8th Northwest Algal Symposium

Humboldt State University

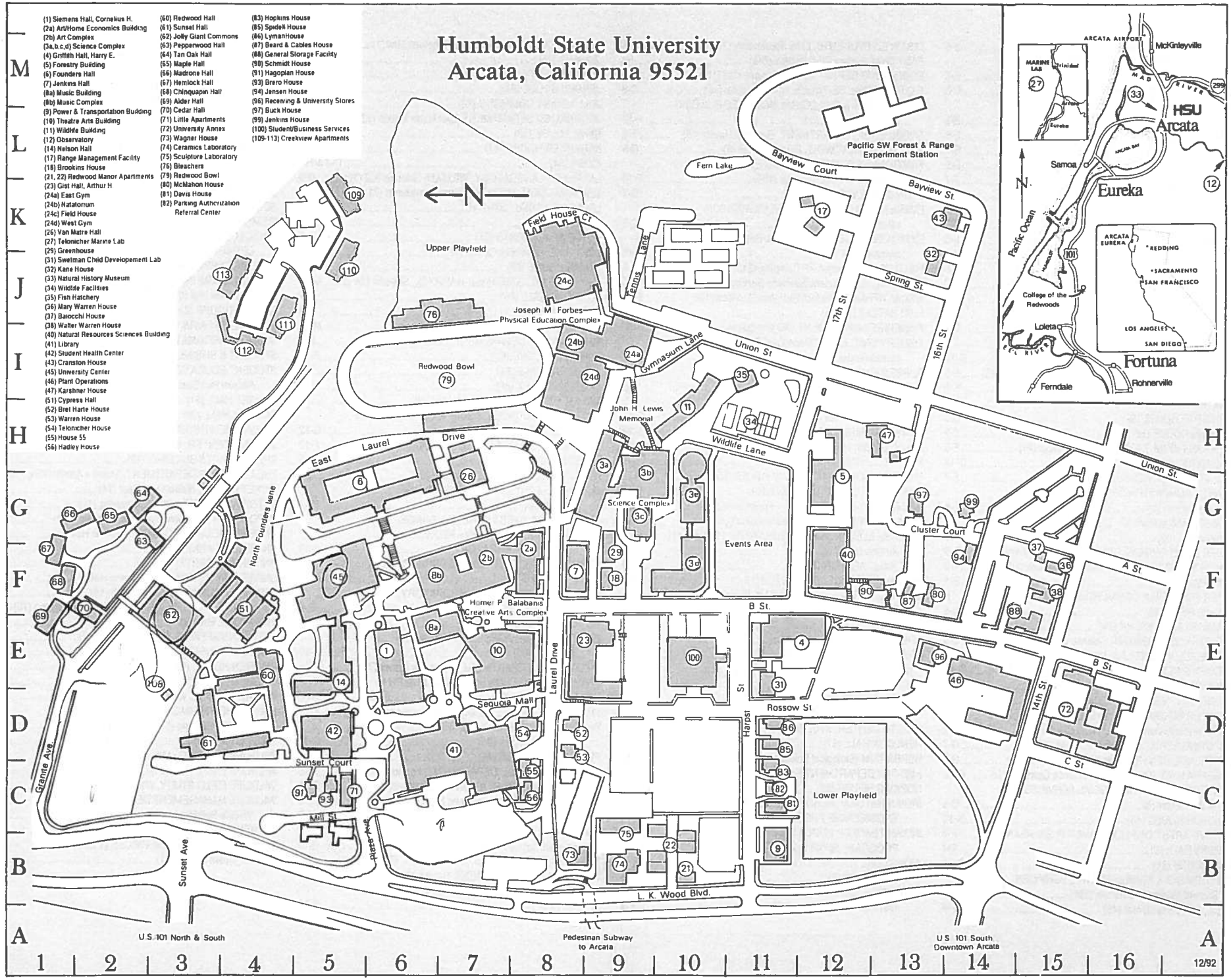
Arcata, California

1-3 April 1994

Organized by:

