27th NORTHWEST ALGAL SYMPOSIUM PROGRAM

Casey Conference Center, Seattle Pacific University
Coupeville, Washington October 18 – 20, 2013

Friday Afternoon, October 18

15:00 **Registration and Housing Assignments** at COMPANY QUARTERS F

Friday Evening, October 18

18:30 **Dinner** (Mess Hall A)

19:30 **Welcome to the 27th NWAS!** (COMPANY QUARTERS F)
Report on the ISS Meeting from Bali, Indonesia – Rob Fitch
Poster Set up (Company Quarters F -Plan to remove Posters by 11:30 AM Sunday)

20:30 Prepare for field trip to Point Partridge

21:00 Field trip to Point Partridge – carpools will be arranged. Return by 23:00.

Saturday Morning, October 19

07:30 **Breakfast** (Mess Hall A)

08:00 **Registration resumes** in COMPANY QUARTERS F

08:30 **Welcome & Contributed Papers** (COMPANY QUARTERS F)

09:00 TOP DOWN CONTROL OF CANOPY-FORMING KELP BY CRUSTACEAN CONSUMERS
Katie Dobkowski. University of Washington, Department of Biology. kdobkows@uw.edu

09:15 ONTOGENIC STRATEGIES OF KELP SPECIES TO MITIGATE DISLODGEMENT RISK
Sam Starko & Patrick T. Martone. Department of Botany, University of British Columbia, Vancouver, British Columbia

09:30 A COMPARISON OF THE GROWTH, PHOTOSYNTHETIC EFFICIENCY , PROTEIN AND PIGMENT CONTENTS OF TWO SPECIES OF NORTHWEST ATLANTIC NORI UNDER A MATRIX OF CONDITIONS
Lindsay A. Green & Christopher D. Neefus. Department of Biological Sciences, University of New Hampshire, Durham, NH 03824, U.S.A. lae82@wildcats.unh.edu

09:45 CONVERGENT CORALLINES: MATERIAL STRENGTH IN INDEPENDENTLY EVOLVING GENICULA
Kyra G. Janot & Patrick T. Martone. Department of Botany, University of British Columbia, Vancouver, British Columbia. kyra.janot@botany.ubc.ca.

10:00 Coffee/Tea Break

10:30 DO GREEN ALGAL EXUDATES AFFECT SEA URCHIN DEVELOPMENT?
Yolimar Rivera Vázquez[1], Cynthia D. Trowbridge[2], Luke Harman[3], Rob McAllen[3]. [1]Shannon Point Marine Center, Western Washington University; [2]Oregon Institute of Marine Biology, University of Oregon; [3]University College Cork, Ireland. riveray2@students.wwu.edu

10:45 IT'S A STICKY SITUATION: THE EFFECT OF pH ON THE ADHESION OF RED ALGAL SPORES
Guenther, R.[1,2] and Miklasz, K. [2,3] 1-University of British Columbia, 2-University of Washington Friday Harbor Laboratories, 3-Stanford University. rebecca.guenther@botany.ubc.ca

11:00 DIATOMS FROM THE LAKE SHELOKUM HOT SPRINGS IN S.E. ALASKA
Christopher Donar & Melissa Williams. Department of Biology, University of Alaska Southeast-Ketchikan, Alaska. cdonar2@uas.alaska.edu

11:15 Business Meeting (COMPANY QUARTERS F)

12:00 Lunch (Mess Hall A)

Saturday Afternoon, October 19

13:00 Poster Session (COMPANY QUARTERS F) Authors to be available for discussion until 14:30 PM

THE WASHINGTON MARINE VEGETATION ATLAS: AN INTERACTIVE MAP OF KELP, EELGRASS AND OTHER MACROALGAE STUDIES
Kate Sherman, Helen Berry, Lisa Ferrier, Washington State Department of Natural Resources, Olympia, WA; and Allison Bailey, SOUNDGIS, Seattle, WA helen.berry@dnr.wa.gov

THE EFFECTS OF POLYELECTROLYTE THIN FILMS ON DIATOM BIOFILM FORMATION AND MORPHOLOGY
Jeremy Campbell, Nathan Harms, Dustin Harris, Greg Rorrer, Oregon State University, Corvallis, OR

PHYCOLOGICAL EDUCATIONAL ENDEAVORS: ASSESSING ALGAL KNOWLEDGE IN MUSEUMS, ZOOS, AQUARIUMS, AND HERBARIUMS
J.L. Collier[1], R. Fitch[2], J. Jorve[3], R. Kodner[4], J.F. Juhlin[5] and K. Schoenrock[6] rfitch@wvc.edu . 1-Stony brook University, USA; 2-Wenatchee Valley College, USA; 3-University of British Columbia, Canada; 4-Western Washington University, USA: 5-Maine Maritime Academy, USA: 6-University of Alabama at Birmingham, USA.

