The 13th Northwest Algal Symposium

May 14-16, 1999 Yachats, Oregon

PREVIOUS NORTHWEST ALGAL SYMPOSIA

1st	1984 Nov 10-12	Friday Harbor Labs, UW, Friday Harbor, WA	Hansen
2nd	1985 Mar 27-31	Bamfield Marine Station, WCUMBS, Bamfield, BC	Foreman, Hansen
3rd	1987 Oct 9-12	Oregon Institute of Marine Biology, UO, Charleston, OR	Lippert
4th	1989 Mar 24-26	Walla Walla College Marine Station, Rosario Beach, WA	Dixon
5th	1990 Oct 5-7	Walla Walla College Marine Station, Rosario Beach, WA	DeWreede, Dixon
6th	1992 Mar 20-22	Oregon Institute of Marine Biology, UO, Charleston, OR	Wood, Henry
7th	1993 Apr 9-11	Ft. Worden State Park, Port Townsend, WA	Waaland, Mumford
8th	1994 Apr 1-3	Humboldt State University, Arcata, CA	Rasmussen
9th	1995 Mar 31-Apr 2	Walla Walla College Marine Station, Rosario Beach, WA	Hawkes, Dixon
10th	1996 Mar 15-17	Oregon Inst. of Marine Biology, UO, Charleston, OR	Adamson
11th	1997 May 9-11	University of Victoria, Victoria, BC	Lucey, Barraclough
12th	1998 May 29-31	Camp Casey, Whidbey Island, WA (with the Pacific Estuarine Research Society)	Mueller-Parker (Strom, Bulthuis)
13th	1999 May 14-16	Adobe Resort, Yachats, OR (OSU)	Hansen, Apple

13TH NORTHWEST ALGAL SYMPOSIUM

May 14-16, 1999 Yachats, Oregon

Co-Hosts, Gayle Hansen and Martha Apple

We would like to thank the following people and organizations
for their assistance in meeting preparation:

Cover Illustration and Cups: June Mohler
Program Printing & Projection Equipment: HMSC
Projectionists: June Mohler, Nobu Kawasaki, Jan Conitz
WEB Page: James Gallagher & Dann Cutter
Housing and Meals: Adobe Resort, Yachats, OR

SCHEDULE

Friday, May 14

06:00–07:30 pm	Registration and Poster Set-Up	Cape Perpetua Room
07:30–07:40 pm	Welcome and Agenda	Cape Perpetua Room
07:40–09:00 pm	Plenary Session	Cape Perpetua Room
09:00 pm–on	No-Host Mixer	Lounge

Saturday, May 15

06:00–09:00 am	Continental Breakfast	Pacific Room
06:15–09:00 am	Field Trip (7:30 am tide)	Strawberry Hill
09:00–10:30 am	Session 1	Cape Perpetua Room
10:30–11:00 am	Coffee/Tea Break	Cape Perpetua Room
11:00–12:45 pm	Session 2	Cape Perpetua Room
01:00–02:30 pm	Buffet Lunch	Pacific Room
02:30–04:00 pm	Session 3	Cape Perpetua Room
04:00–05:30 pm	Coffee/Tea Break and Poster Viewing.	Cape Perpetua Room
05:00–05:30 pm	Business Meeting	Cape Perpetua Room
05:30–06:30 pm	No-Host Mixer	Lounge
06:30–07:30 pm	Buffet-Style Banquet	Pacific Room
07:30–08:30 pm	After Banquet Talk	Pacific Room
08:30–09:00 pm	Student Awards and Auction	Pacific Room

Sunday, May 16

06:00–09:00 am	Continental Breakfast	Pacific Room
06:15–09:00 am	Field Trip (8:00 am tide)	Seal Rock
09:00–10:30 am	Session 4	Cape Perpetua Room
10:30–11:00 am	Coffee/Tea Break (Room Check-out)	Cape Perpetua Room
11:00–01:00 pm	Session 5	Cape Perpetua Room
01:00 pm	Concluding Remarks & Poster Removal	Cape Perpetua Room

PROGRAM

Friday May 14

6:00–7:30 pm	**Registration and Poster Set-up**	**Cape Perpetua Room**
7:30–7:40 pm	**Welcome and Agenda**	**Gayle Hansen and Martha Apple**
7:40–9:00 pm	**Plenary Session.** Gayle Hansen, moderator.	**Cape Perpetua Room**
7:40–8:20 pm	MOLECULAR SYSTEMATICS OF RED ALGAE BASED ON DNA SEQUENCE ANALYSIS: AN OVERVIEW. **Suzanne Fredericq**, University of Southwestern Louisiana, Lafayette, LA	
8:20–9:00 pm	BROWN ALGAL SYSTEMATICS: A MOLECULAR ASSESSMENT OF INTER-ORDINAL TO INTERSPECIFIC CONCEPTS. **Naomi Phillips**, University of Southwestern Louisiana, Lafayette, LA	
9:00 pm–on	**No-host Mixer in the Lounge.**	

Saturday May 15

6:00–9:00 am	**Continental Breakfast**	**Pacific Room**
6:15–9:00 am	**Field Trip (using individual cars): 7:30 am tide**	**Strawberry Hill**
9:00–10:30 am	**Session 1.** Martha Apple, moderator.	**Cape Perpetua Room**
9:00–9:15 am	ECOLOGICAL PHYSIOLOGY OF *PORPHYRA*: RESPONSE OF *P. TORTA* GAMETOPHYTES TO NITRATE, SALINITY AND INORGANIC CARBON IN CULTURE. **Jan M. Conitz*[1], Robert Fagen[1], Sandra C. Lindstrom[2], G. Gerald Plumley[3], Michael S. Stekoll[1].** [1]School of Fisheries and Ocean Science, University of Alaska Fairbanks, Juneau Center. [2]Dept. of Botany, University of British Columbia, [3]Institute of Marine Science, University of Alaska Fairbanks.	
9:15–9:30 am	PHOTOBIOREACTOR CULTIVATION OF *AGARDHIELLA SUBULATA* REGENERATED MICROPLANTLETS. **Yao-ming Huang* and Gregory L. Rorrer.** Dept. of Chemical Engineering, Oregon State University.	
9:30–9:45 am	PHYTOPLANKTON AND NUTRIENT DYNAMICS IN THE YORK RIVER ESTUARY, VIRGINIA: ANALYSES OF LONG TERM DATA. **Yongsik Sin*[1] and Richard L. Wetzel[2].** [1]Coastal Ecology Branch, US EPA, and [2]Virginia Institute of Marine Science, School of Marine Science, College of William and Mary.	
9:45–10:00 am	DOC RELEASE BY PHYTOPLANKTON: A COMPARISON BETWEEN BATCH AND CONTINUOUS CULTURES. **Nobuyaki Kawasaki* and Patricia A. Wheeler**. College of Oceanic and Atmospheric Sciences, Oregon State University.	
10:00–10:15 am	AN ECOLOGICAL BASIS FOR EXTRACELLULAR CARBONIC ANHYDRASE IN MARINE UNICELLULAR ALGAE. **Louis Hobson* and Christine Hanson**. Dept. of Biology, School of Earth & Ocean Sciences, University of Victoria, Victoria, B. C.	

10:15–10:30 am	DEPRESSION OF PHYTOPLANKTON CONCENTRATIONS OVER OYSTER GROUNDS. **Kathleen A. Sayce*[1] and Anne C. Sigleo[2].** [1]Shoalwater Botanical and [2]Coastal Ecology Branch, Western Ecology Division, US EPA.	
10:30–11:00 am	**Coffee/Tea Break**	**Cape Perpetua Room**
11:00–12:45 pm	**Session 2.** Brian Oates, moderator.	**Cape Perpetua Room**
11:00–11:15 am	A RE-INVESTIGATION OF THE ULTRASTRUCTURE OF *GLAUCOCYSTIS NOSTOCHINEARUM* USING CRYO-FIXATION AND FREEZE-SUBSTITUTION TECHNIQUES. **Brian R. Oates* and Kathleen M. Cole.** Dept. of Botany, University of British Columbia.	
11:15–11:30 am	*ANABAENA* IN THE NORTHWEST: A TALE OF PLASTICITY. **Charles R. Williams*, Brock Peters, and J. R. Waaland.** Dept. of Botany, University of Washington.	
11:30–11:45 am	*CHROMULINA FREIBURGENSIS* IN THE BERKELEY PIT LAKE WATER SYSTEM. **Sarah Dakel and Grant G. Mitman.** Biology Dept., Montana Tech of the University of Montana.	
11:45–12:00 noon	SCYTONEMIN, A CYANOBACTERIAL SHEATH PIGMENT, PROTECTS AGAINST UVC RADIATION: IMPLICATIONS FOR EARLY PHOTOSYNTHETIC LIFE. **Jesse G. Dillon* and Richard W. Castenholz.** Dept. of Biology, University of Oregon.	
12:00–12:15 pm	THE ROLE OF SULFURIC ACID IN THE ECOLOGY OF THE BROWN ALGA *DESMARESTIA MUNDA*.. **Karen Pelletreau.** Shannon Point Marine Center, Western Washington University.	
12:15–12:30 pm	CHEMOSENSORY AND FEEDING RESPONSES OF THE NUDIBRANCH *AEOLIDIA PAPILLOSA* (L.) TO THE SEA ANEMONE *ANTHOPLEURA ELEGANTISSIMA* (B.) SYMBIOTIC WITH TWO ALGAE. **Barbara F. Emerson-Seavy**, Biology Dept., Western Washington University.	
12:30–12:45 pm	VARIATION IN MACROPHYTE SIZE AND ABUNDANCE: A NUTRIENT EFFECT? **Tess L. Freidenburg*, Gary W. Allison, and Bruce Menge.** Dept. of Zoology, Oregon State University	
1:00–2:30 pm	**Buffet Lunch**	**Pacific Room**
2:30–4:00 pm	**Session 3.** Bruce Menge, moderator	**Cape Perpetua Room**
2:30–3:00 pm	PISCO: A CONSORTIUM FOR LONG-TERM, MULTI-SCALE ECOLOGICAL RESEARCH IN THE NEARSHORE ECOSYSTEM. **Bruce Menge* and Jane Lubchenco.** Dept. of Zoology, Oregon State University.	
3:00–3:15 pm	KELP BIOMASS ESTIMATES OFF THE OREGON COAST AND RELATED RESEARCH BY THE OREGON DEPARTMENT OF FISH AND WILDLIFE. **Jim Golden*, Dave Fox, and Arlene Merems.** Marine Resources Program, Oregon Dept. of Fish and Wildlife at the Hatfield Marine Science Center.	
3:15–3:30 pm	FALSE COLOR NEAR-INFRARED VS. NATURAL COLOR AERIAL PHOTOGRAPHY FOR MAPPING INTERTIDAL VEGETATION IN PACIFIC NORTHWEST ESTUARIES. **David T. Specht*[1], David R. Young[1], Bradley D.**	

Robbins[1], Henry Lee II[1], and Patrick J. Clinton[2]. [1]Coastal Ecology Branch, Western Ecology Division, US EPA, and [2]OAO Corporation.