Bob Rasmussen

Humboldt State University
Arcata, California 95521



NWAS Schedule

FRIDAY			
1200 -		Registration and Check-in	Jolly Giant Commons
1530 -	1730	Attitude Adjustment	Jolly Giant Commons
SATURDAY			
0730 -		Breakfast	Jolly Giant Commons
0830 -		Posters	Karshner Lounge
1000 -	1230	Field trip and lunch	Library Circle
1330 -		Seaweed harvsting and management on the West Coast (Gayle Hansen)	Kate Buchanan Room
		Discussion of regulatory problems	
1430 -		*Laminaria* gametophytes in bioreactors (Greg Rorrer et al.)	Kate Buchanan Room
		Discussion of interdisciplinary research	
1530 -		Coffee break	Karshner Lounge
1600 -		Earthquake! Two years later (Bob Rasmussen)	Kate Buchanan Room
		Discussion of biodiversity and baselines	
1730 -	1830	Attitude Adjustment	Goodwin Forum
1830 -		Buffet banquet	Goodwin Forum
1930 -		Antarctica the blue-green continent (Dick Castenholz)	Goodwin Forum
SUNDAY			
0730 -		Breakfast	Jolly Giant Commons
0830 -		Business meeting	TBA

CURRENT STATUS OF SEAWEED HARVESTING AND MANAGEMENT ON THE WEST COAST OF NORTH AMERICA

Talks

Hansen, Gayle I., Thomas F. Mumford, and Eric Gilman
Oregon State Univ. and Washington Dept. of Natural Resources

With the increasing public concern for the conservation of marine life along the west coast of North America, state and provincial policies regarding seaweed harvest are being re-evaluated. The current regulations and associated problems for commercial, personal, and scientific collection of seaweeds will be summarized and discussed.

PHOTOLITHOTROPHIC GROWTH OF *LAMINARIA SACCHARINA* GAMETOPHYTE CULTURES IN STIRRED-TANK AND BUBBLE-COLUMN BIOREACTORS

Gregory L. Rorrer, Jason Modrell, Charlie Zhi, and Hans Qi, Department of Chemical Engineering, and William H. Gerwick, College of Pharmacy, Oregon State Univ., Corvallis, OR 97331.

Liquid cell suspension cultures derived from marine plants have the potential to biosynthesize novel biomedicinal compounds in a controlled environment. Of particular interest are the eicosanoid metabolites emanating from the 15-lipoxygenase manifold of the arachidonic acid cascade, which is present in the brown alga *Laminaria saccharina*. Filamentous cultures of *L. saccharina* female gametophytes were cultured in a 250 mL bubble-column bioreactor and a 1000 mL stirred-tank bioreactor under photolithotropic conditions in GP2 artificial seawater nutrient medium at 13 ^{o}C. Growth kinetics were obtained as a function of illumination intensity (1500 to 19,000 lux), air flowrate (0.2 to 2.0 vvm) and inoculum density. Initial work on isolation of eicosanoid metabolites from these cultures showed some 15-lipoxygenase activity but no presence of 15-HETE, the primary eicosanoid derived from 15-lipoxygenase oxidation of arachidonic acid. However, 18-carbon fatty acid analogs of 15-HETE were isolated.

INTERTIDAL REACTIONS AFTER A SEISMIC UPLIFT EVENT SECOND YEAR PROGRESS REPORT

Robert A. Rasmussen, Milton Boyd, Eric Justesen, Steve Kalloger, Natalie Cosentino, and Mike Richey. Dept. of Biological Sciences. Humboldt State University. Arcata, CA 95521

Two years after the intertidal zone at Mussel Rock, Humbopldt Co. CA was lifted 140 cm many changes are still taking place. Many organisms held on longer than anticipated. Reestablishment of some species has been set back several times, resulting in secondary succession patterns. The susceptibility of juveniles is clearly important in establishing intertidal ranges. The presence of successful settlers eases the way for more growth. The lack of established baslines and standard techniques posed some problems in the research.

Reproductive ecology of clumps of *Chondrus crispus* (Rhodophyta, Gigartinales) from Nova Scotia, Canada.