13:00 **Poster Session** (cont.)

PHYLOGEOGRAPHY OF SPECIES IN THE *MAZZAELLA OREGONA* CLADE (GIGARTINACEAE, RHODOPHYTA) IN THE NORTHEAST PACIFIC
Sandra C. Lindstrom, Department of Botany, University of British Columbia, Vancouver, BC, & Meriadeg Hervieux, PolyTech Clermont Ferrand, France

LARGE-SCALE PHYLOGENETIC ANALYSIS OF MARINE METAGENOMES REVEALS PATTERNS IN PHYTOPLANKTON POPULATION DIVERSITY
Ryan McLaughlin and Robin Kodner, Department of Biology, Western Washington University. mclaughlinr2@gmail.com

EXPLORING THE LIPID CONTENT OF OF AN ACIDIPHILIC ALGA *CHROMULINA FREIBURGENSIS DOFL.* ISOLATED FROM THE BERKELEY PIT.
Lyndsi Jonart and Grant Mitman. Department of Biological Sciences. Montana Tech of The University of Montana, Butte, Montana 59701. Dr.algae@yahoo.com

THE PHYOTOPLANKTON COMMUNITY IN BELLINGHAM BAY
Staci A Nazario and Robin Kodner, Shannon Point Marine Center, Western Washington University, Bellingham, WA. nazarios@spu.edu

14:30 **Free Time!**
Explore Fort Casey/Camp Casey
Hike
Beachcomb
Press algae collected from field trip Friday night
Visit Coupeville
Catch up on old acquaintances – build new acquaintances!
Network with colleagues
Nap!

Saturday Evening, October 19

17:30 **Pre-Banquet Social** (Chief's Club, Whidbey Island Naval Air Station – see map in program)

18:30 **NWAS Banquet** (Chief's Club)

19:30 **NWAS Banquet Speaker: Dr. Patrick Martone**, Department of Botany, University of British Columbia, Canada.
The World Famous NWAS auction follows the banquet speaker – bring your checks and cash!

Sunday Morning, October 20

07:30 **Breakfast** (Mess Hall A)

09:00 **Contributed Papers** (COMPANY QUARTERS F)

09:00 USING FLOW CYTOMETRY TO EXPLORE GENOME SIZE AND EVOLUTIONARY DIVERSIFICATION IN CORALLINE ALGAE
Katy Hind and Patrick Martone. Department of Botany, University of British Columbia, Vancouver, British Columbia. katharine.hind@botany.ubc.ca

09:15 DEPENDENCE OF CELL PRODUCTIVITY ON NUTRIENT AND LIGHT DELIVERY FOR CULTIVATION OF THE DIATOM CYCLOTELLA IN A BUBBLE COLUMN REACTOR
Altan Ozkan and Greg Rorrer, School of Chemical, Biological, and Environmental Engineering, Oregon State University altanoezkan@gmail.com

09:30 MARINE ALGAE ON JAPANESE TSUNAMI DEBRIS AND THE RISK OF INVASION – (Part 1)
Gayle I. Hansen. Department of Botany and Plant Pathology, Oregon State University, Newport, Oregon. gaylehansen@q.com

09:45 MARINE ALGAE ON JAPANESE TSUNAMI DEBRIS AND THE RISK OF INVASION – (The Sequel . . .)
Gayle I. Hansen. Department of Botany and Plant Pathology, Oregon State University, Newport, Oregon. gaylehansen@q.com

10:00 Coffee/Tea Break

10:30 INITIAL CHANGES IN KELP BEDS IN RESPONSE TO ELWHA DAM REMOVAL
Helen Berry, Washington State Department of Natural Resources, Olympia, WA. helen.berry@dnr.wa.gov

10:45 OXYGEN: CAN'T LIVE WITH IT AND CAN'T LIVE WITHOUT IT
Dylan Cottrell[1], Cynthia D. Trowbridge[1], John Davenport[2], Rob McAllen[2], Colin Little[3]. [1]Oregon Institute of Marine Biology, University of Oregon; [2]University College Cork, Ireland; [3]Beggars Knoll, Westbury, UK cdt@uoregon.edu

11:00 CHANGES IN BROWN SEAWEED DISTRIBUTIONS IN LOUGH HYNE, SW IRELAND: A LONG-TERM PERSPECTIVE
Cynthia D. Trowbridge[1], Colin Little[2], Brittney Dlouhy-Massengale[1], Penny Stirling[2] and Graham M. Pilling[3]
[1] Oregon Institute of Marine Biology, University of Oregon; [2] Beggars Knoll, Westbury, UK;
[3] Secretariat of the Pacific Community, New Caledonia cdt@uoregon.edu

11:15 SPATIAL DISTRIBUTION OF THE NUTRIENT PLUME EMANATING FROM AN INTEGRATED MULTI-TROPHIC AQAUCULTURE (IMTA) FARM IN BRITISH COLUMBIA: USE OF AN IN SITU KELP BIOASSAY.
Emrys Prussin. Department of Geography, University of Victoria, Victoria, British Columbia.

