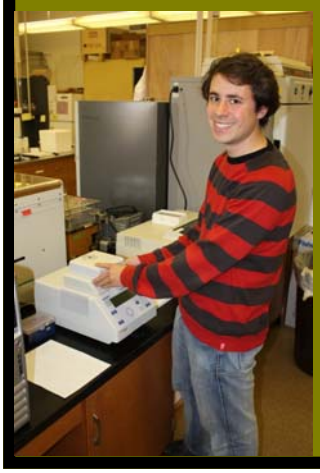
December 2008

DEPARTMENT OF MICROBIOLOGY

OBSERVE

WONDER



DISCOVER

Research and Higher Education

positive strand RNA viruses ◆ cyanobacterial blooms ◆ Bacterial N metabolism and bioremediation ◆ Yeast physiology and fermentation ◆ infections of fish ◆ Mycobacterial and related infectious agents ◆ bacterial physiology ◆ soil nitrogen cycle ◆ Microbial Ecology ◆ rumen microbes and detoxification ◆ bacterial ecology ◆ markers of fecal pollution ◆ bacterial vaccines ◆ dairy bacteriology ◆ bacterial ecology and genomics ◆ ocean bacteria ◆ pathogenesis of vibrio ◆ Vaccinia virology ◆ bioterrorism ◆ parasitology ◆ Zebrafish health ◆ Chemical challenges to the immune system ◆ virology ◆ herpes viruses and latency ◆ immunology ◆ Francisella tularensis ◆ HIV ◆ Influenza ◆ bacterial genetics ◆ gene transfer by Agrobacterium ◆ Chlamydia pathogenesis ◆ DNA viruses ◆ baculoviruses ◆ biology of food poisoning Clostridia ◆ quorum-sensing and biofilm formation in *Pseudomonas aeruginosa* ◆ biosensors ◆ pedagogy in science

OSU Oregon State University

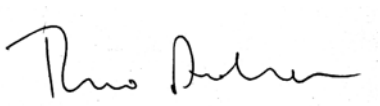
FROM THE CHAIR:

Greetings to friends and alumni of the Department of Microbiology at the end of a year that will be remembered by all of us for some time. The political shift brought by the last election and the economic turmoil are factors that will be shaping the next few years. However those changes play out, the field of microbiology is likely to continue to play an important role in society, through its connection to medicine and food systems. Microbiology may even achieve a higher profile because of increasing recognition of the large contributions of microbial communities to the biology of planet Earth. It has become clear that the contributions of microbes need to be considered in predicting and following the changes brought by global warming. We intend to invest in that area with our next Assistant Professor hire, in the field of Environmental Microbiology.

This newsletter highlights some of the truly exciting things that are happening in the Department, both in the research we do and in our teaching. Research projects never stand still. They change in response to evolving funding opportunities that are reflective of societal goals, in response to evolving interests of professors and opportunities afforded by collaborations with colleagues, and sometimes because of unexpected turns that result from research discoveries. One thing's for sure: the results we get are rarely predictable, emphasizing the importance of doing the research rather than simply modeling expected outcomes to better understand our world.

The element of surprise is what makes research such an interesting endeavor. These days, we try to expose most of our undergraduate majors to that aspect of science, because it can light a spark of interest in a particular career direction or at least give them a flavor of how scientific information accumulates. Undergraduates participating in real research are now a common sight in our labs. It's an extension of the training provided by traditional lecture and lab classes that brings students in close contact with professors, postdocs, technicians and graduate students. This experience can result in skills that give a student the edge in the job market after graduation or in graduate school applications. Undergraduate students are contributing authors on some of our journal papers in recognition of their assistance in getting real research done.

I hope you feel proud of your past association with the Department of Microbiology when you read of our current endeavors. Although the coming year will bring budget problems, OSU is will remain a great place for education and research, and we intend to keep this department at the forefront of innovation. With best wishes for a happy and peaceful Holiday Season and 2009,



INNOVATION IN THE CLASSROOM

MB 230 Introduction to Microbiology is the department's non-majors microbiology course. Designed to fulfill the baccalaureate core requirements for non science majors the course serves students from about 20 different departments each term. In addition to fulfilling bac-core requirements for a science course with lab, MB230 is required for majors such as Chemical Engineering, Dietetics, and Animal Science. The broad range of students' backgrounds and lectures of approximately 200 students can be a challenge, but over the last three years Drs. Stephanie Yarwood and Linda Bruslind have introduced new technology to engage students and make the course more effective.

Starting in 2006-2007, Dr. Bruslind introduced a classroom response system into the course, and when Dr. Yarwood was hired to teach the class in 2007-2008 she continued to use the system. Each student provides or checks out a Quizdom remote. The remote allows them to answer a variety of questions that the instructor poses throughout the class period. For instance students may be asked a multiple choice question in preparation for an exam or to give an opinion about a controversial scientific issue. The immediate feedback allows the instructor to assess students' understanding and make adjustments and can provide a springboard for class discussion. Students come to class ready to interact and this system removes some of the barriers associated with large classes.