Ricardo Scrosati, The University of British Columbia, Dept. of Botany, Vancouver, BC V6T 1Z4, Canada (<scrosati@unixg.ubc.ca>), David Garbary, St. Francis Xavier University, Dept. of Biology, Antigonish, NS B2G 1C0, Canada, and Jack McLachlan, Acadia University, Dept. of Biology, Wolfville, NS B0P 1X0, Canada. Funding from CIDA-WUSC is gratefully acknowledged.

The reproductive ecology of clumps of *Chondrus crispus* Stackhouse was studied in an intertidal population at Tor Bay, NS, Canada, between June and October 1991. Two reproductive periods were distinguished based on mean diameter of cystocarps and the number of cystocarps and tetrasporic sori per g of frond. Based on lab observations, the pattern of daily spore release was very variable among months. Spore viability varied between monthly means of 4-16% for carpospores and 6-26% for tetraspores. Variation of spore viability also occurred among cystocarps and tetrasporic sori on the same frond as well as among different fronds. Such variation provides additional levels of complexity that need to be explored further in order to fully understand the reproductive success of this and other seaweed species. In addition, the relationship between frond density and clump biomass density within 51 reproductive clumps was analyzed in a log-log plot. No evidence of self-thinning was found, since both variables were significantly positively correlated. Higher frond densities could favour increased water retention during low tides, thus contributing to higher rates of biomass production. This positive relationship seems to be common among seaweeds with a similar thallus morphology.

TENDRILS AND HOOKS: PATTERNS OF VEGETATIVE REPRODUCTION IN TWO SUBTIDAL RHODOPHYTES IN STILLWATER COVE, CALIFORNIA

J.W. Downing, Moss Landing Marine Laboratories
Moss Landing, CA

Beneath the giant kelp canopy in Stillwater Cove, *Plocamium cartilagineum* and *Laurencia subopposita* are most abundant in mats of geniculate coralline algae. They seldom occur on vertical surfaces or under *Pterygophora* canopies. *Laurencia* appears to reproduce vegetatively by entwining tendrils around host plants. No such mechanism has been described for *Plocamium*, although its branches are often outcurved or hooked. Fragments with this and the normal incurved morphology are commonly observed free floating or entangled in coralline algal mats. Most fragments held captive in the field grew to adult size within 8 months, confirming viability. A comparison of vegetative recruitment on coralline algal mimics and flat substrata in various habitats showed higher recruitment on the mimics, especially on horizontal surfaces without canopies. Viewed with information on reproductive phenology and spore production, these results suggest that vegetative reproduction drives the observed patterns of distribution and abundance of these species in Stillwater Cove.

Acclimation to ultraviolet radiation exposure in cyanobacterial mat communities of Yellowstone National Park

Stephan D. Brenowitz and Richard W. Castenholz, Department of Biology, University of Oregon, Eugene OR 97403

The purpose of this study was to examine the process of adaptation to high levels of solar ultraviolet (UV) radiation in two cyanobacterial mat communities present in Yellowstone National Park. The communities consisted of essentially monospecific mats of two species of the genus *Calothrix*, one of which produces scytonemin and the other which does not. Scytonemin is a sheath pigment known to protect cyanobacteria from exposure to incident solar radiation in the UV portion of the spectrum. Mats were maintained in the field under a set of filters which excluded different portions of the incident solar radiation. The mats were studied over a two month period to observe the effects of these light treatments on pigment composition and photoinhibition of photosynthesis.

Both types of *Calothrix* mat adapted to full sunlight showed enhancement of photosynthetic rates when UV was excluded during experimental incubations. When acclimated to full sunlight, enhancement of photosynthesis under UV exclusion was less pronounced in the scytonemin-producing *Calothrix* mat than in the scytonemin-lacking mat. Photoinhibition studies of both mat types showed that cells growing for one month under a UV-excluding filter were more tolerant of UV radiation than were cells grown under full solar radiation. However, after two months of incubation under UV-excluding filters this trend was reversed, with photosynthesis in UV-protected cells showed greater sensitivity to UV inhibition. In the scytonemin-producing mat, scytonemin production was greatest under UV excluding filters. The results suggest that the initial effect of shielding *Calothrix* from UV radiation is increased vigor resulting from alleviation of UV stress. Continued shielding from UV, however, produces cells that become more sensitive to UV inhibitory effects.