11:30 Closing comments, instructions for clean-up of rooms
Take down posters if you have not already done so.

12:00 **Lunch (**Mess Hall A - Sack Lunch - is part of the meal plan)
Clean up and check out. Have a safe trip home and thank you for attending!

ORAL PRESENTATION ABSTRACTS:

INITIAL CHANGES IN KELP BEDS IN RESPONSE TO ELWHA DAM REMOVAL

Helen Berry, Washington State Department of Natural Resources, Olympia, WA.
helen.berry@dnr.wa.gov

This study documents short-term changes in kelp abundance and distribution following initiation of the Elwha River Restoration Project, the largest dam removal project in U.S. history. Dam removal began in 2011, reintroducing millions of tons of sediment that was formerly trapped in reservoirs into the river and adjacent nearshore. We surveyed approximately 50 km of shoreline near to the Elwha River mouth, an area identified by the Elwha River Nearshore Consortium and sub-divided into reference and impact sections. Understory kelp was surveyed with towed underwater videography, and floating kelp canopies were surveyed with aerial photography. In the first year following dam removal work, profound changes were observed in both understory kelp and floating kelp. Understory kelp coverage changed from extensive to virtually absent near the river mouth. The magnitude of change decreased with distance from the mouth of the river, as measured by change in total vegetated area and cover class within vegetated areas. Floating kelp canopy area decreased markedly throughout the study area, continuing an observed long term decadal decrease in floating kelp canopies in the eastern Strait of Juan de Fuca. Much work is needed to understand the factors that are driving the observed changes, such as light limitation, scour, and burial.

TOP DOWN CONTROL OF CANOPY-FORMING KELP BY CRUSTACEAN CONSUMERS

Katie Dobkowski. University of Washington, Department of Biology. kdobkows@uw.edu

Bull kelp (*Nereocystis luetkeana*) plays an important ecological role in nearshore subtidal ecosystems around the Salish Sea, including primary production, supply of detrital material, and creation of three-dimensional habitat for other species. Large crustacean consumers such as the northern kelp crab (*Pugettia producta*) may influence kelp distribution and abundance. Exclusion cages at a subtidal field site near Point Caution on San Juan Island were used to assess herbivory on juvenile *N. luetkeana*. The four treatments, each utilizing a concrete block with attached juvenile bull kelp, were: unenclosed, partially mesh enclosed, fully mesh enclosed, and fully mesh enclosed with *P. producta* inside. The only treatment in which juvenile bull kelp increased in mass or blade length was the fully caged treatment. In a laboratory feeding trial, kelp crabs were starved for 12 hours, then allowed to feed for 12 hours on two similar-sized pieces of *N. luetkeana*. One of the pieces was freshly collected and the other aged in a dark, flowing seawater tank for one week. On average, *P. producta* consumed 6.01336 g of fresh blade and 1.52482 grams of aged blade. The results of these experiments indicate that kelp crabs may sometimes play a detritivore role in kelp forest food webs but may

exert top-down control on bull kelp distribution and abundance when kelp sporophytes are small and therefore more vulnerable to catastrophic herbivory.

DIATOMS FROM THE LAKE SHELOKUM HOT SPRINGS IN S.E. ALASKA

Christopher Donar & Melissa Williams. Department of Biology, University of Alaska Southeast-Ketchikan, Alaska. cdonar2@uas.alaska.edu

We conducted a biotic survey of freshwater diatoms from geothermal springs in the vicinity of Lake Shelokum, Alaska, in July 2013. Periphyton samples were collected along a temperature gradient from a source geothermal spring. Surface temperatures of the geothermal pools ranged from 87 to 42^{o} C and pH values ranged from 7-7.5. Structurally complex biofilms containing distinctively colored layers of thermophilic filamentous bacteria, coccoid cyanobacteria, and diatoms were observed. Diatom abundance and species diversity was greatest in geothermal pool R-8 (temperature 74^{o} C) and geothermal source pool S-4 (temperature 87^{o} C). Diatom floras were composed primarily of *Eunotia* spp., *Frustulia* spp., *Achnanthes* spp., and *Gomphonema* spp. Diatom samples taken from the surface of biofilms in geothermal source pool S-4 contained a virtual monoculture of the diatom, *F. rhomboides* var. *saxonoica*. Motile benthic diatoms and epiphytic diatoms were the dominate biotopes observed. Lake Shelokum contained some *Eunotia* spp., and *Frustulia* spp. in common with the geothermal pools. We compared diatom taxonomic diversity and relative abundance of the Lake Shelokum hot springs with those reported from Kuril and Sakhalin islands of Russia (Nikulina & Kociolek 2011). Diatom floras in the Lake Shelokum hot springs are unique and diverse, due to numerous microhabitats created by temperature gradients in the geothermal streams and pools.