In addition to the classroom response system, Dr. Yarwood has also incorporated other forms of in-class activities. Instead of a straight lecture format, students regularly work in small groups to fill in tables, discuss questions, and review material. During summer term, students played games such as "Microbiology Jeopardy" in preparation for exams; Dr. Yarwood is currently working on ways to include these games in the larger lectures. Through homework assignments, students also learn to make good use of the World-Wide Web. It can be difficult for students new to microbiology to know what internet sources can be trusted. Homework assignments steer them to trustworthy websites such as those of The American Society for Microbiology and the CDC Centers for Disease Control. The main goal of MB 230 is to engage the broader student population and demonstrate the importance of microbiology in everyday life. Students often leave the course amazed that microbiology is of central importance in broad topic areas such as foods, medicine, agriculture, industry, and the environment.

JANINE TREMPY LAB

The Trempy research program received quite a bit of press time since the recent publication of a discovery in Microbial Biotechnology. Student involvement in this work was key to this success. This publication, titled, *Erythrophore cell response to food-associated pathogenic bacteria: implications for detection*, describes a novel technology for detecting pathogenic bacteria that contaminate food. This new technology is built on the unusual characteristics of certain "chromatophore" or pigment bearing cells, called erythrophores, from Siamese fighting fish. Our research found that when Siamese fighting fish encounter certain stressful or threatening environmental conditions, such as exposure to toxin producing bacteria like *Bacillus cereus*, *Salmonella*, *Clostridium perfringens* and *Clostridium botulinum*, the erythrophores change appearance, and the pigment moves in a characteristic pattern to an internal part of the cell. The change in pigment location in response to these pathogenic bacteria is rapid, obvious and can be numerically described. This patented technology has the potential to directly assess the toxic behavior of the contaminating bacteria, not just detect the simple presence of the DNA or protein of these bacteria. Janine Hutchison and Stephanie Dukovcic, student co-authors on this publication, got to be part of a mini-documentary describing this discovery, which will be aired on Discovery Channel, Canada, the Planet Earth series. Karen Dierksen and Calvin Carlyle, additional co-authors on this publication also contributed greatly to this discovery! As we all learned from this exciting experience, expect the unexpected as it will lead to discovery! Happy Holidays!

MEDICAL IMMUNOLOGY LECTURE AND LABORATORY RECENT HIGHLIGHTS:

The Medical Immunology class has seen full capacity enrollment these past few years with many students interested in pursuing health-related careers. To keep pace with ongoing research, during the class we discuss new findings that may influence the way disease is treated. In the laboratory class, we have challenged the students creatively by having teams compete in the annual Immuno-olympics event. During this event, the students have several categories in which they must expand on an immunology topic through drawing, poetry, and drama. The challenge has been a student favorite for the past 2 years now, and has been very successful.

There have been several major advancements in recent years in our understanding of how the immune system functions to protect us from infections. One expanding area of research is in our first line of defense, called innate immunity, named because it is present and ready to function at birth. Innate immunity provides anti-microbial cells from the immune system and promotes clearance of infections in a rapid and constant manner at all of the body's natural barriers, such as the skin, mucous membranes, and the gut. An interesting convergence of nutrition and the immune system occurs in the way that immune cells are attracted to the skin and the mucous membranes. At these sites, the local production and transport of vitamins and vitamin precursors act as factors which "imprint" location in the body to the immune cells that get activated there by infection, and allows these cells to later circulate back to these sites. In the skin the key signal is Vitamin D, made from sunlight exposure, while in the gut the key signal is Vitamin A, taken in from the diet. Recent studies have shown that deficiencies in either vitamin can lead to a compromised immune system at these key barrier locations. So remember to eat well to keep your immune system in tip-top shape!

— Malcolm Lowry, Assistant Professor

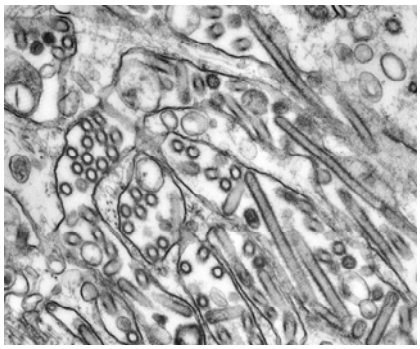
BRUCE GELLER LAB

Influenza A virus infections remain a worldwide, constant threat to human and animal health. It is now well-documented that H5N1 avian influenza virus has infected hundreds of people, and killed over half of those infected. All that remains for a pandemic to occur is a change in the viral genome that makes human-to-human transmission easier.