3:30–4:00 pm — M/V NEW CARISSA GROUNDING INCIDENT: CASE HISTORY AND DAMAGE ASSESSMENT FOR LIVING MARINE AND ESTUARINE RESOURCES. **Steve Rumrill**. South Slough National Estuarine Reserve.

4:00–5:30 pm — **Coffee/Tea Break and Poster Viewing.** — **Cape Perpetua Room**

Posters:

A POSSIBLE OSMOREGULATORY ROLE OF OXYLIPINS IN RHODOPHYCEAE. **William H. Gerwick[1] Mary Ann Roberts*[1], Alexandra Vulpanovici[2], and David L. Ballantine[2].** [1]College of Pharmacy, Oregon State University and [2]Dept. of Marine Sciences, University of Puerto Rico.

THE BENTHIC MARINE ALGAE OF ALASKA: A PRELIMINARY REPORT ON THE INVENTORY OF EXISTING COLLECTIONS. **Gayle I. Hansen*[1] and Sandra C. Lindstrom[2].** [1]Hatfield Marine Science Center, Oregon State University, and [2]Dept. of Botany, University of British Columbia.

EFFECTS OF ELEVATED TEMPERATURE AND UV-B RADIATION ON ZOOXANTHELLAE *IN HOSPITE* AND EXPELLED FROM THE TROPICAL SEA ANEMONE *AIPTASIA PALLIDA*. **Erin Macri*, Gisele Muller-Parker, Suzanne Strom, Jack Hardy, Jason Berger, Dan Bostrom, Troy Markus, Steve McKagan, and Brandi Wallace.** Shannon Point Marine Center, Western Washington University.

MICROCYSTIS SPECIES AND STRAIN DIVERSITY IN NORTHWEST LAKES USING THE PHYCOCYANIN OPERON. **Brock Peters*, Charles R. Williams, and J. R. Waaland.** Dept. of Botany, University of Washington.

THE EFFECTS OF ELEVATED UV-B RADIATION ON PRODUCTIVITY AND BLEACHING OF ZOOXANTHELLAE IN THE CORAL *MONTASTRAEA FAVEOLATA*. **Trevor Rivers*, Erin Macri, Adrienne Miller, and Gisele Muller-Parker.** Shannon Point Marine Center, Western Washington University.

AN INSTRUCTIONAL LABORATORY EXERCISE USING *CHLORELLA* VIRUS. **Kristin Rorrer.** Dept of Microbiology, Oregon State University.

CHANGES IN OPTICAL REFLECTANCE AND PIGMENTATION OF THE CORAL *MONTASTRAEA FAVEOLATA* IN RESPONSE TO ELEVATED TEMPERATURE AND ULTRAVIOLET RADIATION. **Carl Schmidt*, Teresa Steely*, John Hardy, Suzanne Strom, Maria Bynagle, Emily Peterson.** Shannon Point Marine Center, Western Washington University.

DATABASE: THE MARINE MACROPHYTES OF THE NORTHEAST PACIFIC. **Thomas B. Widdowson**. Victoria, BC.

5:00–5:15 pm — **Business Meeting** — **Cape Perpetua Room**

5:30–6:30 pm — **No-Host Mixer** — **Lounge**

6:30–7:30 pm — **Buffet-Style Dinner** — **Pacific Room**

7:30-8:30 pm — **SEAWEED SENSATIONS. Bob Waaland, UW** — **Pacific Room**

8:30–9:00 pm — **Student Awards and Auction** — **Pacific Room**

Sunday May 16

6:00–9:00 am	**Continental Breakfast**	**Pacific Room**
6:00–9:00 am	**Field Trip (using individual cars): 8: 00 am tide**	**Seal Rock**
9:00–10:30 am	**Session 4.** Pat Wheeler, moderator.	**Cape Perpetua Room**
9:00–9:30 am	NUTRIENT-LIMITED GROWTH AND SOURCES OF NUTRIENTS FOR CORAL REEF MACROALGAE. **Scott Larned.** Coastal Ecology Branch, Western Ecology Division, US EPA.	
9:30–10:00 am	SEQUESTERING OF IRON IN MARINE AND ESTUARINE ECOSYSTEMS BY MARINE MACROALGAE. **Patricia A. Wheeler* and Mariachiara Naldi.** College of Oceanic and Atmospheric Sciences, Oregon State University.	
10:00–10:15 am	HOW CALCIFICATION IMPROVES NUTRIENT UPTAKE. **Ted McConnaughey.** Selah, WA.	
10:15–10:30 am	WHAT'S HAPPENING TO THE WORLD'S CORAL REEFS? **Ted McConnaughey.** Selah, WA.	
10:30–11:00 am	**Coffee/Tea Break** (and Room Check-out)	**Cape Perpetua Room**
11:00 am–1:00 pm	**Session 5.** Grant Mitman, moderator.	**Cape Perpetua Room**
11:00–11:30 am	OBSERVATIONS ON THE OCEANOGRAPHY, NUTRIENT DYNAMICS AND PRIMARY PRODUCTION OF WASHINGTON STATE COASTAL ESTUARIES. **Jan Newton.** Washington State Dept. of Ecology and University of Washington.	
11:30-11:45 am	BIOLUMINESCENCE SIGNALS FROM *PYROPHACUS STEINII*. **A. Michelle Wood*[1,2], D. Nielson[2], D. Young[2], and James Case[3].** [1]Dept. of Biology, University of Oregon, [2]Office of Naval Research, Stennis Space Center, and [3] Marine Science Institute, University of California at Santa Barbara.	
11:45–12:00 noon	EXTINCT DISCOASTERS ARE RECENT MARINE DINOFLAGELLATES. **Rita Horner.** School of Oceanography, University of Washington.	
12:00–12:15 pm	DECEW'S GUIDE TO THE MARINE ALGAE: AN INTRODUCTION AND PROGRESS REPORT. **Robert A. Rasmussen*[1], Paul C. Silva[2] and Richard L. Moe[2].** [1]Dept. of Biological Sciences, Humboldt State University, and [2]The Herbarium, University of California at Berkeley.	
12:15–12:30 pm	PHLOROTANNIN PRODUCTION BY KELP GAMETOPHYTES. **Kathryn Van Alstyne*, Karen Pelletreau, Hilmar Stecher, and Elizabeth Sanchey.** Shannon Point Marine Center, Western Washington University.	
12:30–1:00 pm	The Grant Finale: A BIOLOGICAL SURVEY OF THE BERKELEY PIT. **Grant G. Mitman.** Biology Dept., Montana Tech of the University of Montana.	
1:00 pm	**Concluding Remarks & Poster Removal**	**Cape Perpetua Room**

ABSTRACTS

ECOLOGICAL PHYSIOLOGY OF *PORPHYRA*: RESPONSE OF *P. TORTA* GAMETOPHYTES TO NITRATE, SALINITY AND INORGANIC CARBON IN CULTURE.

Jan M. Conitz*, Robert Fagen, Sandra C. Lindstrom, F. Gerald Plumley, Michael S. Stekoll. University of Alaska Fairbanks, Juneau Center, School of Fisheries & Ocean Science (JMC, RF, MSS); University of British Columbia, Dept. of Botany (SCL); University of Alaska Fairbanks, Institute of Marine Science (FGP).

Porphyra torta, a candidate species for mariculture in Alaska, occurs along mainly the outer coast of Southeast Alaska, suggesting that physical factors differing between inside and outside coastal waters control its distribution and growth. To answer questions about environmental limits to growth, and under what conditions this species could be cultivated outside of its natural range, growth and phycoerythrin concentration were compared in juvenile gametophytes grown under "normal" concentrations of nitrate (88 µmol L^{-1}), salinity (30 ppt), and inorganic carbon (2.0 mmol L^{-1}) and in media reduced in nitrate (2.2 µmol L^{-1}), salinity (15 and 7.5 ppt) and/or inorganic carbon (1.0 and 0.5 mmol L^{-1}). Blade growth rates were modeled from weekly measurements of blade area using two-stage or derived variable analysis. Phycoerythrin concentration was determined spectrophotometrically from aqueous extracts and compared using ANOVA. Low nitrate had a significant, negative effect on both growth and phycoerythrin concentration. Blades exposed to low nitrate for 2, 4 and 6 weeks regained growth rates and pigment concentrations comparable to or higher than those in unexposed blades, when returned to normal growth media (nitrate = 88 µmol L^{-1}, salinity = 30 ppt, inorganic carbon = 2.0 mmol L^{-1}) for 10 days. *P. torta* blades appear to be tolerant of levels of salinity and inorganic carbon as low as those found in most inside coastal waters of Southeast Alaska.

Posters

THE TRANSPORT AND DISTRIBUTION OF THE TOXIC DIATOM *PSEUDONITZSCHIA* IN THE COOS BAY ESTUARY AND THE ADJACENT CONTINENTAL SHELF.

Chris Cziesla, Oregon Institute of Marine Biology, Charleston, OR 97420

Harmful algal blooms have been documented on the west coast of the United States repeatedly during the last century. The threat to fishery resources and human health have been illustrated by a multitude of events. Since the initial documentation in Prince Edward Island, Canada in 1987, outbreaks of the toxic diatom *Pseudonitzschia* spp., have been implicated in human and marine mammal deaths, as well as fishery closures. Along the Oregon coast blooms of *Pseudonitzschia* have been an almost annual occurrence since monitoring began in the late 80's.