A COMPARISON OF THE GROWTH, PHOTOSYNTHETIC EFFICIENCY, PROTEIN AND PIGMENT CONTENTS OF TWO SPECIES OF NORTHWEST ATLANTIC NORI UNDER A MATRIX OF CONDITIONS

Lindsay A. Green & Christopher D. Neefus. Department of Biological Sciences, University of New Hampshire, Durham, NH 03824, U.S.A. lae82@wildcats.unh.edu

In the Northwest Atlantic, there is growing interest in seaweed aquaculture. *Porphyra umbilicalis* Kützing is a species of the economically important red seaweed nori that reproduces only asexually in the Northwest Atlantic. *Pyropia leucosticta* (Thuret) Neefus & J. Brodie is closely related to commercially produced nori species. This study aimed to determine the growth rate, photosynthetic efficiency, pigment and protein content of *P. umbilicalis* and *P. leucosticta* grown under different temperatures, light levels, and photoperiods. Independently controlled water baths maintained temperature (10°, 15°, and 20°C), while neutral density filters controlled light levels (250, 110, 60, and 30 µmol photons m^{-2} s^{-1}), and separate growth chambers regulated photoperiods (8:16, 12:12, and 16:8 light: dark). Both species grew best at 10-15ºC and above 110 µmol photons m^{-2} s^{-1} light. *Pyropia leucosticta* had a higher growth rate under all conditions (10.17% day^{-1} and 7.06% day^{-1}, respectively, at 10ºC). Temperature had a significant effect on growth of *P. leucosticta* ($p=0.0004$) but that effect was dependent on photoperiod for *P. umbilicalis* ($p=0.0081$). Photosynthetic efficiency was negatively affected by increasing light level in both species although *P. leucosticta* had lower efficiency at all light levels. Temperature had a significant effect on phycobilin content in *P. umbilicalis* with R-phycoerythrin (R-PE; $p=0.003$) and R-phycocyanin (R-PC; $p=0.0123$) content highest at 10ºC.

Temperature also had a significant effect on the R-PE ($p=0.0034$) and R-PC ($p=0.0216$) content of *P. leucosticta* but content was highest at 20ºC. Overall, *Pyropia leucosticta* performed better than *Porphyra umbilicalis,* exhibiting higher growth rates and pigment content.

IT'S A STICKY SITUATION: THE EFFECT OF pH ON THE ADHESION OF RED ALGAL SPORES

Guenther, R.[1,2*] and Miklasz, K.[2,3]1-University of British Columbia, 2-University of Washington Friday Harbor Laboratories, 3- Stanford University
rebecca.guenther@botany.ubc.ca

Algal spores are a rarely studied, yet, extremely important stage of the life cycle of an alga. Whether or not a spore can settle and germinate ultimately determines if the alga can grow and reproduce to complete its life cycle. The adhesive properties of algal spores are affected by abiotic factors such as temperature, and it is likely that they also respond to other abiotic factors. The decrease in pH of the world's oceans caused by increased dissolution of atmospheric CO2, termed ocean acidification, is hypothesized to have effects on mature seaweeds, especially calcified species, but the broad effects of pH on spore adhesion have not been studied. This study examined the effect of pH on red algal spore adhesion and time to settlement of a common intertidal red alga, *Pterosiphonia bipinnata*. We found that a reduction in pH to 7.3 from ambient (7.75) delays the time to attachment of this species. Under ambient pH, spores settled in about 15 hours, however, at low pH, it took spores 26 hours to settle. We also documented a trend in the reduction of strength with which spores attach in the lower pH treatment. Our results suggest that acidification may have unanticipated broadscale effects on many seaweed communities, not just those species that calcify. Future studies will help resolve these intriguing patterns.

MARINE ALGAE ON JAPANESE TSUNAMI DEBRIS AND THE RISK OF INVASION

Gayle I. Hansen. Department of Botany and Plant Pathology, Oregon State University, Newport, Oregon. gaylehansen@q.com

Approximately 50 species of marine algae have been identified from Japanese debris arriving on Oregon and Washington shores from the Great Tohoku Earthquake and Tsunami. Of these, 76% were found to be fertile and dropping spores. By examining the prevalence of the species on debris, their life forms, successional types, and world distributions, it has been possible to evaluate the risk of recruitment and possible invasion. The diagnostic features of the more unusual algal species will be illustrated in the talk.