Recent molecular genetic analyses of influenza virus genomes involved in previous epidemics have discovered that influenza virus subtypes that infect birds and possibly other intermediate mammalian host (such as swine) have mutated or recombined to form highly pathogenic strains that have caused human pandemics. Therefore, commercial animals including chickens are a reservoir for influenza virus that can spread to humans.

The US poultry industry is a worldwide leader in top quality meat production. An uncontrolled outbreak of avian influenza virus in the US would have a serious economic impact on the industry and compromise our position and reputation as a worldwide leading exporter of top quality poultry.

The Geller lab has teamed up with our OSU colleague Manoj Pastey (College of Veterinary Medicine) to develop a vaccine for poultry, which would reduce the incidence of infection by influenza A virus. The vaccine is a live bacterium originally used to make cheddar cheese, but with genetic modifications enabling it to express specific influenza virus antigens. The vaccine would have an impact in two important areas: 1) It would protect the leading position of US poultry exports by protecting the health of commercial chickens, and 2) it would reduce the risk of human pandemics caused by the spread of mutant or recombinant influenza A virus subtypes from commercial birds to humans. In this way, the vaccine would break the zoonotic connection between chickens and humans. This project was recently funded by the USDA.



Avian influenza virus type A inside infected cells .

STEPHEN GIOVANNONI LAB

Stephen Giovannoni's research group enjoyed another exciting year pursuing scientific breakthroughs created by the OSU's new High Throughput Cultivation Laboratory (HTCL). Giovannoni's group and the HTCL pioneered methods for culturing elusive bacteria from nature. This year the group published papers that explain why many of the new organisms isolated from the oceans have "miniaturized" genomes". These cells apparently have "outsourced" the synthesis of some small molecules they need to other organisms in the ecosystem, reducing the cost of replication at the expense of metabolic independence. The group is now exploring the ramifications of these findings for ocean ecology. Some of the new findings are supported by protein abundance data from the oceans, provided by their research partners Doug Barofsky, of OSU, and Dick Smith and Mary Lipton, at Pacific Northwest National Laboratory in Richland, Washington.

This year the group was successful renewing two major grants. *Genomics of Oceanic Bacteria*, funded by the Marine Microbiology Initiative of the Gordon and Betty Moore Foundation, supports genome sequencing and experimental work. *Transitions in the Surface Layer and the Role of Vertically Stratified Microbial Communities in the Carbon Cycle,* funded by the National Science Foundation, supports their long-term field study in the Western Sargasso Sea, with collaborator Craig Carlson from UC Santa Barbara. Steve and Craig have been working together for over a decade to translate laboratory work into the ocean environment, in particular the oligotrophic gyres that make up 70% of the ocean surface. The team is also joining other OSU researchers from the College of Oceanic and Atmospheric Sciences to study oxygen minimum zones off the coasts of Oregon and Chile, with support from another Gordon and Betty Moore Foundation grant.

Giovannoni's group is now using the insights they have gained from eight years of HTCL operation to pursue the next generation of high throughput culturing technologies. Their continuing goal is to link the world of experimental cell biology and genomics to the problem of understanding the ocean carbon cycle.

Adapting Cutting-Edge Microbial Identification Technology for the Teaching Lab: Genetic Identification of Uncultured Bacteria from Environmental Samples

WALT REAM, PROFESSOR OF MICROBIOLOGY

With support from an **L. L. Stewart Faculty Development Award**, I replaced an outdated experiment in my **Molecular Microbiology Laboratory** course (MB311) with an up-to-date method for genetic identification of uncultured bacterial populations present in environmental samples. In previous offerings of this class, students studied only bacterial species that grow on artificial media. This was not ideal, because >99% of the bacterial species present in many environmental samples (e.g. soil) cannot be cultured in the laboratory. Also, culture-based procedures provide no information on the complexity of the microbial population present in a sample. A new procedure allows us to characterize uncultured bacterial populations in environmental samples based on terminal restriction fragment polymorphism (T-RFLP) analysis of 16S ribosomal RNA genes. T-RFLP analysis provides a rapid, inexpensive, quantitative, and comprehensive overview of the bacteria associated with a sample, including species that do not grow in laboratory cultures. Individual members of the bacterial community are identified by subsequent DNA sequence analysis. Because T-RFLP analysis is widely used by microbial ecologists and is currently the preferred method to study bacterial populations in the environment, I felt it was important to teach our students to use this technology.

T-RFLP technology was recently introduced into my research laboratory by **Larry Hodges**, who used it to study bacterial populations in soil and in gastric fluids. However, I lacked direct experience with this method. The L. L. Stewart award allowed me to learn the method through hands-on experience as I personally tested the T-RFLP procedure on bacterial populations present in a variety of environmental samples. **Stephanie Yarwood**, a new instructor in our department, patiently taught me how to use the computer programs required to interpret T-RFLP data. I wrote step-by-step instructions for the lab manual and introduced the new experiment during the winter term of 2008. The new experiment was a success: 100% of the students generated informative T-RFLP profiles. The first edition of the Molecular Microbiology Laboratory manual based on this class was published in 2003 by Academic Press; the editors have requested a second edition, which will include this new experiment.

