chloroplasts we intend to determine the likely history of endosymbioses in the evolution of the algae.

Notes:

CHARACTERIZATION OF THE CHLOROPLAST AND MITOCHONDRIAL GENOMES IN THE RED ALGA *GRIFFITHSIA PACIFICA*

Ning Li & Rose Ann Cattolico, Botany Department KB-15, University of Washington, Seattle, WA 98195

It is suggested that chloroplasts have arisen in a polyphyletic manner. That is, different ancestors have served as the source of the plastids which occur in extant plants. It would be instructive in the determination of evolutionary relatedness to better understand genome size, gene composition and gene organization of organellar genomes in chlorophytic, rhodophytic and chromophytic plant types. Unfortunately, to date virtually no data are available on organellar DNA of rhodophytic plants. Rhodophytic plants encompass a complex assemblage of organisms which range from unicellular species to those which have significant amounts of tissue differentiation. It is suggested (Whatley, J. 1983; Inter. Rev. Cytol. 329-373) that blue-green algae served as the ancestor for this phylogenetic group and that a rhodophytic eukaryote served as the plastid source for chromophytes. Some of the work in this laboratory has centered on the characterization of the chloroplast and mitochondrial genomes in the multicellular filamentous alga *Griffithsia pacifica.* Cells are fractionated in a buffer containing KCl, PVP, ascorbic acid and glucose, and rhodoplasts recovered after centrifugation on discontinuous sucrose gradients. Single and double restriction enzyme digests demonstrate that the rhodoplast genome size is 178 thousand base pairs (kb) and unlike most ctDNA species in other plants does not contain a large duplicated DNA fragments arranged in an inverted or tandom structure. The mitochondrial genome is composed of different sizes of DNA molecules which vary from 27 kb to 350 kb based on endonuclease restriction and electron microscope analysis. Restriction maps of these organellar genomes have been constructed and several mitochondrial and rhodoplast specific genes have been located on these physical maps.

Notes:

PATTERNS OF FEEDING IN HETEROTROPHIC DINOGLAGELLATES: *OXYRRHIS MARINA* AND *POLYKRIKOS KOFOIDII*

Gregory Gaines and F.J.R. Taylor, Department of Oceanography, University of British Columbia, Vancouver, B.C. V6T 1W5

About half of all dinoflagellate species are non-photosynthetic. Recent studies show that many of these are voracious predators on other microalgae. The mechanisms of feeding and energetic characteristics of most of these are only vaguely known. The present study involves feeding observations and measurements of two common coastal predatory dinoflagellates that can reach bloom concentrations. Feeding observations and scanning electron microscopy show elaborate feeding structures in both species, including the attachement of a contractile thread to the prey. The mechanism of *Polykrikos* is even more elaborate, involving the firing of nematocysts. Both species have potential ingestion rates of tens of prey individuals per day, depending on ambient food concentrations. These rates are analyzed with respect to the apparent mechanisms of prey capture, predator sizes, swimming characteristics and life cycles.

Notes:

ARE NUTRIENTS AT BAMFIELD LIMITING TO ALGAL GROWTH?

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Nutrients such as ammonium, nitrite, nitrate and phosphate were monitored in brown algae and in ambient seawater over a 2 year period at the Bamfield Marine Station (Vancouver Island, B.C.) *Macrocystis integrifolia* and *Nereocystis luetkeana* were the two algae analyzed. Sharp seasonal fluctuations for most of the nutrients were observed in the tissues as well as in surrounding surface waters. In general, higher values were prevailing during the winter months and lower values during the summer months. At lower depths (2-8 m) the seasonal variations diminished and increased concentrations were noticed. At 10 m depth higher values were found during the summer months compared to winter months. An extraction procedure for determination of tissue NH_4^+, NO_2^-, and NO_3^- will also be presented.

UPTAKE AND INCORPORATION OF SELENIUM: FURTHER EVIDENCE OF A SPECIFIC REQUIREMENT FOR SELENIUM IN THE MARINE DIATOM *THALASSIOSIRA PSEUDONANA* (CLONE 3H)

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An obligate requirement for selenium (Se) is demonstrated in axenic culture of the marine diatom *T. pseudonana*. Se deficiency is characterized by a reduction in growth rate, an increase in cell size and ultimately, by cessation of cell division. The addition of 1 nM selenite to artificial seawater supports excellent growth of *T. pseudonana*. Selenate fails to support growth at concentrations less than 100 nM and best growth is seen at 100 uM. Uptake of 75-Se, in the form of selenite, was measured in batch culture of *T. pseudonana*. Analysis of biochemical constituents indicates that 55-75% of the 75-Se is incorporated into protein with the remaining radioactive label appearing in the amino acid, and low molecular weight metabolite pools. There is equal partitioning of 75-Se between the soluble and membrane bound proteins. Protein separation was achieved by gel electrophoresis and 2 soluble polypeptides are found to be heavily labelled with 75-Se. Further work is in progress to elucidate the function of these proteins in *T. pseudonana*.