USING FLOW CYTOMETRY TO EXPLORE GENOME SIZE AND EVOLUTIONARY DIVERSIFICATION IN CORALLINE ALGAE

Katy Hind and Patrick Martone. Department of Botany, University of British Columbia, Vancouver, British Columbia. katharine.hind@botany.ubc.ca

Molecular approaches to taxonomy have improved our ability to quantify the number of species present across a diversity of taxa. However our understanding of the evolutionary mechanisms that give rise to taxonomic diversity is poorly understood. Polyploid transitions have been documented in land plants and are estimated to have occurred in 95% of fern species and 70%

of angiosperms at some point in their evolutionary history. For algae, preliminary data suggest that polyploidy has played a role in speciation, yet nuclear DNA content estimates have been published for less than 1% of all algal lineages; hence the role of genome duplications in the diversification of algal species remains unknown. The red algal order Corallinales is a species-rich lineage of calcifying macroalgae that encompasses two predominant morphological forms: (1) prostrate crusts and (2) erect, articulated fronds composed of calcified and non-calcified segments. Limited data suggest that articulated taxa have more than double the DNA content of crustose species, suggesting that genome duplications are involved in the evolutionary diversification of these morphological forms. We have developed novel protocols to estimate genome sizes for several genera and species of coralline algae using flow cytometry. This promising method will provide the data necessary to infer patterns of evolutionary diversification between crustose and articulated taxa.

CONVERGENT CORALLINES: MATERIAL STRENGTH IN INDEPENDENTLY EVOLVING GENICULA

Kyra G. Janot & Patrick T. Martone. Department of Botany, University of British Columbia, Vancouver, British Columbia. kyra.janot@botany.ubc.ca.

For upright macroalgae in the wave-swept intertidal and subtidal, the ability to bend over and reduce drag when hit by waves is necessary for survival. While fleshy seaweeds are flexible throughout their thalli, articulated corallines bend only at discrete uncalcified joints along otherwise calcified fronds. These joints, called genicula, must simultaneously resist breakage due to stress while remaining sufficiently flexible to allow whole fronds to bend in flow. The importance of joints to the survival of upright corallines is indicated by the thrice-repeated independent evolution of these structures, which has led to three subfamilies: the Amphiroideae, the Corallinoideae, and the Metagoniolithoideae. Mechanical tests were performed on representative species from these three groups, in order to compare the material properties of genicula thought to be most relevant to bending performance in waves. Strength was investigated at the level of the whole plant, tissue, and cell wall. Similarities and differences are discussed in the context of previously described development and structure, as well as chemical components currently being investigated.

DEPENDENCE OF CELL PRODUCTIVITY ON NUTRIENT AND LIGHT DELIVERY FOR CULTIVATION OF THE DIATOM CYCLOTELLA IN A BUBBLE COLUMN REACTOR

Altan Ozkan and Greg Rorrer, School of Chemical, Biological, and Environmental Engineering, Oregon State University altanoezkan@gmail.com

Algal photobioreactors have been researched for production of algal biomass and metabolites that have potential uses in energy, pharmaceutical, and food industries. The productivities of algal photobioreactors are highly dependent on the controlled environments created within these systems. For diatoms, the most important parameters that control the growth include the photosynthetically active radiation that is delivered and, the delivery and consumption of CO_2, and the initial concentrations of macronutrients such as nitrogen and silicon. To better analyze and understand the relation between cell productivity and these parameters, an experimental study was conducted using a bubble column photobioreactor system that allows the control of the photosynthetically active radiation received by the algal cells, and online monitoring of CO_2

available for algal growth and rate of its fixation. In addition, the nitrate and silicon uptake rates were determined to characterize their effects in biomass productivity. The results show that (i) the final cell density of the photobioreactor until light control was determined by silicon provided for growth, (ii) volumetric CO_2 consumption rates during the light phase of the photoperiod were similar for both log and lag phases of the cultivation, and (iii) compared to CO_2 uptake, the nitrogen uptake rate of the algal cells decreased during the lag-phase of growth, which may suggest an increase in production of metabolites that do not contain nitrogen i.e. lipids and polysaccharides.

SPATIAL DISTRIBUTION OF THE NUTRIENT PLUME EMANATING FROM AN INTEGRATED MULTI-TROPHIC AQAUCULTURE (IMTA) FARM IN BRITISH COLUMBIA: USE OF AN IN SITU KELP BIOASSAY.

Emrys Prussin. Department of Geography, University of Victoria, Victoria, British Columbia.