Our students requested additional training in the use of computers to solve biological problems. The L. L. Stewart funds allowed me to purchase two statistical software packages widely used for multivariate analysis of ecological communities. These programs will be installed in the undergraduate computer lab that adjoins the teaching lab in which MB311 is held. In addition, I purchased five books to help students understand statistical analysis of ecological data. These materials will ***(continued on page 8)***

PETER BOTTOMLEY LAB

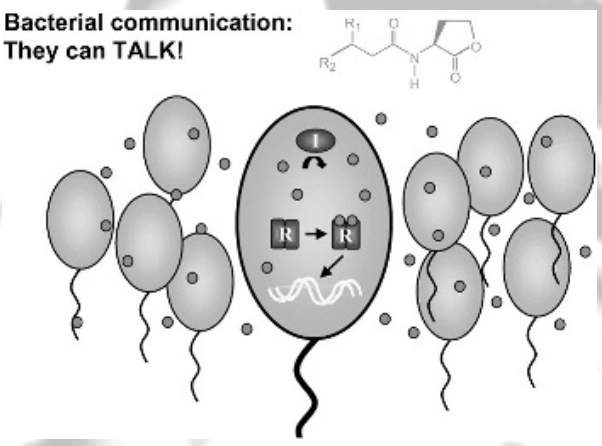
2009 will be my 30th year affiliated with the department of microbiology. Over the years my group has been involved in a variety of research activities focused upon the microbial ecology of soil and the subsurface environment. I have had good fortune to have been surrounded by a good group of graduate students affiliated with the Microbiology department and many others who have obtained graduate degrees from other departments such as Soil Science, Botany, Forest Science, Environmental Engineering, Ag Chemistry, Bioengineering, and the Molecular and Cellular Biology program. These interdisciplinary collaborations with other professors on campus have permitted us to get some unique perspectives on various microbiological phenomena. Two recent projects can be highlighted to illustrate this.

1) Shawn Starkenburg, a native of South Dakota, came to my program sponsored by the Subsurface Biosphere IGERT-(Interdisciplinary Graduate Education Research Training)- an NSF-funded training grant that emphasized interdisciplinary training in environmental microbiology and subsurface science. Shawn was interested in applying genomics to environmental microbiology. He took the lead on a project involved with annotation of the genomes of three nitrite oxidizing bacteria that had been sequenced by the Joint Genomics Initiative of DOE. Shawn was able to interact with computational biologists at JGI/DOE and compared the sequences of the three nitrite oxidizers to determine how similar they were to each other, and identify which genes defined a nitrite oxidizing bacterium by comparing their genomes with those of phylogenetically similar bacteria that are not nitrite oxidizers. One particularly interesting comparison that we were able to make was a comparison between a marine and a soil nitrite oxidizer in an attempt to identify the genes that define a "soil bug" relative to those that define a "marine bug". Several unique gene clusters were identified in the marine isolate that might reflect adaptation to the marine life style. Interestingly, the soil bacterium possessed more regulatory and signaling genes than were found in the marine nitrite oxidizer perhaps reflective of its fluctuating environment. Much more needs to be done!

The second project was associated with an NSF-funded Microbial Observatory that was located in the HJ Andrews Experimental Forest about 100 miles south east of Corvallis off highway 126 along the Mackenzie river. This area contains magnificent old growth coniferous trees up to 400-500 years old. One project focused upon the symbiotic association that exists between fungi and old growth douglas fir commonly referred to as "ectomycorrhizae". These fungal tree associations form an extensive network of external hyphae referred to as a "mat" that can extend several meters away from the tree roots and cover about 25% of the forest floor. Although these associations have been known for a long time and studied extensively by mycologists, very little is known about the identity of the fungi and bacteria in these associations because they are difficult to culture. In collaboration with David Myrold, (Soil Science), Joey Spatafora (Botany and Plant Pathology), and Bruce Caldwell (Forest Science), a study was designed to survey the forest and to determine if any specific fungi were the dominant mat-formers. Through use of molecular biological techniques we determined that a particular genus of fungus, *Piloderma*, is the major ectomycorrhizal fungus whose mats are primarily localized in the organic layer of the forest floor. In contrast, fungi of the genus *Ramaria* dominate ectomycorrhizae that form mats in the mineral soil underneath the organic layer. The fungal communities associated with the mats are quite complex, and contain different types than those found in non mat soil. It is going to be quite interesting to try and unravel whether or not the two mat forming fungal species provide different "services" to the trees and to identify the role of the other members of the mat microbial community. Working with scientists involved in computational biology on one hand, and with mycology-ecology types on the other, represents extremes of collaboration that have uncovered a wealth of information. Let's hope it continues for a few more years!