This study looks at the distribution of *Pseudonitzschia* in relation to the meteorological and oceanographic conditions. A series of nearshore transects were done in 1995-98 under a variety of oceanographic conditions. Within Coos Bay transects were made to determine the extent of bloom penetration into the bay, where potentially sensitive shellfish beds are located. An intense sampling program was undertaken in June 1998, with simultaneous nearshore and in bay (Coos Bay) sampling, including a nearshore grid, 24 hour fixed station in the bay, and an in bay incoming tide drift study.

The results suggest that blooms develop nearshore after upwelling events. In conditions of relaxed upwelling highest cell concentrations are found up against the coast in surface and mid depth waters. Nutrient concentrations were low in surface waters and increased with depth below the seasonal pycnocline. At stations in Coos Bay, *Pseudonitzschia* concentrations increased with the incoming tide. Nearshore phytoplankton populations are transported into the bay, initially in the more saline bottom waters, but were rapidly mixed throughout the water column by the turbulent flow in the channeled bay. On ebbing tides there was a reduced number of phytoplankton in the water column, possibly indicating consumption by in bay filter feeders.

CHROMULINA FREIBURGENSIS DOFL. IN THE BERKELEY PIT LAKE WATER SYSTEM

Sarah M. Dakel* and Grant G. Mitman. Department of Biological Sciences, Montana Tech of the University of Montana, Butte, MT.

A preliminary experiment was conducted with a set of one-liter aspirator bottles containing unfiltered, unsterilized samples from the Berkeley Pit Lake Water System. Eight bottles were used, and no replicates were included. Four of these bottles were aerated, and four were not. In each set of four, one bottle was treated with nutrients, one with an organic carbon source, one with both, and the final bottle with no additions. During a three month period in a culture chamber at a photo fluence rate of 100 $u$mol m^{-2} s^{-1}, a species of Chrysophyta—*Chromulina freiburgensis* Dofl. was isolated. This species reached a maximum population of 1.04×10^7 cells/ml. This abundant population could have bioremediative potential due to the possibility of adsorbing or absorbing metals, or producing large amounts of organic carbon for heterotrophs, which could in turn raise the pH of the water. Although these results are only preliminary, a more complete experiment is planned. The same principle will be applied by setting up an experimental matrix, including replicates.

SCYTONEMIN, A CYANOBACTERIAL SHEATH PIGMENT, PROTECTS AGAINST UVC RADIATION: IMPLICATIONS FOR EARLY PHOTOSYNTHETIC LIFE

Jesse G. Dillon and Richard W. Castenholz. Department. of Biology, University of Oregon, Eugene, Oregon 97403-1510, USA

During the Precambrian, ultraviolet radiation reaching the Earth's surface, including UVC wavelengths (190-280 nm), was considerably higher than present due to the lack of absorbing gases (e.g. O2, O3) in the atmosphere. High UV flux would have been damaging to photosynthetic organisms exposed to solar radiation. Nevertheless, fossil evidence indicates that cyanobacteria-like ancestors may have evolved as early as 3.5 x 109 yr ago, and were common in shallow marine habitats by 2.5 x 109 yr ago. Scytonemin, a cyanobacterial extracellular sheath pigment, strongly absorbs UVC radiation. Exposure to high-irradiance conditions caused cells to synthesize scytonemin and resulted in decreased UVC inhibition of photosynthetic carbon uptake. It was further demonstrated that scytonemin alone was sufficient for substantial protection against UVC damage. This represents the first experimental demonstration of biological protection against UVC radiation in cyanobacteria. These results suggest that scytonemin may have evolved during the Precambrian and allowed colonization of exposed, shallow-water and terrestrial habitats by cyanobacteria or their oxygenic ancestors.

CHEMOSENSORY AND FEEDING RESPONSES OF THE NUDIBRANCH *AEOLIDIA PAPILLOSA* (L.) TO THE SEA ANEMONE *ANTHOPLEURA ELEGANTISSIMA* (B.) SYMBIOTIC WITH TWO ALGAE

Barbara F. Emerson Seavy. Biology Department, Western Washington University, Bellingham, WA 98225.

The aeolid nudibranch *Aeolidia papillosa* (Linnaeus) is an important predator of the sea anemone *Anthopleura elegantissima* (Brandt), host to two endosymbiotic algae: zooxanthellae and zoochlorellae. The effect of endosymbiont complement on the predation response of *Aeolidia papillosa* was examined in a laboratory study. Two hypotheses were tested: (1) *A. papillosa* does not preferentially choose *Anthopleura elegantissima* containing one endosymbiont complement over the other; and (2) Algal endosymbionts associated with *A. elegantissima* are not differentially digested by *Aeolidia papillosa*. Neither hypothesis was rejected. The nudibranch showed no prey preference for anemones harboring either endosymbiont in paired choice chemosensory experiments and in feeding experiments. No substantial digestion of either endosymbiont by *A. papillosa* was observed. The productivity of zooxanthellae in nudibranch feces was 38% higher (0.83 ± 0.14 pg C $cell^{-1}$ h^{-1}) than that of zooxanthellae freshly isolated from anemones (0.52 ± 0.04 pg C $cell^{-1}$ h^{-1}). The chlorophyll-a content of fecal zooxanthellae was 36% lower than that of zooxanthellae freshly isolated from anemones. The mitotic index (percent cells dividing) of fecal zoochlorellae was 61% higher than that of zoochlorellae freshly isolated from anemones. These results indicate the algal endosymbionts are benefiting from being indirectly consumed in anemones by *A. papillosa*.

Based on the results of this study, there is no direct benefit to *Anthopleura elegantissima* of associating with either endosymbiont as predation refuge from *Aeolidia papillosa*. Furthermore, *A. papillosa* may not affect the anemone population through selective predation, hence, may not affect the relative contribution of the two endosymbionts to the gross primary production of the intertidal community. The nudibranch may play an important role in maintaining the symbiotic relationship of *Anthopleura elegantissima* with zooxanthellae and zoochlorellae by providing viable algae in its feces, a mechanism enabling infection of nonsymbiotic anemone larvae and juveniles as well as re-infection of bleached anemones.

MOLECULAR SYSTEMATICS OF RED ALGAE BASED ON DNA SEQUENCE ANALYSIS: AN OVERVIEW.

Suzanne Fredericq*[1], Max H. Hommersand[2] & D.Wilson Freshwater[3]. [1]Dept. of Biology, University of Southwestern Louisiana, Lafayette LA 70504-2451. [2]Dept. of Biology, University of North Carolina, Chapel Hill, NC 27599-3280. [3]Center for Marine Science Research, 7205 Wrightsville Avenue, Wilmington, NC 28403.

Kylin (1956) classified the Florideophycean red algae into orders, families and genera based primarily on the structure of the cystocarp, the fruiting body which grows parasitically on the female gametophyte. Since we first published a phylogeny for the Rhodophyta based on plastid-encoded rbcL (Freshwater *et al.* 1994) we have obtained rbcL sequences from over 600 species representing each of the orders and most families of red algae. This expanded data set permits a re-evaluation of the naturalness of assemblages recognized in traditional and recent classification systems inferred from ultrastructural evidence and molecular phylogenies including nuclear small-subunit ribosomal DNA (SSU), nuclear large-subunit ribosomal DNA (LSU), and internal transcribed spacer regions (ITS) of nuclear ribosomal DNA. We find that at higher taxonomic levels, molecular-based phylogenies highlight the evolution of the earliest stages in the development of the female reproductive apparatus and its formation in relation to thallus growth. We will present phylogenetic hypotheses and classification criteria derived from a reinterpretation of such ontogenetic evidence for the major lineages of the red algae. Families recognized by Kylin are mostly resolved as monophyletic clades, but certain interfamilial and ordinal relationships are not supported.

VARIATION IN MACROPHYTE SIZE AND ABUNDANCE: A NUTRIENT EFFECT?

Tess L. Freidenburg*, Gary W. Allison and Bruce Menge

Observations this spring suggested that intertidal kelps on the central Oregon coast may have been strongly impacted by the1997-98 El Nino; qualitatively, they appeared to be less abundant and smaller than in previous years. However, at Cape Blanco, a persistent upwelling center on the southern Oregon coast, kelps seemed abundant and large. Data we collected following the El Nino event in summer 1998 suggest that large scale variation in nutrients may underlie the differences in size and abundance of macrophytes. The evidence is consistent with the hypothesis that during the 1997-98 El Nino, nutrients were severely depleted along the central Oregon coast but at normal concentrations at Cape Blanco.

A POSSIBLE OSMOREGULATORY ROLE OF OXYLIPINS IN RHODOPHYCEAE

William H. Gerwick, Mary Ann Roberts*, Alexandra Vulpanovici, and David L. Ballantine. College of Pharmacy, Oregon State University, Corvallis, OR. and Department of Marine Sciences, University of Puerto Rico, Mayaguez, Puerto Rico.

Oxylipins, which are fatty acids of all chain lengths oxidized by at least one enzymatic step of mono- or dioxygenase-dependent oxygenation, have been isolated from representatives of most major algal groups (Rhodophyceae, Phaeophyceae, Chlorophyceae, Bacillariophyceae, and Cyanophyceae). A specific biological role by these compounds in algae has not been elucidated as yet, but several have been suggested. In mammalian systems, mediation of sexual reproduction, chemotaxis, osmoregulation, and inflammation responses, are influenced by oxylipins. Projecting a similar function in marine algae, oxylipins may participate in osmoregulation, defense mechanisms against predation, detoxification of reactive oxygen species, regulation of plant growth and tissue development, and mediation of wound responses. Based on observations of sodium ion stimulation of the pathway, on modulatory activity to mammalian ATPase ion pumps by algal oxylipins, and of a pronounced effect by the lipoxygenase inhibitor nordihydroguararetic acid (NDGA) on cell volume in *Murrayella periclados*, we present preliminary experimental results examining the role that algal oxylipins may play in osmoregulation of marine Rhodophyceae.

KELP BIOMASS ESTIMATES OFF THE OREGON COAST AND RELATED RESEARCH BY THE OREGON DEPARTMENT OF FISH AND WILDLIFE

Jim Golden*, Dave Fox, and Arlene Merems. Marine Resources Program, Oregon Department of Fish and Wildlife at the Hatfield Marine Science Center, Oregon State University, Newport, OR.