In-situ kelp bioassays were employed to assess the spatial distribution of nutrient wastes around an open-water integrated fish/mollusk/kelp farm. Growth rates were measured over a four-month growing season and used as a proxy for relative nutrient concentrations. The experiment identified significantly different rates of growth around the local farm vicinity compared to up to 700 m away at a control. Growth around the pens was 0.20 cm $\cdot$ day^{-1} higher than at the control, and reached a maximum of 1.4 cm $\cdot$ day^{-1}. Around the pen system the highest growth occurred to the south of the pens extending from west to east. This shows that nutrients are concentrated in these areas of higher growth. To make this conclusion, we have assumed that all other abiotic conditions are similar due to the small size of the bay. These results on the spatial distribution of the nutrient plume are site specific and show that optimal kelp sitting is to the south of the pens. IMTA represents a means of mitigating nutrient loading from fish farm operations and this study re-iterates this fundamental benefits.

ONTOGENIC STRATEGIES OF KELP SPECIES TO MITIGATE DISLODGEMENT RISK

Sam Starko & Patrick T. Martone. Department of Botany, University of British Columbia, Vancouver, British Columbia

High water velocities caused by crashing waves impose great drag forces on the thalli of intertidal seaweeds. The largest, habitat-forming species of macroalgae are kelps (Order Laminariales). Because drag is directly, and positively, correlated to size, kelps have evolved strategies that reduce dislodgement risk of large, sexually mature plants. Within a wide repertoire of growth strategies, kelps can both (1) streamline as they grow, demonstrating better hydrodynamic performance with increased size, and (2) increase their attachment strength to the substratum, so as to tolerate the increased forces. In this study, streamlining and attachment strategies were quantified, empirically, for several species of wave-exposed intertidal kelp. Preliminary data suggests that streamlining and tolerance strategies are negatively correlated, presumably due to the cost that each strategy incurs.

OXYGEN: CAN'T LIVE WITH IT AND CAN'T LIVE WITHOUT IT

Dylan Cottrell[1], Cynthia D. Trowbridge[1], John Davenport[2], Rob McAllen[2], Colin Little[3].
[1]Oregon Institute of Marine Biology, University of Oregon; [2]University College Cork, Ireland;
[3]Beggars Knoll, Westbury, UK cdt@uoregon.edu

Ephemeral macroalgae are proliferating on wave-sheltered, nutrient-enhanced shores throughout the world. During a 20-year monitoring study of Europe's first marine reserve (Lough Hyne Marine Reserve in SW Ireland), we documented the increased occurrence of ulvoid and ectocarpoid mats forming a thick blanket on the low intertidal and shallow subtidal benthos. In 2010, we started measuring oxygen levels (1) in the seawater above and below shallow subtidal rocks and (2) within stands of perennial seaweed and ephemeral algae. During sunny days, dissolved oxygen levels increased substantially, often to hyperoxic levels, in submerged rocky shore communities whereas under-rock oxygen levels were typically hypoxic to anoxic. At night, dissolved oxygen levels in the water column plummeted to hypoxic levels (except during strong winds). Recent declines of mobile and sessile benthic invertebrates (e.g., sea urchins, sponges, bryozoans, ascidians, etc.) in the lough coincide closely with the summer hyperoxia/hypoxia in shallow water. The oxygen fluctuations may be defaunating the marine reserve.

CHANGES IN BROWN SEAWEED DISTRIBUTIONS IN LOUGH HYNE, SW IRELAND: A LONG-TERM PERSPECTIVE

Cynthia D. Trowbridge[1], Colin Little[2], Brittney Dlouhy-Massengale[1], Penny Stirling[2] and Graham M. Pilling[3]
[1] Oregon Institute of Marine Biology, University of Oregon; [2] Beggars Knoll, Westbury, UK;
[3] Secretariat of the Pacific Community, New Caledonia cdt@uoregon.edu

Distributions of brown seaweeds (Phaeophyceae: Fucales, Laminariales and Tilopteridales) were surveyed in 2011 in Europe's first marine reserve, Lough Hyne in SW Ireland and compared with distributions from three historical surveys (1930, 1955 and 1980). The most salient phycological differences were the incursion of the low intertidal and shallow subtidal species *Fucus serratus*, *Himanthalia elongata*, and *Saccharina latissima* into the north basin of the marine reserve after the recent mass mortality of the purple urchin (*Paracentrotus lividus*). Monitoring surveys (1990–2012) at 10 sites in the lough indicated that populations of *S. latissima* peaked in 1994, abruptly crashed in 1996, and then slowly recovered. As well as documenting the expansion of kelp, our annual, whole-lough snorkel surveys (2004–2012) demonstrated the recent proliferation of the introduced *Sargassum muticum* and native *Cystoseira foeniculacea*. Although the causal role of top-down factors (fishing ban and/or urchin population crash), bottom-up factors (nutrient enhancement), climatic variables (warming vs. episodic cooling), and pathogens (urchin and algal) is being widely debated, decadal-scale and inter-annual changes are clearly detectable and most consistent with a release from herbivory within the marine protected area.