MARTIN SCHUSTER LAB: BACTERIAL CHEATERS CORRUPT THE CONVERSATION

In many different social systems, there is the opportunity for individuals to cheat, taking advantage of the benefits of the group, but not paying the cost of participation. We have found that this is also true of communicating microorganisms. Not appreciated until recently, bacteria too are social. They communicate by sensing and responding to self-produced chemical signals, allowing the production of common goods and coordination of group activities. This mechanism, commonly referred to as quorum sensing, is important medically because it allows pathogenic bacteria to produce shared virulence factors that cause disease. We found that the pathogenic bacterium *Pseudomonas aeruginosa,* which chronically colonizes the lungs of cystic fibrosis patients, cheats by ceasing to produce such virulence factors. Instead, these cheater variants thrive by taking advantage of their production by the group. The existence of these cheaters demonstrates the sociality of microbes, and provides a compelling resolution to the long-standing paradox that although quorum sensing is required for infection in animal models, quorum sensing-deficient variants are commonly associated with infections. Our work underscores the importance of quorum sensing during infection and suggests that quorum sensing would be an excellent novel drug target. More generally, our work on the sociality of microbes has great potential to offer insights into the genetic determinants of behavior in more complex organisms (even humans!), that are much more difficult to study.

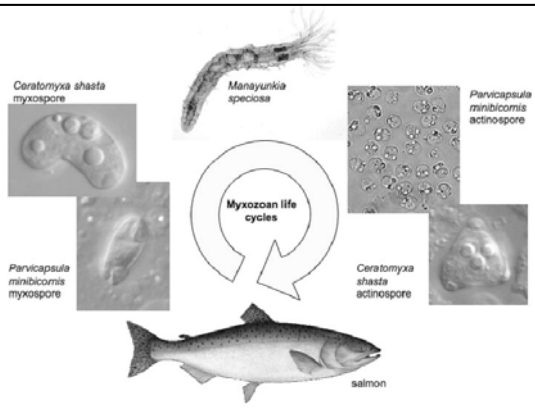


JERRI BARTHOLOMEW LAB: KLAMATH RIVER FISH DISEASE RESEARCH

The 263-mile long Klamath River begins at the outlet of the Upper Klamath Lake and flows through southern Oregon and northern California to enter the Pacific Ocean just south of Crescent City. Once the path for abundant salmon runs, over the past several decades, salmon losses have had devastating effects on the fisheries industry, coastal towns, and tribal communities along the river. In 2006, the reduction of the commercial catch by 90% was largely due to the weak returns of Chinook to the Klamath River.

Although there are numerous factors that have contributed to the declining numbers of Chinook and coho salmon, infection by parasites certainly plays a role in juvenile mortality. Ceratomyxosis, caused by the myxozoan *Ceratomyxa shasta,* has been identified as the most significant disease for juvenile salmon in the Klamath Basin. In addition, kidney damage associated with a second myxozoan, *Parvicapsula minibicornis,* is even more prevalent and thus many fish suffer from dual infections. The high prevalence and severity of ceratomyxosis in fish that should have evolved resistance to this disease indicates this parasite is a key factor limiting salmon recovery in this system.

As myxozoans, these parasites have a complex life cycle, involving an invertebrate worm host as well as salmon. Our research has described the life cycles for both *C. shasta* and *P. minibicornis*, finding that they require the same worm host – the freshwater polychaete *Manayunkia speciosa* **(Figure 1)**.



Bartholomew Lab: Studies on life cycles of Myxozoa

Figure 1. Life cycle of Ceratomyxa shasta and Parvicapsula minibicornis, showing release of actinospore stages of each parasites from the polychaete, infection of the salmon and release of myxospore stages that then infect the polychaete.

Other of our studies have described the habitat of the polychaete, mapped its distribution and relative abundance throughout the Klamath River and developed molecular methods for determining parasite abundance in samples of water collected from the river. Monitoring studies using these methods have identified an area of the river where parasite densities are extremely high and which could be targeted for control actions **(Figure 2)**.

In 2008, disease effects in this area of the river appeared more severe than in any year since monitoring began (approximately 2002). In studies where juvenile fish were held in the Klamath River for 3 d during May and June to simulate the exposure they might have received during their natural migration, Chinook salmon suffered over 90% mortality and greater than 80% of coho salmon died. Mortality was much lower (0-20%) in salmon held at sites upriver or downriver from the infectious zone. Results of water monitoring show that mortality in juvenile salmon occurs when parasite levels exceed 10 parasites/liter of water, and levels in this section sometimes exceeded 100 parasites/liter.