Bull kelp *Nereocystis luetkeana* abundance has been studied by the former Fish Commission of Oregon and present Oregon Department of Fish and Wildlife since 1954. Kelp abundance off of the southern Oregon coast has been monitored through field sampling and aerial photography annually since 1996. In 1954, kelp beds dense enough to be considered "harvestable" covered 484 hectares in the nearshore off southern Oregon. In 1990, we estimated coverage to be 987 hectares. Since 1996, estimates have ranged from 179 – 379 hectares. Plant weight, density, and surface area have fluctuated inconsistently among years, requiring all three to be quantified to obtain realistic estimates of bull kelp biomass.

The Division of State lands has let out two experimental leases since 1988. Interest in leasing and harvesting kelp was initially high. A Kelp Advisory Committee appointed by DSL recommended small experimental harvests to measure potential environmental disturbance effects and to satisfy State Goal 19 requirements. Findings and recommendations may be approved as part of the Territorial Sea Plan. To date, little harvest has occurred and interest appears to be declining, as recent abundance has been low. The Department may continue to monitor kelp distribution, density and weight along with other methods of mapping and classifying marine subtidal habitats. Managers are looking for new approaches toward conservation and management of nearshore fisheries resources. Continued reef inventories, including estimates of kelp distribution, may have utility in identifying critical marine habitats and potential sites for marine protected areas.

THE BENTHIC MARINE ALGAE OF ALASKA: A PRELIMINARY REPORT ON THE INVENTORY OF EXISTING COLLECTIONS.

Gayle I. Hansen*[1] and Sandra C. Lindstrom[2]. [1]Hatfield Marine Science Center, Oregon State University, Newport, OR 97365 USA, and [2]Department of Botany, University of British Columbia, Vancouver, BC V6T 1Z4 CAN

As an initial phase in the production of a *Benthic Marine Algal Flora of Alaska*, we are conducting an inventory of all existing collections of Alaskan marine algae known worldwide (~40,000 specimens). Our data are being recorded in a relational database designed specifically for the project. For this phase, we are incorporating primarily specimen information into the database, and our metadata (outlined in the poster) consists of 5 major categories: (1) specimen location and status data, (2) identification data (including nomenclatural and systematic information), (3) specimen condition data, (4) reproductive state data, and (5) collection data (including the coordinates of all sites).

At the completion of our Inventory, we plan to produce the following publications: (1) A Web-based database on Alaskan marine algae that will include the records of all known herbarium specimens and the state-wide distribution of each species, (2) A species checklist and biogeographic analysis of the flora, and (3) A hard-copy catalog of the specimen information. These publications will form the foundation for the future Flora. In addition, they will provide valuable resource material for a wide variety of phycological studies and act as useful references for teachers, environmental consultants and resource managers. Perhaps most importantly, they will substantially increase our baseline knowledge of the Alaskan marine environment and help to make possible informed decisions on marine conservation that will affect this vast and biologically rich area for years to come.

AN ECOLOGICAL BASIS FOR EXTRACELLULAR CARBONIC ANHYDRASE IN MARINE UNICELLULAR ALGAE.

Louis Hobson* and Christine Hanson. Department of Biology/School of Earth & Ocean Sciences, University of Victoria, Victoria, B.C.

The concentration of dissolved inorganic carbon (DIC) in seawater equilibrated with atmospheric CO_2 is about 2 mM. At equilibrium, most DIC is HCO_3^{-1} with small amounts of dissolved CO_2 and CO_3^{-2}. The expression of extracellular carbonic anhdyrase (CA) by species that take up CO_2 would enhance transport rates of CO_2 from an alkaline medium in which DIC is dominated by HCO_3^{-1}. CA has been detected in some, but not all, autotrophic marine protistans and in most cases the enzyme is expressed when concentrations of DIC decrease. The purpose of our study was to obtain additional information regarding variations in CA in species representative of different phases of the annual succession of species. We observed largest actitivities in spring- and fall-bloom diatoms (*Chaetoceros similis, Ditylum brightwellii, Skeletonema costatum*) exposed to long photoperiods (16 hr). Minimum activities were recorded for one diatom (*Cylindrotheca closterium*) and a number of flagellated species (*Heterosigma carterae, Rhodomonas salina, Tetraselmis gracilis*), typical of summer, low nutrient conditions. Varying concentrations of DIC (1-4 mM) had no affect on CA activity in any test organism. We conclude that expression of CA is an important component of the carbon-concentrating mechanism of those species that occur in large blooms when bulk seawater pH can increase to 8.6.

EXTINCT DISCOASTERS ARE RECENT MARINE DINOFLAGELLATES

Rita Horner*. School of Oceanography, University of Washington, Seattle, WA 98195-7940.

Discoasters are stellate, calcareous marine microfossils thought to be produced by organisms related to present-day coccolithophorids. They were first described by Ehrenberg (1854), but it was Tan Sin Hok (1927) who first used *Discoaster* as a generic name and provided early species descriptions. Discoaster is now used as a general group name, as the name of the star-shaped structures, and as a generic name for the star-producing organisms.

Discoasters are known from the Upper Paleocene (ca. 60 Ma) to the end of the Pliocene (ca. 2 Ma) and were particularly abundant in the Eocene. Their extinction is sometimes used as an indicator of the Pliocene-Pleistocene boundary and they have been used to assign ages to strata because their stratigraphic ranges are fairly short and relatively well-known. Their presence in marine sediments is thought to be indicative of warm water depositional environments. Over time, however, star morphology changed from compact rosettes to a few, narrow rays, calcification became lighter, and the diameter of the stars decreased reflecting general cooling of the physical environment.

The first real evidence that discoasters may be living today was provided by Bursa, based primarily on sea ice samples from the Canadian Arctic. He described a new genus, new species, and transferred discoasters to a new family in the dinoflagellates. I have grown live discoasters in rough cultures started with pieces of sea ice from northern Alaska and they have been seen in first-year ice samples from the Weddell and Greenland seas. Scanning electron microscopy and elemental analysis show that the stars are composed of calcium carbonate. Thus, there is evidence that discoasters are still living today in polar sea ice, albeit in relatively small numbers.

PHOTOBIOREACTOR CULTIVATION OF *AGARDHIELLA SUBULATA* REGENERATED MICROPLANTLETS

Yao-ming Huang* & Gregory L. Rorrer. Department of Chemical Engineering, Oregon State University, Corvallis, Oregon 97331

Suspension cultures derived from red macroalgae are a potential source of valuable compounds. Controlled biological production of these compounds first requires the development of an engineered biomass production system that circumvents many of limitations of field cultivation. Toward this end, a microplantlet suspension culture of the red macroalga, *Agardhiella subulata,* was established through controlled regeneration of filamentous clumps. The effects of process parameters of growth and primary metabolic processes during photobioreactor cultivation of the microplantlet suspension were examined. Specific process parameters included temperature, agitation intensity, CO_2 and light delivery. The optimal temperature for the microplantlet culture was 24°C. Controlled cultivation of *Agardhiella subulata* microplantlets was successful in both externally-illuminated bubble-column and stirred-tank bioreactors. The growth was not CO_2-limited in either bioreactor system when aerated at 0.3 v v^{-1} min^{-1} with ambient air. At an incident light intensity of 65 $\mu E/m^2$-s, a photoperiod of 20:4 LD or higher inhibited culture growth.

DOC RELEASE BY PHYTOPLANKTON: A COMPARISON BETWEEN BATCH AND CONTINUOUS CULTURES

Nobuyuki Kawasaki* and Patricia A. Wheeler. College of Oceanic and Atmospheric Sciences, Oregon State University, Corvallis, OR.

Both macroalgae and phytoplankton release DOC and it appears that release rates are strongly dependent on culture conditions. *Dunaliella tertiolecta* (Chlorophyte) was used to compare release rates in batch and continuous cultures. POC, PON and cell counts were also measured. *D. tertiolecta* released DOC in both batch and continuous cultures and the released DOC accounted for about 10 % of total fixed carbon. DOC release rate during the exponential growth in the batch culture was much higher than during lag and stationary phases. The DOC release rate in the continuous culture was as low as that during the stationary phase of the batch culture. Low release rates in the continuous culture may have resulted from light limitation and a slow growth rate of 0.1 day^{-1}. These results may indicate that DOC release by *D. tertiolecta* is related to their growth phases and environmental conditions, such as nutrients and light intensity.

NUTRIENT-LIMITED GROWTH AND SOURCES OF NUTRIENTS FOR CORAL REEF MACROALGAE.

Scott Larned. Coastal Ecology Branch, U. S. Environmental Protection Agency, Newport, OR.

The availability of nutrients for benthic macroalgae is usually assessed by measuring nutrient concentrations in the overlying water column. At many coral reefs, macroalgae reach high levels of productivity under conditions of very low water column nutrient concentrations. Several hypotheses can be proposed to explain this apparent contradiction. One is that high flow rates in the water column result in rates of nutrient advection high enough for sustained macroalgal growth. Water near the benthos is generally slower moving and less turbulent than the overlying water column, however, and the benthic boundary layer impedes nutrient transport to algal thalli. An alternative is that macroalgae acquire nutrients from an enriched zone near the benthos that is generated by sediment efflux and invertebrate excretion. The alternative hypotheses were addressed in a study of macroalgae from coral reefs in Kaneohe Bay, Hawaii. Laboratory and field experiments were used to 1) determine whether macroalgal growth on these reefs is nutrient-limited, and if so, by what nutrients, and 2) determine the relative importance of nutrients supplied by the water column, sediment and invertebrates in supplying limiting nutrients.

Effects of elevated temperature and UV-B radiation on zooxanthellae *in hospite* and expelled from the tropical sea anemone *Aiptasia pallida.*

Erin Macri, Gisele Muller-Parker, Suzanne Strom, Jack Hardy, Jason Berger, Dan Bostrom, Troy Markus, Steve McKagan, and Brandi Wallace.
Shannon Point Marine Center, Western Washington University
Bellingham, WA 98225-9081. macrie@cc.wwu.edu

The tropical symbiotic anemone *Aiptasia pallida* was exposed to elevated temperatures and UV-B radiation to investigate the nature of coral bleaching. Anemones received either 30°C with enhanced UV-B (+UV), or 31°C with no UV-B (-UV) for up to 5 days. Expelled zooxanthellae (EZ; up to 12%) and those remaining in the animal (AZ) were compared. Anemones exposed to UV showed a decrease in protein and zooxanthellar density, and a 10 fold increase in zooxanthellae expulsion. Photosynthesis of expelled algae was affected: Pmax and alpha of EZ decreased from 1.62 to 0.46 pgC/pgchla/hr, and from 0.012 to 0.002 pgC/pgchla/hr/(umol·m^{-2}·s^{-1}), respectively. EZ pigments did not change over time; however, EZ consistently had less chlorophyll c than AZ. AZ division, productivity, and pigments did not change during exposure to UV. Temperature stress alone did not affect protein, zooxanthellar density, % expulsion, and photosynthetic parameters. EZ pigments decreased while AZ pigments did not. Decreased productivity of expelled zooxanthellae +UV shows that the animal protects zooxanthellae from UV damage *in hospite*. Zooxanthellae expelled during bleaching events are likely to sustain extensive damage due to UV radiation.