The Impact of Ultraviolet Radiation on Photosynthesis in Two Hot Spring Microbial Mat Communities

Scott R. Miller and Richard W. Castenholz
Department of Biology, University of Oregon

Hot spring cyanobacterial mat communities at Octopus Spring (OS) in Yellowstone National Park, Wyoming and at Hunter's Hot Springs (HHS) in eastern Oregon are seasonally subjected to high fluxes of ultraviolet radiation, both in the UV-A (320-400 nm) and the UV-B (285-320 nm) wavebands. To assess the relative importance of UV-A and UV-B in the inhibition of photosynthetic activity in these communities, *in situ* assays of photosynthesis, measured as the light dependent uptake of radioactive bicarbonate, were performed during the summer of 1993. Unacclimated cyanobacterial suspensions were inoculated in quartz tubes and then exposed to a set of modified UV/light environments provided by screening filters which discriminate against selected wavebands. Knowledge of the transmission properties of the filters allowed for analysis of bicarbonate uptake data with multiple regression techniques. Two studies at HHS and one at OS suggest that UV-A is a particularly effective inhibitor of photosynthesis in these systems, which indicates that these cyanobacteria have not fully adapted to the high levels of ultraviolet radiation they experience in nature.

A demographic study of seaweeds at Titlow Beach, Tacoma, Washington

Bryce A. Maxell and Kathy Ann Miller
University of Puget Sound
Tacoma, Washington

The demographic characteristics of the sporophytes of two annual phaeophycean algae, the canopy-forming kelp *Nereocystis luetkeana* (Mertens) Postels et Ruprecht and the understory kelp *Costaria costata* (C.A. Agardh) Saunders , were described, compared, and analyzed for a subtidal community in the Puget Sound. The study site, located at Titlow Beach, on the west side of Tacoma, Washington (47° 15' N, 122° 33' W), is a shallow, estuarian environment with a mixed sand and cobble substrate that is exposed to swift tidally generated currents. SCUBA was used to monitor recruitment, growth, survival, and mortality rates throughout 1993; biomass allocation was assessed in July and September. The density of three additional species of brown seaweeds inhabiting the study area was assessed monthly. We hypothesized that demographic characteristics of the sporophytes of *Nereocystis* and *Costaria* at our site would be different from those reported in populations inhabiting coastal waters. We also hypothesized that the unstable substrate at our site would lead to relatively higher mortality rates than those reported at sites with stable substrates. Juvenile *Nereocystis* and *Costaria* were first observed between the 8th and 26th of March and continued to recruit until the middle of June. *Nereocystis* stipe growth rates peaked (~ 5 cm/day) at the beginning of July and then declined, while blade growth rates increased (to 6 cm/day) through the middle of September. *Costaria* blade growth declined from ~ 2 cm/day in late May until growth ceased in mid-August. *Nereocystis* first went reproductive in the first week of May; 85% of the population was fertile by the first week of July. Reproductive *Costaria* were first observed on the 22nd of June; 83% were fertile by the first week of August. Between the 15th of July and the 4th of September, a significant increase in biomass allocated to soral tissue and stipe was measured in *Nereocystis* and a significant decrease in vegetative blade area in *Costaria*. All *Nereocystis* were gone by the end of November and all *Costaria* by the end of December. Trends in densities of phaeophycean seaweeds were strongly correlated with photoperiod from February 1993 to February 1994.