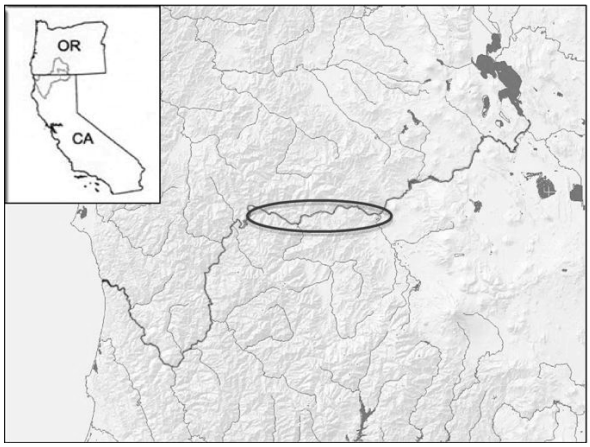


Figure 2. The Klamath River indicating the highly infectious zone.

We are beginning to explore ways to decrease disease effects on juvenile salmon in the Klamath River. This fall a pilot study was conducted to test the effects of removing adult salmon carcasses on decreasing parasite numbers. We believe that these adult fish contribute large numbers of parasites that result in infection of the worm host and that by breaking this cycle we could reduce the number of parasites that subsequently cause infection in the juvenile salmon. However, this solution alone is unlikely to be sustainable or to solve the problem over the long-term. We have identified several additional actions as being the most likely to cause a biological effect and as high priority for further research. Potential management actions would have the goal of decreasing the numbers of the polychaete worm host or disrupting the parasite life cycle through manipulation of available water flows. Research on these actions will include both controlled laboratory studies and field experiments conducted collaboratively between OSU, the US Fish and Wildlife Service, Klamath River Tribes, University of California and Humboldt State University. These proposed studies will be conducted over 2-3 years, leading to large-scale tests or implementation to reduce disease in salmon on the Klamath River. Salmon trollers estimate that reducing disease effects by as little as 10% would increase the number of Klamath River adult salmon to the point that fishing on that population could resume and allow that industry to survive.

Support for this research has come from a variety of sources, including the US Fish and Wildlife Service, Bureau of Reclamation, Oregon Sea Grant, Oregon Department of Fish and Wildlife, the Pacific States Marine Fisheries Commission, PacifiCorp and the Yurok, Karuk and Hoopa tribes. Five graduate and seven undergraduate students have worked, or are currently working on these Klamath River disease studies.

MAHFUZ SARKER LAB

One of the most important anaerobic pathogens is the Gram-positive spore-forming bacterium *Clostridium perfringens*. Based on the toxin-producing (alpha-, beta-, epsilon- and iota-toxin) capabilities, *C. perfringens* can be classified into five types (A through E). A small percentage of type A isolates produce *Clostridium perfringens* enterotoxin (CPE), a causative agent of food-borne and non-food-borne diarrhea. All five types of isolates form metabolically dormant spores that can survive in the environment for long periods of time and possess high resistance to heat treatments, chemicals, prolonged storage and freezing (-20ºC). To cause diseases, these dormant spores of *C. perfringens* isolates must germinate to get back to life.

One approach to develop efficient therapies against *C. perfringens* diseases, and considering that *C. perfringens* spores are the infectious morphotype, is to block or induce spore germination. Blocking germination of *C. perfringens* spores would block the resumption of growing vegetative cells, while inducing germination would yield *C. perfringens* spores that have lost their resistance properties to conventional treatments applied in the food industry and in clinical settings, and thus becoming more sensitive to inactivation by milder treatments. Therefore basic knowledge on the mechanism of germination is warranted. Although some aspects of the germination mechanism are conserved among *Clostridium* and *Bacillus* species, for which sporulation is much better studied, striking differences arise in the regulation of the germination cascade.

Performing research in *Clostridium* species is challenging but very exciting and rewarding. A clear example of how

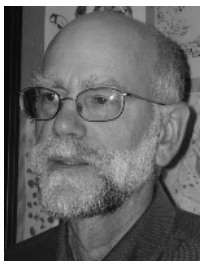
exciting of clostridial research can be is the case of a current Chilean graduate student in my lab, Daniel Paredes-Sabja. He joined my lab 4 years ago with a Food Science project aiming to inactivate *C. perfringens* spores using novel High Pressure Processing technologies. However, during working with his initial project, he became fascinated with the molecular biology of this important pathogen, which led him to pursue a new research avenue: "Molecular Mechanism of *C. perfringens* Spore Germination", an important and poorly understood step in the pathogenesis of *C. perfringens*. His excitement for research in my lab has led him to be highly productive, publishing 12 scientific articles in peer-reviewed journals in the fields of both Food Science and Microbiology. Such intensive training has made him proficient in the fields of Food science, Food-borne pathogens and Bacterial pathogenesis and he hopes to become a major contributor in these fields upon his return to Chile.