HOW CALCIFICATION IMPROVES NUTRIENT UPTAKE.

Ted McConnaughey, 1304 Cedar Lane, Selah, WA 98942-1717.

Nutrient-deficient environments host some of the earth's outstandingly calcareous communities, including coral reefs, marly lakes, and summertime coccolithophorid blooms. Research mainly on terrestrial plants suggests how calcification may facilitate high-affinity nutrient uptake. First, the protons generated through calci-fication improve the performance of proton cotransport mechanisms. Second, proton secretion hyperpolarizes the cell membrane, allowing electrophoretic uptake of positively charged combinations (for example, phosphate + 4-6 protons). The thermodynamics of these mechanisms will be summarized, and supportive examples discussed, showing for example how nutrient deprivation induces algae and coral-algae symbioses to calcify faster.

WHAT'S HAPPENING TO THE WORLD'S CORAL REEFS?

Ted McConnaughey, 1304 Cedar Lane, Selah, WA 98942-1717.

Coral reefs over much of the world have suffered considerable deterioration in the past couple decades. Two especially troubling problems are reef overgrowths by fleshy algae, and coral bleaching. Both may be related to human fertilization of the oceans through coastal sewage discharges and agricultural run-off. Overgrowths by fleshy (non-calcareous) algae are easiest to understand. Reef-building calcareous algae and algae-invertebrate symbioses dominate on reefs largely because calcification enables them to assimilate nutrients more efficiently. "Nutrification" of the water allows fleshy algae and their consumers to overwhelm the slow-growing calcifiers. Coral bleaching however resembles a nutrient deficiency problem in many respects, and is therefore harder to understand in the context of human fertilization. Preferential human fertilization of the oceans with N and P may however intensify iron deficiency in a system that is already largely iron limited. Paradoxically, human fertilization of the oceans could therefore worsen iron deficiencies and exacerbate coral bleaching.

PISCO: A CONSORTIUM FOR LONG-TERM, MULTI-SCALE ECOLOGICAL RESEARCH IN THE NEARSHORE ECOSYSTEM

Bruce Menge* and Jane Lubchenco. Department of Zoology, Oregon State University, Corvallis, OR.

A recently awarded five-year grant by the Packard Foundation supports a four-member consortium of US west coast universities to investigate nearshore ecosystem dynamics in Oregon and California. Goals include evaluating the patterns and importance of benthic-pelagic coupling in determining patterns of spatial and temporal variability in populations and communities of benthic organisms in rocky intertidal and subtidal habitats. Research includes quantification of distribution and abundance of benthic invertebrates, algae, and fishes at >60 sites; quantification of rates of predation, grazing, algal and invertebrate recruitment, algal growth, and sessile invertebrate growth at 12-30 sites; quantification of patterns of larval abundance, larval transport, currents, upwelling, and productivity in waters from 0-5 km offshore at up to 30 sites; and studies aimed at determining the sources and destinations of larvae and spores. Research is strongly interdisciplinary, including collaborations between ecologists, oceanographers, physiologists, molecular biologists, population geneticists, biomechanics, behaviorists, and larval biologists. Examples of patterns prompting the consortium include variation in predation on mussels related to nearshore oceanographic variation in larval transport and phytoplankton productivity, variation in algal growth related to upwelling variation, and biogeographic patterns related to current patterns.

A BIOLOGICAL SURVEY OF THE BERKELEY PIT.

Grant G. Mitman*, Biology Department, Montana Tech of the University of Montana, 300 West Park Street, Butte, Montana 59701

The Berkeley Pit Lake System is estimated to contain more than 30 billion gallons of acidic, metal-laden water. Current investigations examine how the naturally occurring organisms in the Berkeley Pit Lake System might be stimulated by nutrient additions to begin a self-purification process for aqueous environments impacted by acid mine drainage. The combined physiological processes have been observed to bioremediate aquatic mine waste environments. Consequently, if a mine waste site like the Berkeley Pit Lake System is properly nutrified with Nitrogen, Phosphorous, or Potassium (eg. Manure or sewage as inexpensive sources), this nutrification may cause a successional cascade of increased diversity and biomass that is coupled with an increase in pH. A pH increase, in turn, may lead to a natural restoration process. Thus, if systems are to function correctly and to recover from pollution-induced perturbations, fundamental information both on the autotrophic and on the heterotrophic components of the microbial community is essential. Defining the baseline community structure is the first step toward understanding the interactions of the different groups of extremeophiles and toward assessing any improvement in biodiversity within the biotic community.

OBSERVATIONS ON THE OCEANOGRAPHY, NUTRIENT DYNAMICS AND PRIMARY PRODUCTION OF WASHINGTON STATE COASTAL ESTUARIES.

Jan Newton, Washington State Dept. of Ecology and University of Washington, WA.

The biological oceanography of the Pacific Northwest outer coastal estuaries is relatively unknown, due to a lack of intensive studies on these waterbodies and to the inherent complexity of estuarine systems. Analysis of Washington State Department of Ecology long-term monitoring data from Grays Harbor and Willapa Bay reveals a profound difference in the degree of freshwater influence, with Grays Harbor being fresher over more of its area than Willapa Bay. The implications of this difference on resultant phytoplankton production and community structure are not well known. More detailed data from Willapa Bay, collected through an EPA-funded study, show that the balance of oceanic and riverine influences on the bay is dynamic with season and location in the estuary. The highest primary production is found near the ocean mouth. This may be a combination of influence from the highest phytoplankton biomass and relief from nutrient limitation at these sites, as opposed to stations to the south and in the river reaches. Nutrient limitation of primary production is evident from April through September, despite well-mixed water columns and the proximity of the benthos (~10 m water columns). Nutrient limitation is strongest at the center of the bay, away from both oceanic and riverine sources. Whether blooms are primarily stimulated within the estuary or are largely driven by oceanic intrusions is still under investigation. A caveat of the observations given above is our measurements were made in the channels of these estuaries. The outer coast estuaries are composed of channels, which average in depth at 10 m, and flats, which drain at low tide and are submerged at high tide. Measurements of the biology and chemistry in the water overlying the flats are lacking and may be very different than the channels.

A re-investigation of the ultrastructure of Glaucocystis nostochinearum using cryo-fixation and freeze-substitution techniques.

Brian R. Oates and Kathleen M. Cole. Department of Botany, University of British Columbia, Vancouver, B. C. V6T 1Z4

Confocal laser scanning microscope images and transmission electron microscope images of Glaucocystis nostochinearum have revealed features of the chloroplast (cyanelle) and other organelles not described previously. CLSM images revealed that the cell contains one or two stellate chloroplasts with a unique pattern of chlorophyll-based autofluoresence. TEM images of the chloroplast substantiate the autofluoresence patterns and exhibit a thylakoid stacking arrangement not previously described. The lobes of the chloroplast appear to be joined at the centre by a pyrenoid-like body. Careful observations of the organelle also indicate that certain membranes usually associated with chloroplasts may actually be absent. Cortical alveoli, another membrane system thought to be present in G. nostochinearum, also could not be found in our cells. The cell walls of these cells are also distinct and are specialized in the region over the embedded flagella. The cell wall also has inward extensions around the circumference of the cell.

THE ROLE OF SULFURIC ACID IN THE ECOLOGY OF THE BROWN ALGA DESMARESTIA MUNDA.

Karen Pelletreau*. Shannon Point Marine Center, Western Washington University, Bellingham WA.

The proposed roles of sulfuric acid in the ecology of the acid-containing species of the Desmarestiales have included herbivore deterrence, osmotic regulation and enhancement of gametophyte settlement. In this study, grazing on the acidic *Desmarestia munda* was compared to grazing on other common phaeophyte algae *(Alaria marginata, Laminaria saccharina, Costaria costata, and Nereocystis leutkeana)*. The sea urchin *Strongylocentrotus droebachiensis* avoided eating *D. munda* in controlled laboratory feeding trials. Analysis of polyphenolic content and nutritional quality of the five algae suggested lack of preference for *D. munda* was not due to polyphenolic concentration and nitrogen content. Sulfuric acid comprised 15.6 % by dry weight of the *D. munda* tissue and the average pH of homogenized material was 2.01. In other experiments, sulfuric acid was added to a synthetic food base and fed to urchins. Urchins were given a choice of control foods (pH $\approx$ 6.20) and treatment foods with a range of pH values from 1.43-6.18. Urchins strongly avoided foods with pH values $\leq$ 3.56. These results support the hypothesis that sulfuric acid in *D. munda* does deter grazing by large mobile grazers such as *S. droebachiensis*, however the results do not exclude other possible roles that H_2SO_4 may play in the ecology of *D. munda*.

MICROCYSTIS SPECIES AND STRAIN DIVERSITY IN NORTHWEST LAKES USING THE PHYCOCYANIN OPERON.

Brock Peters*, Charles R. Williams, and J.R. Waaland. Department of Botany, University of Washington, Seattle, WA.

Traditional and current methods of cyanobacterial species and strain identification rely heavily on morphological characteristics such as cell size and shape, and colony structure (Bolch *et al.* 1996). Differences in regulation of buoyancy, pigment content, mode of reproduction, and presence or absence of nitrogen fixation structures are also used (Neilan 1996). Classical methods can be inconclusive due to similarities among different species. Geographic variation and environmental factors can also interfere with identification by giving rise to morphological plasticity within cyanobacterial species and strains (Bolch *et al.* 1996).