DO GREEN ALGAL EXUDATES AFFECT SEA URCHIN DEVELOPMENT?

Yolimar Rivera Vázquez[1], Cynthia D. Trowbridge[2], Luke Harman[3], Rob McAllen[3]. [1]Shannon Point Marine Center, Western Washington University; [2]Oregon Institute of Marine Biology, University of Oregon; [3]University College Cork, Ireland. riveray2@students.wwu.edu

Green macroalgal blooms, or so called "green tides", are known to contain chemicals that can be exuded when the algae encounter stress conditions, such as desiccation by exposure to sunlight during low tides. The effects of these exudates could negatively affect the planktonic larval stages of marine invertebrates that drift into areas where green algae bloom. This study addressed the effects of *Ulva intestinalis* and *Codium vermilara* exudates on different developmental stages of the purple sea urchin *Paracentrotus lividus* as a possible causal explanation for the drastic urchin decline at Europe's first marine reserve, Lough Hyne, in SW Ireland. Light microscopy was used to determine the fertilization and early development success and image analysis was used to evaluate larval morphology after the exposure to the algal exudates. Only *U. intestinalis* exudates negatively affected the fertilization success of *P. lividus* when the algae were highly stressed. Our study indicates that exudates from *U. intestinalis* could have contributed to the decline of *P. lividus* at Lough Hyne.

POSTER ABSTRACTS

THE WASHINGTON MARINE VEGETATION ATLAS: AN INTERACTIVE MAP OF KELP, EELGRASS AND OTHER MACROALGAE STUDIES

Kate Sherman, Helen Berry, Lisa Ferrier, Washington State Department of Natural Resources, Olympia, WA; and Allison Bailey, SOUNDGIS, Seattle, WA helen.berry@dnr.wa.gov

Greater access to historical and current marine vegetation data is needed to guide management decision-making, support scientific research, and assess change over time. The Marine Vegetation Atlas will provide access to information on eelgrass, kelp, and other marine vegetation throughout Washington State. Historical and current observations from a broad range of sources, including large area inventories, research studies, and permit-related site surveys were compiled into a spatial geodatabase. The first version of this spatial inventory of marine vegetation data will be available for use through a web-based interactive map in 2014. The Atlas will be accessible through DNR's website for use by managers, policy makers, scientists, and the general public. This poster presentation includes a live demo of the interactive mapping application.

THE EFFECTS OF POLYELECTROLYTE THIN FILMS ON DIATOM BIOFILM FORMATION AND MORPHOLOGY

Jeremy Campbell, Nathan Harms, Dustin Harris, Greg Rorrer, Oregon State University, Corvallis, OR

Diatoms are single celled photosynthetic marine organisms that play a critical role in biofilm formation on submerged surfaces. Understanding how surface properties affect the formation of biofilms has implications for the prevention of biofouling and for the successful fabrication of engineered biofilms of marine diatoms. In this study, the role of surface charge on diatom adhesion and biofilm morphology was investigated. Substrates with positive and negative surface charge were prepared by adsorbing cationic and anionic polyelectrolyte thin films on glass slides, respectively. Multilayer films were prepared by alternately adsorbing cationic and anionic polymers several times, amplifying the exposed charge on the substrate surface. Improved adhesion and dispersion of the benthic diatom *Pinnularia* sp. were measured on positively charged surfaces relative to controls and negatively charged polyelectrolyte films. Diatom adhesion and dispersion on multilayer films was improved relative to controls regardless of the charge of the uppermost surface, although negatively terminated surfaces showed smaller improvements than multilayer films terminated in a positively charged layer. This data suggests that diatoms have a strong affinity for positively charged surfaces and that they may be capable of interacting with buried positive charge in heterogeneous surface films.

PHYCOLOGICAL EDUCATIONAL ENDEAVORS: ASSESSING ALGAL KNOWLEDGE IN MUSEUMS, ZOOS, AQUARIUMS, AND HERBARIUMS

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Public knowledge of algae is often limited. For example, initial reactions to the workd "algae" are frequently neutral to negative in tone. To gain perspective into how phycology is taught to public audiences (ranging from children to adults) the Phycological Society of America (PSA)'s Education Committee developed and deployed an online survey to assess how algae are curated, displayed, and interpreted in museums, zoos, aquariums and herbariums. These data will inform the PSA Education Committee on how to improve algal education across a wide spectrum of audiences and knowledge bases.