NASH HALL CONSTRUCTION

The occupants of Nash Hall breathed a sigh of relief when all the construction trailers and equipment left the area and the walkways and entrances were finally opened up again. The work on the building was completed in April and the landscaping around the building was finished during the summer when the ground was dry enough to plant. The reprieve from the noise and disruption will be short lived as we gear up for more construction in the summer of 2009. Additional funds of $14M were granted to Nash to decrease the building's energy consumption by replacing windows, lighting and improving the heating and cooling systems. The funding is not enough to complete the long list of deferred maintenance projects that are needed to bring the building up to today's building codes. Additional funds will hopefully be identified to replace the aging elevator and other urgent needs. Long time Microbiology Department Assistant Building Manager, Cindy Fisher was on the selection team to interview and select the architectural firm and contractor firm for the upcoming construction and continues on as part of the design team for the project and she will be the liaison between Nash Hall occupants and the contractors once the construction begins.

An additional construction project will run concurrently with the Nash project when the Linus Pauling building is built in the NW section of the Nash parking lot. Anderson Construction was selected for both projects and the plan is to have the construction on Nash Hall and Linus Pauling completed by fall term 2011.

OPEN ACCESS BOOKS



Conventional publishing of scientific books on specific subjects has a variety of drawbacks, including a lag time of up to two years between the completion of the work and its publication, and an often very expensive cost. This limits distribution to selected university libraries and individuals in the field or a closely related area. If the book is informative and relatively up to date, many members of the largest audience (students, post doctoral fellows and many international scientists) would only have limited or no access. Furthermore, individuals with a more casual interest, such as faculty preparing general lectures on the topic or researchers in peripheral areas, would also not have convenient access. To partially address this problem, Bookshelf, a publishing arm of the National Center for Biotechnology Information (NCBI) of the National Library of Medicine, has adapted a number of books including textbooks and monographs for open access on the web [http://www.ncbi.nlm.nih.gov/sites/entrez?db=books]. These books have previously been published by commercial publishers, but the authors and the company have agreed to allow an open access version of the text to be available on the Bookshelf web site. Such internet publications have a number of advantages over conventional texts in that they are interactive and references can be readily examined, they lack an index because the reader can simply type in the term of interest and locations in the publication are listed for ready access, and of course, they are freely available to anyone with a computer and an internet connection.

In a new variation of this approach, NCBI has started to publish books that have not been previously available through a commercial publisher. The first of these books is entitled **Baculovirus Molecular Biology** and was written by **Professor George F. Rohrmann** of our department [http://www.ncbi.nlm.nih.gov/bookshelf/br.fcgi?book=bacvir]. In addition to the advantages of widespread access, and an interactive format described above, these stand-alone internet books have the additional advantage of a reduced lag time from completion to publication from two years to a few months. More importantly, they can be revised and upgraded on a yearly basis. In the case of Prof. Rohrmann's book, a publication delineating the structure of a critical protein occurred late in the production process. Whereas, there was not time to include a complete description of this work in the current version,it will be incorporated in the next version of the text.

What are the disadvantages to this approach to publishing? Although there was editorial assistance provided by Bookshelf for the text of the book, all the permission for use of figures, and the preparation of new figures were done by the author. In addition, the final proof reading was also the responsibility of the author, although this is no different from the most scientific publications. In addition, in contrast to commercially published books that are adapted for open access on Bookshelf, where you can purchase a hard copy of the work, with a stand-alone open access book, such copies are unavailable. Although pdfs are available for download, they are not formatted like a journal report, the text is followed by the figures rather than the figures being integrated into the text. This deficiency is something that is currently being addressed. Finally, since the publication is open access, the author receives no payment for his efforts. It remains to be seen whether this is a detriment to open access publishing. However, in addition to the texts available on Bookshelf, a few faculty have taken this process to the extreme of making their textbooks available on the web. Whereas one can sympathize with the publishers who may lose the ability to sell some textbooks, the students certainly will not be able to complain about their high cost! [http://www.nytimes.com/2008/09/15/technology/15link.html?src=linkedin]

DENNIS HRUBY LAB

One of the privilege's of working at a research university such as Oregon State University, is the ability to work on interesting and important problems. Funding for this research typically comes from agencies such as the National Institutes of Health who are increasingly interested in translating basic research outcomes into useful medical interventions (drugs, vaccines, or diagnostics). Translational medicine involves the interface between the public and private sector as these products move towards commercialization. I have had the good fortune over the past decade to work in both the academic and company environments. As such I have received a second education into legal and regulatory affairs, clinical trials, manufacturing, toxicology, government relations, etc. – all classes I did not take in graduate school. However, this training has broadened my perspective on what it takes to create a useful product for people, and has provided me with the opportunity to share my insights with the students as they consider what types of careers and opportunities they will seek in the future. It also provides some of these students the opportunity to participate in internships so that they can make an educated choice.