The application of molecular and biochemical methods combined with traditional morphological techniques can greatly improve identification of cyanobacteria and resolve many taxonomic issues. Studies of deoxyribonucleic acid using PCR can rapidly yield sequences of genes for comparison among strains. In this study, sequences from the genes encoding the b- and a-phycocyanin subunits of phycobilisomes (*cpc*B and *cpc*A) of cyanobacteria were used to investigate species and strain compositions of the genus *Microcystis* in Pacific Northwest lakes.

BROWN ALGALSYSTEMATICS: MOLECULAR ASSESSMENT OF INTERORDINAL TO INTERSPECIFIC CONCEPTS

Naomi. Phillips,[1]Department of Biology, University of Southwestern Louisiana, Lafayette LA 70504-2451.

The brown algae, as currently classified, include some 2000 species in 265 genera and 15 orders. At the ordinal level, traditional classification schemes are based on comparative anatomy, morphology and life history traits. As traditionally interpreted, phylogenetic relationships between orders and families reflect increased morphological complexity and reproductive advancement culminating in complex parenchymatous thalli with gametic life histories (Fucales). Early molecular tests of traditional hypotheses using 18S sequence data challenged these traditional concepts and highlighted several ordinal ambiguities. Yet, 18S (SSU) data was limited in resolving some ordinal relationships. Recent studies using other gene regions (partial LSU and SSU (Rousseau et al.)and rbcL gene (Phillips et al.) regions revisit these ordinal issues and test systematic and phylogenetic concepts within the brown algae. These data confirm earlier work while providing many novel insights into ordinal circumscriptions and overall phylogenetic relationships within the brown algae.

Another area of interest developing in the brown algae is at using molecular data to resolve systematic issues at or below the genus level. One of the largest and historically systematically problematic genera in the brown algae is Sargassum. This genus contains over 400 species in a complex system of subgenera, sections, subsections and series. Sequence data from the intergenic region of the Rubisco operon (rbcL-IGSrbcS) was used to test this systematic system and inherent phylogenetic concepts. Much of the traditional treatment was supported while phyletic concepts were not. This research has produced the first modern phylogeny for the genus and developed molecular characters for further systematic revision.

DECEW'S GUIDE TO THE MARINE ALGAE: AN INTRODUCTION AND PROGRESS REPORT.

Robert A. Rasmussen*, Paul C. Silva, and Richard L. Moe. Department of Biological Sciences, Humboldt State University, Arcata, CA, and The Herbarium, University of California, Berkeley, CA.

First displayed and offered for sale, in draft form, at the International Seaweed Symposium, at the University of California, Santa Barbara, in 1977, DeCew's massive bibliography and iconography is tantalizingly near completion. The sections on Chlorophyta and Phaeophyta are complete. The section on the Rhodophyta is stalled in editing. Copies of the keys will be available for test driving.

The effects of elevated UV-B radiation on productivity and bleaching of zooxanthellae in the coral *Montastraea faveolata.*

Trevor Rivers, Erin Macri, Adrienne Miller, and Gisele Muller-Parker
Shannon Point Marine Center, Western Washington University
Bellingham, WA 98225-9081 n9740089@cc.wwu.edu

Enhanced UV-B Radiation has a detrimental effect on productivity of zooxanthellae from the coral *Montastraea faveolata.* Experiments were performed on coral samples collected from 16.5 m in the Bahamas. Corals were subjected to three different treatments for up to 120 hours at 29°C: Enhanced PAR and UV-B, *in situ* PAR and enhanced UV-B, and *in situ* PAR and UV-B. Less than 1% of the zooxanthellae were expelled in bleaching corals. This indicates that the initial bleaching response results from pigment loss by zooxanthellae and not from expulsion. Zooxanthellae removed from the coral after 48 hours of enhanced UV-B showed a consistent 25% reduction in P_{max}, while the P_{max} of zooxanthellae removed from corals in the other treatments showed no reduction. Photosynthesis of zooxanthellae expelled by the corals in the enhanced PAR and UV-B treatment was substantially reduced (78%); expelled zooxanthellae in the *in situ* PAR and enhanced UV-B treatment showed a 38% reduction in comparison to zooxanthellae in the corals in these treatments. These results show that UV-B radiation damages zooxanthellae, but that the coral provides some protection against damage to the photosynthetic apparatus.

AN INSTRUCTIONAL LABORATORY EXERCISE USING *CHLORELLA* VIRUS

Kristin Rorrer. Department of Microbiology, Oregon State University, Corvallis, OR.

The existence of viruses that infect *Chlorella* is well-established. Free-living *Chlorella* are not infected by these viruses; the host *Chlorella* species are those normally existing as symboints. An exsymbiont of *Paramecium*, the *Chlorella* strain NC64A, was used in a teaching lab as a host for titering a purified virus and as an indicator of the presence of *Chlorella* virus in filtrates of local pond water. A sensitive plaque assay, using techniques common to bacteriophage assays, was employed. This laboratory exercise uniquely combines principles of algal culture and virology.

M/V NEW CARISSA GROUNDING INCIDENT: CASE HISTORY AND DAMAGE ASSESSMENT FOR LIVING MARINE AND ESTUARINE RESOURCES.

Steve Rumrill, South Slough National Estuarine Reserve, Charleston, OR 97420

The 639-foot cargo vessel M/V New Carissa ran aground on the morning of February 4, 1999, on the sandy shore of North Spit (Coos Bay), Oregon. The ship was inbound from Japan with empty cargo holds but the fuel tanks carried 359,000 gallons of heavy #2 bunker oil and 37,400 gallons of diesel. The hull was battered in 15-20 foot surf for several days and began to leak oil on February 8th. Leaking oil initially washed ashore on the sandy beaches from Horsefall Beach northward to the mouth of the Tenmile Creek Estuary, and the tarballs and oil sheen eventually found their way into the Coos Estuary and South Slough on Feb 11-18. The damaged hull broke into two pieces following an attempt to burn the oil, and the buoyant bow section was towed out to sea during a severe storm on March 1st. The bow section broke free from the tug and was blown back to the shore at the mouth of Alsea Bay on March 3rd. An additional 2,000 gallons of oil leaked onto the beaches and into the Alsea Estuary, and tarballs eventually washed ashore from Cape Arago, Oregon, to southern Washington. It is estimated that a total of 70,000 gallons were released from the M/V New Carissa and about 10,000-25,000 gallons reached the shore. Salvage operations, contingency planning, natural resource damage assessment, and spill response actions were carried out simultaneously throughout the duration of the grounding incident. During the damage assessment process particular attention was given to several sensitive species and habitats including snowy plovers, several species of shorebirds, winter runs of anadromous fish, marine mammals, recreational clams, oysters, burrowing shrimp, eelgrass beds, and salt marshes.

DEPRESSION OF PHYTOPLANKTON CONCENTRATIONS OVER OYSTER GROUNDS

K.A. Sayce*, Shoalwater Botanical, Nahcotta, WA 98637 and A.C. Sigleo, U.S. EPA, WED, Newport, OR 97365

Spatial distributions of phytoplankton volumes in estuaries are influenced by nutrient supply, available light (PAR), several physical processes and herbivory. In Willapa Bay, WA, phytoplankton were collected from two sites, one in a main channel, the other in a side channel among extensive oyster growing grounds. Net tows were used to sample surface phytoplankton volumes (0.5 m beneath the surface), and settled in Imhoff cones. Volumes were read directly from the cones in milliliters. Comparisons of sample volumes show a regular depression in phytoplankton volumes over growing grounds relative to main channel samples. Numerous filter feeders, including oysters, clams, and burrowing shrimp, occupy the intertidal flats of the growing area.

Dissolved nutrients, on the other hand, were present at the same concentration throughout the estuary at high slack tide. Exceptions to uniform nutrient concentrations occurred during high flow events due to dilution.We conclude that nutrient uptake by phytoplankton is continuous and replenished by physical processes such as oceanic upwelling and river flow to the estuary, whereas phytoplankton uptake by oysters and other species is proportional to animal density and feeding activity.

Changes in optical reflectance and pigmentation of the coral *Montastraea faveolata* in response to elevated temperature and ultraviolet radiation.

Carl Schmidt, Teresa Steely, John Hardy, Suzanne Strom, Maria Bynagle, Emily Peterson.
Shannon Point Marine Center, Western Washington University, Bellingham, WA 98225-9081. n9710040@cc.wwu.edu, n9641106@cc.wwu.edu

Elevated temperature and ultraviolet-B (UVB) radiation can induce coral bleaching, i.e. the loss of symbiotic zooxanthellae and their pigments. It may be possible to detect bleaching by remote sensing through measured changes in the reflectance spectra. We examined the relationship between coral pigments and *in vivo* optical spectra. We collected 2.1 cm diameter cores of *Montastraea faveolata* at 16.5 m depth (29.5°C) from Lee Stocking Island, Bahamas in July 1998. Replicate samples from three colonies were exposed in an outdoor incubator for 96 hours at 31°C at three levels of solar radiation. Radiation treatments included *in situ* doses of photosynthetically active radiation (PAR) and UVB, *in situ* PAR and enhanced UVB, and enhanced PAR and UVB. Coral pigments were measured by HPLC analysis and *in vivo* reflectance of coral was measured using a portable fiber optic spectrofluorometer. After four days of enhanced UVB treatment, chl-a surface densities decreased 43% while reflectance in the chl-a region increased 90%. These UVB doses were 1 to 2 orders of magnitude greater than the *in situ* dose. Results suggest that small changes in pigmentation can be detected *in vivo* as changes in optical reflectance

PHYTOPLANKTON AND NUTRIENT DYNAMICS IN THE YORK RIVER ESTUARY, VIRGINIA: ANALYSES OF LONG TERM DATA

Yongsik Sin* and Richard L. Wetzel. EPA, 2111 S.E. Marine Science Drive, Newport, OR 97365 and School of Marine Science/Virginia Institute of Marine Science, College of William and Mary, Gloucester Pt. VA 23062

Ten years (1985-1994) of data were analyzed to explore general patterns of phytoplankton and nutrient dynamics, and to identify major controlling factors on those dynamics in the York River Estuary, Virginia. The estuary, in general, had winter-spring blooms and smaller-scale summer blooms. Peak phytoplankton biomass during the winter-spring blooms occurred in the mid reach of the mesohaline zone whereas peak phytoplankton biomass during the summer bloom occurred in the tidal fresh-mesohaline transition zone. River discharge appears to be the major factor controlling the location and timing of the winter-spring blooms and the relative degree of potential N and P limitation. Phytoplankton biomass in tidal fresh water regions was limited since the residence time was less than the cell division rate during high flow seasons. Positive correlations between PAR at 1m depth and chlorophyll *a* suggested light limitation of phytoplankton in the tidal fresh-mesohaline transition zone. In mesohaline regions, riverine nitrite+nitrate input during the winter results in winter-spring blooms. Tidal mixing also influences summer phytoplankton dynamics in the mesohaline zone by supplying regenerated nutrients via a predictable cycle of column stratification-destratification. In general, phytoplankton dynamics appear controlled to large extent by resource limitation (bottom-up control) rather than zooplankton grazing (top-down control).