Foster, M.S. Moss Landing Marine Labs, P.O. Box 450, Moss Landing, Ca. 95039. PHYCOBOTANICAL ECOLOGY: RESEARCH AT MOSS LANDING. The phycology group at Moss Landing is involved in a number of studies including the causes of the shallow limit of Macrocystis, the ecology of the microscopic stages of Desmarestia, the effects of light and thallus orientation on pigmentation in Bossiella, interactions between kelp canopies and understory vegetation, the population ecology of limpets living on Pterygophora, and the effects of mycorrhizae on dune plant growth. These studies will be summarized to inform, and to facilitate criticism and discussion.

Genetic relationships in a population of *Nereocystis luetkeana* in Puget Sound: inferences from DNA fingerprinting

Kathy Ann Miller , Bryce Maxell, Rachel Squillace and Brian Nelson
University of Puget Sound
Tacoma, Washington

We are using multilocus DNA fingerprinting with the M13 probe to study genetic relationships within a population of *Nereocystis luetkeana* (Mertens) Postels et Ruprecht in southern Puget Sound. To date, we have analyzed individuals from three localities along a 3 km transect, and find that similarities (percent shared bands in the 20-6 kb range) within and between localities are statistically indistinguishable, indicating that these individuals are part of the same effective population. We interpret this as evidence of long distance dispersal via the strong tidal currents characteristic of this site. All individuals share two adjacent bands at 6.0 and 6.2 kb; we wonder whether these bands are specific to the population. Currently, we are increasing our sample size and comparing our population with individuals from Hernando, British Columbia. We are also testing the hypothesis that soral abscission and sinking at times of low tidal flow promote local recruitment. We have sampled plants on a smaller scale (60 m transects), both along and perpendicular to the predominant flow of the current, and are comparing the degrees of similarity (genetic relationship) among individuals as a function of proximity and in relation to the direction of water motion, and, presumably, dispersal.

The effects of light, temperature, and salinity on the growth and photosynthesis of *Ulva fenestrata*

Jennifer King and Kathy Ann Miller
University of Puget Sound
Tacoma, Washington

Ulva fenestrata Postels et Ruprecht is a low to mid-intertidal green alga found in many of the mudflats of the Puget Sound. The physical features (light intensity, temperature, and salinity) of the Nisqually Reach (southern Puget Sound) were measured during June, July, and August 1993, when *Ulva* is most abundant. *Ulva* tissue disks were tested in the laboratory using the range of conditions measured in the field. Growth and photosynthesis have and will be measured at six light levels, seven salinities, and four temperatures. Results thus far have shown that optimal growth occurs at light levels above 70 $uE\ m^{-2}\ s^{-1}$ and at salinity levels between 30 to 35 ppt. *Ulva* exhibits broad physiological tolerances, but changes in light and salinity seem to be the major factors affecting its seasonal growth.

Neighborhood effects in high intertidal algae : Interference and Protection by *Mazzaella cornucopiae*

Jeong Ha Kim and Robert E. De Wreede. Department of Botany, University of British Columbia, Vancouver, B.C., Canada.

A turf-forming red alga, *Mazzaella cornucopiae* (=*Iridaea cornucopiae*) and two fucoids, *Fucus distichus* and *Pelvetiopsis limitata*, have been studied on the west coast of Vancouver Island, B.C. The experiment was conducted to investigate potential interactions among the three algal species by monitoring microhabitats at the individual plant level for two years. Results indicated that recruitment of both fucoids within *M. cornucopiae* turf is low, probably because the turf prevents settlement of zygotes or interferes with germination. However, once the fucoids have germinated, survivorship of the recruits shows different species specific patterns. The patterns also vary with the microhabitat gradient from turf to edge to open space. For *F. distichus,* longevity respectively goes from low to high to intermediate. In contrast, longevity of *P. limitata* at all sites is similar. A possible reason for high longevity of *F. distichus* individuals at edge microhabitats may be that these sites have one side open to light and nutrients and another side that buffers them from desiccation and wave impact. *Pelvetiopsis limitata* is apparently more tolerant of the presumably darker, nutrient deplete conditions in the turf and also is relatively stronger to desiccation and wave impact than *F. distichus*. The different responses of these fucoids to the effects of *M. cornucopiae* may be a key factor in structuring this intertidal algal community.