PHYLOGEOGRAPHY OF SPECIES IN THE *MAZZAELLA OREGONA* CLADE (GIGARTINACEAE, RHODOPHYTA) IN THE NORTHEAST PACIFIC

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We examined genetic variation among isolates of species in the *Mazzaella oregona* clade: *M. oregona, M. parksii, M. phyllocarpa,* and *Mazzaella* sp. (this species has been described, but a new combination has yet to be made in *Mazzaella*) using the nuclear ribosomal ITS region, the chloroplast *rbc*L gene, and the mitochondrial *COX*1 "barcoding" gene. Based on our and published results, *Mazzaella oregona* is distributed from southern California to Kodiak Island, Alaska. There is little genetic variation in populations from California to Alaska except for a distinctive genotype found in individuals from the eastern Strait of Juan de Fuca in southern British Columbia and northern Washington and near Prince Rupert in northern BC. *Mazzaella parksii* is distributed from Mendocino Co., CA, north and westward to at least the westernmost Aleutian Island, Attu, Alaska. Populations show significant differentiation between southeastern populations (from southern Oregon to the Kodiak archipelago, Alaska) and northwestern populations (from the Kodiak archipelago to Attu Island, Alaska). *Mazzaella phyllocarpa* is recorded from Russia to Southeast Alaska and north to St. Lawrence Island in the northern Bering Sea. Although there is genetic variation among specimens from Alaska, there is no geographic pattern to this variation. *Mazzaella* sp. is distributed from the Commander Islands, Russia, to northern Vancouver Island, British Columbia. Although there is variation among individuals, there is little geographic pattern to this variation. These results resemble those found for other intertidal marine organisms in the northeast Pacific in that the high intertidal species showed the most phylogeographic differentiation, and a biogeographic break appears in the northwestern Gulf of Alaska for at least one of the species.

LARGE-SCALE PHYLOGENETIC ANALYSIS OF MARINE METAGENOMES REVEALS PATTERNS IN PHYTOPLANKTON POPULATION DIVERSITY

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Microbial organisms make up the vast majority of the diversity found on earth. They play key roles in biological processes which multicellular life relies upon. The importance of microeukaryotic phytoplankton in global biogeochemistry is well known. Like with prokaryotes few have been successfully cultured and remain undercharacterized. As an alternative to culturing, environmental gene surveys, including new metagenomic tools, allow for broad surveys of diversity of the total microbial community in any given environment. The key to using this sequence data to define diversity of a sample is accurate taxonomic/phylogenetic identification of each sequence. Phylogenetic placement software, such as pplacer, can be used in high-throughput on environmental metagenomic data-sets to define the scope of genetic diversity of a sample. In this study, pplacer was used to analyze 101 environmental metagenomes from the CAMERA database to gain insight into diversity and functional differences of microbial populations over a latitudinal gradient. The pilot study focused on 206 genes associated with chloroplasts to focus on phytoplankton members of the microbial populations. Principle components analysis was used to determine similarities between metagenomes and alpha-diversity measures were calculated to further understand the microbial communities.

EXPLORING THE LIPID CONTENT OF OF AN ACIDIPHILIC ALGA *CHROMULINA FREIBURGENSIS DOFL.* ISOLATED FROM THE BERKELEY PIT

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The amount of lipid contained within an algal cell is one of the determining factors used to ascertain whether or not algae may have the potential to be used as biofuels. This study evaluated the lipid production of the acidophilic chrysophyte alga *Chromulina freiburgensis* as a prospective model organism for third generation biofuels. The three medium conditions used for this study were a control (modified acid medium with no alterations), more nitrogen (modified acid medium containing an increased nitrogen content), and more nitrogen and phosphorous (modified acid medium containing an increased nitrogen and phosphorous content). The control produced the greatest percentage of lipids, whereas, the nitrogen and nitrogen/phosphorous variables both produced a smaller percentage of lipids, but an increase in growth of algae/ml.

THE PHYOTOPLANKTON COMMUNITY IN BELLINGHAM BAY

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Bellingham Bay is an excellent sampling site to measure phytoplankton and how they interact with hypoxia because it is known to have DO (dissolved oxygen) concentrations as low as $2mgL^{-1}$. We had samples 3 sites in Bellingham Bay: ELIZA (an open ocean input), BB6 (the center of hypoxia) and NS10 (a freshwater input) over 5 weeks in July-Aug 2013. We used microscopy and flow cytometry to measure the phytoplankton communities. The phytoplankton communities differed by depth although the surface samples were highly consistent throughout the sites. The small plankton community contributed to most of the chlorophyll levels recorded. There were no clear patterns about what site or depth had the most diversity. Nurtrients and 18S ssu rDNA analyses are ongoing and will give a more specific picture of what plankton are present and how nutrient levels affect those plankton. This is part of an ongoing sampling and monitoring of Bellingham Bay.