FALSE COLOR NEAR-INFRARED VS. NATURAL COLOR AERIAL PHOTOGRAPHY FOR MAPPING INTERTIDAL VEGETATION IN PACIFIC NORTHWEST ESTUARIES.

David T. Specht*, David R. Young, Bradley D. Robbins, Henry Lee II, Coastal Ecology Branch, Western Ecology Division, U.S. EPA, and Patrick J. Clinton, OAO Corporation; 2111 SE Marine Science Drive, Newport, OR 97365

Aerial photography is an important tool in landscape ecology. False-color near-infrared (CIR) film has been used very successfully in mapping terrestrial vegetation. However, owing to the strong absorption of infrared radiation by overlying water, the use of natural color film for mapping submersed aquatic vegetation (SAV) has been recommended. This recommendation is based on experience mapping SAV on the southeast Atlantic coast where tidal ranges are minimal, and most of the beds of aquatic vegetation generally are submersed at low tide. However, Pacific Northwest estuaries are characterized by large tidal ranges and extensive intertidal mud flats. This presents the opportunity to use the advantages of CIR film in distinguishing SAV beds from the water and bare substrate background. Here we report a 1997 comparison of two techniques used to recognize exposed SAV distributions in the Yaquina Estuary, on the central Oregon coast. Methods of interpreting orthorectified digital aerial photographs from the two types of film are presented and compared.

PHLOROTANNIN PRODUCTION BY KELP GAMETOPHYTES

Kathryn Van Alstyne, Karen Pelletreau, Hilmar Stecher, and Elizabeth Sanchey. Shannon Point Marine Center, Western Washington University, Anacortes, WA.

Kelps, one of the dominant groups of macroalgae in northeastern Pacific coastal areas, produce a haploid microscopic gametophyte stage that alternates with a diploid macroscopic sporophyte stage. Gametophytes are thought to be an overwintering stage that allows kelps survive periods of high grazing pressure or harsh physiological conditions. Herbivory is an important determinant of the abundance of many kelp species and the structure of kelp communities in cold temperate northeastern Pacific benthic communities. Kelps, like many brown algae, produce phlorotannins, a putative chemical defense against generalist grazers. We measured phlorotannin concentrations in field-collected sporophytes and laboratory-cultured gametophytes of four species of kelps and examined gametophytes and sporophytes histochemically for the presence of physodes, organelles that store phlorotannins. Phlorotannin concentrations in gametophytes were uniformly low relative to reproductive and vegetative sporophyte tissues, indicating phlorotannins are unlikely to serve an antiherbivore function in kelp gametophytes.

SEQUESTERING OF IRON IN MARINE AND ESTUARINE ECOSYSTEMS BY MARINE MACROALGAE

Patricia A. Wheeler and Mariachiara Naldi, College of Oceanic and Atmospheric Sciences,Oregon State University, Corvallis OR 97331

Marine macroalgae dominate algal standing stocks and primary production in many coastal ecosystems. Fe is an essential trace element for all photosynthetic organisms and phytoplankton appear to be Fe-limited in oceanic and coastal upwelling regions. Here we use elemental cellular composition and growth rates to compare the N and Fe demands of phytoplankton and macroalgae globally and for coastal ecosystems. Globally, macroalgae account for 67% of algal organic C standing stocks. Compared to phytoplankton, marine macroalgae have a 3-fold higher Fe:C cellular composition and 8-fold higher Fe:N . As a result of high standing stocks and high Fe:C and Fe:N cell composition, marine macroalgae may contain 90% of algal-bound Fe in the global marine ecosystem. Our estimates of algal nutrient uptake rates for coastal shelves and estuaries indicate that the utilization of N and Fe by macroalgae exceeds that of coastal phytoplankton.

ANABAENA IN THE PACIFIC NORTHWEST: A TALE OF PLASTICITY

Charles R. Williams*, Brock Peters and J.R. Waaland. Department of Botany, University of Washington, Seattle, WA.

The molecular marker, cpcBA-IGS, was used to examine the biogeography of representatives of *Anabaena* collected from Pacific Northwest lakes and their phylogenetic relationship to isolates from the UTEX culture collection. cpcBA-IGS contains portions of the alpha and beta subunit of cyanophycocyanin with an intergenic spacer (IGS) of ~100 base pairs situated between the subunits. The use of this cyanobacteria specific marker and primers allowed us to amplify cpcBA-IGS DNA from unicyanobacterial field samples. The morphology and habit of specimens were documented by photomicroscopy. Single filaments or 3-4 filaments of culture material were then amplified using the polymerase chain reaction (PCR).

Results include analysis of non-toxic summer and toxic winter blooms of *Anabaena* from 1989-1997 in American Lake, WA. A preliminary phylogenetic analysis of Pacific Northwest and UTEX isolates was also performed using parsimony, maximum likelihood and distance methods. The results of this analysis suggest that revision of *Anabaena* taxonomy is needed.

DATABASE: THE MARINE MACROPHYTES OF THE NORTHEAST PACIFIC

Thomas B. Widdowson. 4635 West Saanich Road, Victoria, B.C. V8Z 3G7 Canada

This database includes information from the holdings of the UBC Phycological Herbarium and a selection of the literature. Information can be retrieved and grouped by taxon, locality, or ecology. The taxonomic system has been made consistent with that of the new edition of the *Keys*. The database uses *Access* in MS Office 97.

BIOLUMINESCENCE SIGNALS FROM *PYROPHACUS STEINII*

A. Michelle Wood[1,2]*, D. Nielson[2], D. Young[2], and James Case[3].
[1]Dept. of Biology, University of Oregon, Eugene, Oregon, 97403. [2]Office of Naval Research, Stennis Space Center, MS; [3]Marine Science Institute, UC-Santa Barbara, Santa Barbara, CA.

In 1994-95 we obtained vertical profiles of bioluminescence intensity and flash kinetics in the Arabian Sea using the profiling instrument HIDEX-BP. One of the most interesting profiles we obtained showed a very sharp peak in bioluminescence intensity that was accompanied by a sharp decline in the variance of the kinetics signature, indicating that probably only one type of organism was responsible for the peak in total bioluminescence. Vertical net tows revealed a layer of *Pyrophacus steinii*, at the depth of the bioluminescence maximum. No other organisms known to have the capacity for bioluminescence showed increased abundance at the depth of the bioluminescence maximum. Individual cells of *Pyrophacus steinii*, picked from net tows by hand, showed that mechanical stimulation caused individual cells to emit flashes which were easily visible to the naked eye. Thus, we attribute the layer of extremely high bioluminescence to photon emission from *Pyrophacus steinii.*

REGISTRATION LIST

Martha	**Apple**	Department of Botany and Plant Pathology	E-mail:	mapple@dcz.dods.org
		Oregon State University	Phone: Work:	541-752-7499
		Corvallis, OR 97330	Home:	541-752-7499
Brec	**Clay**	Biology Department	E-mail:	blclay@lamar.colostate.edu
		Colorado State University	Phone: Work:	970-491-7551
		Ft. Collins, CO 80527	Home:	970-221-9102
Jan	**Conitz**	Fisheries & Ocean Sciences	E-mail:	jnjmc@uas.alaska.edu
		University of Alaska	Phone: Work:	907-465-6328
		Juneau, AK 99801	Home:	907-463-3703
Chris	**Cziesla**	Oregon Institute of Marine Biology	E-mail:	czwiz@darkwing.uoregon.edu
		University of Oregon	Phone: Work:	541-484-1379
		Charleston, OR 97420	Home:	
Sarah	**Dakel**	Biology Department	E-mail:	smdakel@hotmail.com
		Montana Tech of U. Montana	Phone: Work:	406-496-4627
		Butte, MT 59701	Home:	406-782-5796
Jesse	**Dillon**	Department of Biology	E-mail:	jdillon@darkwing.uoregon.edu
		University of Oregon	Phone: Work:	541-346-4530
		Eugene, OR 97403	Home:	
Ellie	**Duffield**	Department of Botany	E-mail:	ecsd@u.washington.edu
		University of Washington	Phone: Work:	206-685-1164
		Seattle, WA 98195-5325	Home:	206-632-1983
Barbara	**Emerson-Seavy**	Biology Department	E-mail:	
		Western Washington University	Phone: Work:	360-475-7732
		Bellingham, WA 98225	Home:	
Rob	**Fitch**	Biology Department	E-mail:	
		Wenatchee Valley College	Phone: Work:	509-662-1651
		Wenatchee, WA 98801	Home:	509-662-5589
Suzanne	**Fredericq**	Department of Biology	E-mail:	slf9209@usl.edu
		University of Southwestern Louisiana	Phone: Work:	318-482-5057
		Lafayette, LA 70504-2451	Home:	318-837-2421
Tess	**Freidenburg**	Department of Zoology	E-mail:	freident@bcc.orst.edu
		Oregon State University	Phone: Work:	541-737-5359
		Corvallis, OR 97330	Home:	541-757-1968
Jeannie	**Gilbert**	Shannon Point Marine Center	E-mail:	gilbert.J@worldnet.att.net
		Western Washington University	Phone: Work:	360-303-2807
		Anacortes, WA 98221	Home:	360-756-1427
Jim	**Golden**		E-mail:	jim.golden@hmsc.orst.edu
		Oregon Department of Fish and Wildlife	Phone: Work:	541-867-4741
		Newport, OR 97365	Home:	541-336-5274
Gayle	**Hansen**	Hatfield Marine Science Center	E-mail:	gayle.hansen@hmsc.orst.edu
		Oregon State University	Phone: Work:	541-867-0200
		Newport, OR 97365	Home:	541-265-4061