Notes:

EFFECTS OF SELENIUM DEFICIENCY ON THE ULTRASTRUCTURE OF THE MARINE DIATOM *THALASSIOSIRA PSEUDONANA*

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The effects of selenium deficiency on the siliceous and nonsiliceous components of the marine diatom *Thalassiosira pseudonana* (clone 3H) were examined using light and electron microscopy. Selenium deficiency induces elongation along the pervalvar axis as a result of chain formation caused by the failure of sibling cells to separate and by cell elongation via the production of numerous hyaline girdle bands. In selenium deficient cultures, cell elongation involves the blockage of both mitotic and cytokinetic components of cell division. Selenium deficiency results in ultrastructural alterations in the reticular membrane system and in mitochondrial and chloroplast membranes. Various types of inclusions are seen in vacuolar areas and the accumulation of lipid reserves is evident in selenium deficient cells. These results provide indirect evidence for a metabolic selenium requirement in this algal species.

Notes:

FACTORS AFFECTING THE METAL TOLERANCE OF *AMPHORA COFFEAEFORMIS* AGARDH

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Non-axenic cultures of *A. coffeaeformis* were more tolerant to copper and tributyltin than axenic cultures. Further experimentation showed that extra cellular products of non-axenic cultures were responsible for this increase in tolerance.

A separate study of nutrient limited growth in on-axenic cultures showed that exposure to copper resulted in an increased requirement for nitrate and phosphate. A higher requirement was also characteristic of the cultures exposed to tributyltin. The silicate requirement was not affected by exposure to metal but both copper and tributyltin decreased silicate uptake and caused lower growth rates.

Notes:

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THE PHYTOPLANKTON COMMUNITY AT ST. P IN MAY AND AUGUST, 1984

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Samples collected at St. P in May and August, 1984 from 0 to 120 m were analyzed using epifluorescence, inverted, and scanning electron microscopy in order to describe the vertical and temporal variation of the microplankton community. On the average, 1/3 of the phytoplankton biomass as carbon was in the <2um size fraction, 1/3 in the 2 to 5 um size class, and the remainder >5 um. This generalization held for both months and at all depths. The <2um class was comprised almost exclusively of *Synechococcus* with eucaryotes contributing only ~10%. The 2 to 5 um class was dominated by flagellates in May and coccoid forms in August. The 5 to 10 um class was dominated by flagellates.The 10 to 20 cm class was comprised of dinoflagellates, cryptomonads, other flagellates and diatoms. The >20 um class was comprised of diatoms and, on May 16, dinoflagellates. Following a storm event in May, a shift from biflagellates to uniflagellates was observed in the 2 to 5 um class. A number of changes in the phytoplankton community occurred between May and August: 1) A shift from flagellates to coccoid forms in the 2 to 5 um class. From their appearance in SEM these coccoid forms are assumed to be green algae, Chlorophytes, similar to *Nanochloris* species. 2) Less small diatom biomass (5 to 20 um). 3) More lare diatoms (>20 um) in August. 4) More cryptomonads and dinoflagellates (10 to 20 um).

Growth rates of the algal community were derived from estimates of total phytoplankton carbon and *in situ* primary productivity data. Growth in the upper layers was normal for the conditions of light and temperature.

A MODEL FOR THE PASSIVE DISPERSAL OF RED ALGAL SPORES

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Red algae reproduce by means of spherical, aflagellate spores which depend upon bulk water motions for their dispersal. At this time there is no theory that describes the transport of these biological particles in the chaotic environment of a rocky intertidal shore. A first step in this direction has been made by modeling algal spore dispersal as a diffusive process in a steady, unidirectional flow. Results of the model predict that the probability of an individual spore settling successfully is greatest in the immediate vicinity of the parent plant.

ENVIRONMENTAL REGULATION OF REPRODUCTION IN CONCHOCELIS OF SOME PACIFIC NORTHWEST *PORPHYRA* SPECIES

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We have investigated the effects of temperature, photoperiod and photon irradiance on conchosporangium initiation and conchospore release in five species of *Porphyra* which are native to the Pacific Northwest coast. The winter annual, *P. torta* releases conchospores in response to a short-day photoperiod and the spring and summer annual *P. perforata* releases conchospores in response to long-day photoperiods; this is the first marine red alga in which a long-day response has been observed. The epiphyte, *P. nereocystis*, in nature found only on the annual kelp *Nereocystis luetkeana* requires a dual daylength treatment (a short-day photoperiod treatment followed by a long day photoperiod treatment) to trigger conchospore release; this is the first alga in which a dual daylength response has been discovered. *P. abbottae*, found primarily in spring and summer releases conchospores in response to long days and low temperatures. In *P. pseudolanceolata* conchosporangium formation is a short day response. Discovery of these photoperiodic responses adds significantly to the number of such responses known in marine algae. Furthermore, the environmental conditions required for conchosporangium formation and/or conchospore release correlate well with the seasonal appearance of the annual blade phase of these *Porphyra* species.