Denise	**Hawkes**	Department of Botany University of British Columbia Vancouver, BC		E-mail: Phone: Work: Home: 604-266-4808
Michael	**Hawkes**	Department of Botany University of British Columbia Vancouver, BC		E-mail: mhawkes@unixg.ubc.ca Phone: Work: 604-822-5430 Home: 604-266-4808
Hillary	**Hayden**	Department of Botany University of Washington Seattle, WA	98195	E-mail: hhayden@u.washington.edu Phone: Work: 206-685-8002 Home: 206-632-4173
Eric	**Henry**	Puriponics LLC Corvallis, OR	97330	E-mail: henrye@che.orst.edu Phone: Work: 541-737-3622 Home: 541-757-8159
Catherine	**Hobson**	Department of Biology University of Victoria Victoria, BC		E-mail: Phone: Work: Home: 250-479-3683
Louis	**Hobson**	Department of Biology University of Victoria Victoria, BC		E-mail: lhobson@uvic.ca Phone: Work: 250-721-7124 Home: 250-479-3683
Fran	**Hommersand**	Chapel Hill, NC	27599-3280	E-mail: homersand@bio.unc.edu Phone: Work: Home: 919-967-1745
Max	**Hommersand**	Department of Biology University of North Carolina Chapel Hill, NC	27599-3280	E-mail: homersand@bio.unc.edu Phone: Work: 919-962-6938 Home: 919-967-1745
Rita	**Horner**	School of Oceanography University of Washington Seattle, WA	98195	E-mail: rita@ocean.washington.edu Phone: Work: 206-543-8599 Home: 206-523-2607
Yao-ming	**Huang**	Department of Chemical Engineering Oregon State University Corvallis, OR	97330	E-mail: huangym@che.orst.edu Phone: Work: 541-737-3622 Home: 541-758-3487
Nobu	**Kawasaki**	College of Ocean. and Atmos. Science Oregon State University Corvallis, OR	97330	E-mail: nkawasak@oce.orst.edu Phone: Work: 541-737-0968 Home: 541-754-5994
Young-pil	**Kim**	Department of Botany University of Washington Seattle, WA	98195	E-mail: ypkim@u.washington.edu Phone: Work: 206-543-1627 Home: 206-522-8097
Paul	**Kugrens**	Department of Biology Colorado State University Ft. Collins, CO	80523	E-mail: pkugrens@vines.colostate.edu Phone: Work: 970-491-7551 Home: 970-22900773
Scott	**Larned**	Coastal Ecology Branch US EPA Newport, OR	97365	E-mail: larned.scott@epa.gov Phone: Work: 541-867-4042 Home: 541-265-5186
Sandra	**Lindstrom**	Department of Botany University of British Columbia Vancouver, BC		E-mail: sandracl@unixg.ubc.ca Phone: Work: 604-822-3349 Home: 604-594-9734

Ed	**Lippert**	Department of Biology Portland State University Portland, OR	E-mail: Phone: Work: Home:	algae@gte.net 800-547-8887 503-842-4632
Erin	**Macri**	Shannon Point Marine Center Western Washington University Anacortes, WA 98221	E-mail: Phone: Work: Home:	macri-cc.wwu.edu 360-650-7400 360-756-0790
Ted	**McConnaughey**	1304 Cedar Lane Selah, WA 98942-1717	E-mail: Phone: Work: Home:	coral2@wolfenet.com
Bruce	**Menge**	Department of Zoology Oregon State University Corvallis, OR 97331-2914	E-mail: Phone: Work: Home:	mengeb@bcc.orst.edu 541-737-5358
Todd	**Miller**	Coastal Ecology Branch US EPA Newport, OR 97365	E-mail: Phone: Work: Home:	miller.todd@epa.gov 541-867-5034 541-563-4155
Grant	**Mitman**	Biology Department Montana Tech of the University of Monta Butte, MT 59701	E-mail: Phone: Work: Home:	gmitman@mtech.edu 800-445-tech
June	**Mohler**	Biology Department Mt. Hood Community College	E-mail: Phone: Work: Home:	503-492-0899
Gisele	**Muller-Parker**	Shannon Point Marine Center Western Washington University Anacortes, WA 98221	E-mail: Phone: Work: Home:	gisele@biol.wwu.edu 360-650-7400 360-299-2115
Jan	**Newton**	Washington State Department of Ecology Olympia, WA 98504-7710	E-mail: Phone: Work: Home:	jnew461@ecy.wa.gov 360-407-6675
Brian	**Oates**	Department of Botany University of British Columbia Vancouver, BC V6T 1Z4	E-mail: Phone: Work: Home:	oates@pop.interchg.ubc.ca 604-822-4630 604-222-3525
Karen	**Pelletreau**	Shannon Point Marine Center Western Washington University Anacortes, WA 98221	E-mail: Phone: Work: Home:	n9649832@cc.wwu.edu 360-650-7400 360-714-9848
Brock	**Peters**	Department of Botany University of Washington Seattle, WA 98105	E-mail: Phone: Work: Home:	bpeters@u.washington.edu 206-525-0770
Donna	**Phillips**	Tigard, OR 97223	E-mail: Phone: Work: Home:	donna_phillips@co.washington.or. 503-846-2525 503-590-9617
Naomi	**Phillips**	Department of Biology University of Southwestern Louisiana Lafayette, LA 70504-2451	E-mail: Phone: Work: Home:	nep04130@usl.edu 318-482-5057 318-236-3438
Melanie	**Quenneville**	MB Laboratories Sidney, BC V8L 3S6	E-mail: Phone: Work: Home:	quennevillem@par.dfo-mpo.gc.ca 250-656-1334 250-477-2257

Bob	**Rasmussen**	Department of Biological Sciences Humboldt State University Arcata, CA 95521	E-mail: Phone: Work: Home:	rar1@axe.humboldt.edu 707-826-3260 707-822-5305
Trevor	**Rivers**	Shannon Point Marine Center Western Washington University Anacortes, WA 98221	E-mail: Phone: Work: Home:	n9740089@cc.wwu.edu 360-650-7400 360-752-0295
Mary Ann	**Roberts**	College of Pharmacy Oregon State University Corvallis, OR 97330	E-mail: Phone: Work: Home:	Mary.Ann.Roberts@orst.edu 541-737-5800 541-929-3590
Paul	**Roberts**	Department of Zoology Oregon State University Corvallis, OR 97330	E-mail: Phone: Work: Home:	Paul_Roberts@ous.edu
Kristin	**Rorrer**	Department of Microbiology Oregon State University Corvallis, OR 97330	E-mail: Phone: Work: Home:	rorrerk@bcc.orst.edu 541-753-2848
John	**Rueter**	Department of Biology Portland State University Portland, OR 97207-0751	E-mail: Phone: Work: Home:	rueterj@pdx.edu 503-725-3194 503-247-9661
Steve	**Rumrill**	South Slough National Marine Sanctuary Oregon Division Of State Lands Charleston, OR 97420	E-mail: Phone: Work: Home:	srumrill@harborside.com 541-888-5558
Carl	**Schmidt**	Shannon Point Marine Center Western Washington University Anacortes, WA 98221	E-mail: Phone: Work: Home:	n9710040@cc.wwu.edu 360-650-7400 360-738-3790
Stephanie	**Scott**	Biology Department Wenatchee Valley College Wenatchee, WA 98801	E-mail: Phone: Work: Home:	rfitch@wvcmail.ctc.edu 509-662-1651 509-662-5589
Anne	**Sigleo**	Coastal Ecology Branch US EPA Newport, OR 97365	E-mail: Phone: Work: Home:	sigleo.anne@epa.gov 541-867-5022
Yongsik	**Sin**	Coastal Ecology Branch US EPA Newport, OR 97365	E-mail: Phone: Work: Home:	sin.yongsik@epa.gov
David	**Specht**	Coastal Ecology Branch US EPA Newport, OR 97365	E-mail: Phone: Work: Home:	specht.david@epamail.epa.gov 541-867-4037 541-265-3989
Dick	**Steele**	Coastal Ecology Branch US EPA Bellingham, WA 98226	E-mail: Phone: Work: Home:	rsteele57@aol.com 360-714-8132
Janice	**Steele**	Coastal Ecology Branch US EPA Bellingham, WA 98226	E-mail: Phone: Work: Home:	rsteele57@aol.com 360-714-8132
Teresa	**Steely**	Shannon Point Marine Center Western Washington University Anacortes, WA 98221	E-mail: Phone: Work: Home:	n9641106@cc.wwu.edu 360-650-7400 360-756-1008

Kathy	**Van Alstyne**	Shannon Point Marine Center Western Washington University Anacortes, WA 98221	E-mail: Phone: Work: Home:	kathyva@cc.wwu.edu 360-293-2188 360-299-0614
Jean	**Veluppillai**	Department of Botany University of Washington Seattle, WA 98144	E-mail: Phone: Work: Home:	jeanv@u.washington.edu 206-543-1627 206-322-2140
Bob	**Waaland**	Department of Botany University of Washington Seattle, WA 98195	E-mail: Phone: Work: Home:	jrw@u.washington.edu 206-543-7098 206-523-3036
Sue	**Waaland**	Department of Botany University of Washington Seattle, WA 98195	E-mail: Phone: Work: Home:	sdw@u.washington.edu 206-685-8840 206-523-3036
Pat	**Wheeler**	College of Ocean. and Atmos. Science Oregon State University Corvallis, OR 97330	E-mail: Phone: Work: Home:	pwheeler@oce.orst.edu 541-737-0558 541-838-1436
Ann	**Widdowson**	4635 W. Sanich Road Victoria, BC V8Z 3G7	E-mail: Phone: Work: Home:	awa@islandnet.com 250-479-9167
Tom	**Widdowson**	4635 West Sanich Road Victoria, BC V8Z 3G7	E-mail: Phone: Work: Home:	awa@islandnet.com 250-479-9167
Charles	**Williams**	Department of Botany University of Washington Seattle, WA 98103	E-mail: Phone: Work: Home:	toxin@u.washington.edu 206-685-8002 206-633-1910
Michele	**Wood**	Department of Biology University of Oregon Eugene, OR 97403	E-mail: Phone: Work: Home:	miche@darkwing.uoregon.edu 541-346-0454 541-345-3448