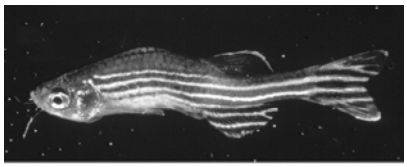
Dr. Hruby currently has a part-time appointment as Professor of Microbiology at OSU while serving as Chief Science Officer for SIGA Technologies, which has laboratories in Corvallis.

MICHAEL KENT LAB

The Kent laboratory conducts research on diseases of fishes and parasitic diseases in general. Regarding fish, we have two ongoing projects:

Diseases in Zebrafish Research Facilities. Since joining OSU in 1999, Dr. Kent's group has been investigating diseases of zebrafish, through support by NIH Natl. Center of Research Resources. There has been a dramatic increase in the number of laboratories using zebrafish as a model organism in biomedical research. Kent's lab is conducting research leading to development of methods to control or eliminate the two most common infectious diseases affecting zebrafish colonies; microsporidiosis and mycobacteriosis. In collaboration with Dr. Robert Tanguay here at OSU and support of the NIEHS Environmental Health Sciences, we have developed the first Specific Pathogen Free zebrafish laboratory at the OSU Sinnhuber Aquatic Research Laboratory. From this laboratory we can now provide valuable, pathogen-free fish for our research endeavors both at OSU and at other facilities.

Second project: Impacts of chronic parasite infections on survival of wild coho in Oregon. This project is funded by Oregon Dept. Fish & Wildlife (ODF&W) through the ODF&W Microbiology Fellowship to a PhD graduate student in Kent's lab, Jayde Ferguson. The John L. Fryer Fellowship, Oregon SeaGrant and other ODF&W resources have also contributed to the project. Parasites have long been recognized in wild salmon from Oregon. However, we have recently documented exceptionally heavy infections in certain populations of coho salmon. Jayde is focusing his research on impacts of these parasites on overwinter survival in coho salmon in the West Fork Smith River. We are focusing on this important river as previous studies by the EPA have shown that certain parts of the river have much lower overwinter survival of coho salmon, and we have found very heavy parasite burdens in these fish in the same part of the river. Jayde joined the Microbology Graduate Program 2 years ago and has shown a great ability to go from the "bench to the pen". He already has published two peer reviewed research papers, and has just submitted a third, a remarkable accomplishment for a new graduate student.

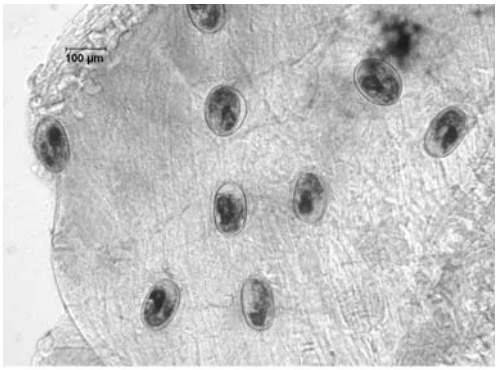


Zebrafish fish with microsporidiosis

Parasites of Terrestrial Animals

Other "non-fish" parasite projects in Kent's lab include investigations of distribution and taxonomy of nematodes causing large nodules in the stomach of cougars, and a survey of parasites on western sage grouse. Both of these projects are supported by ODF&W, and the latter is also supported by a Merck Merial Scholarship to a veterinary student, Brian Dugovich.

We are also evaluating and implementing a new diagnostic test for *Haemonochus contuntorus*, a nematode parasite that causes serious disease in sheep, goats and llamas in Oregon. This infection is diagnosed by finding parasite eggs in fecal samples, but it is very difficult to separate the eggs of *Haemonchus* from other less pathogenic nematodes based on size and shape of the egg. We are modifying and evaluating a lectin-based test developed in Australia, and we plan to have this test available to farmers and their veterinarians through the Veterinary Diagnostic Laboratory by next spring. This work is lead by a veterinary student, Megan Jurasek, Dr. Kent, and Janell Bishop-Stewart from the VDL.



Larval worms (Apophallus) in the muscle of a coho salmon parr

(continued from page 3)

provide our students experience in computational analysis of complex data sets.

My goal as a professor is to give my students the technical and writing skills they will need to succeed as professional scientists. **Carmen Denman**, one of the students who learned T-RFLP analysis in my lab class, is already using this skill in her independent research. She received a fellowship from the National Science Foundation to spend the summer and fall terms in Bermuda studying marine microbial ecology. The following message from Carmen speaks for itself.

"Dear Dr. Ream,

Thank you very much for writing me a recommendation for the BIOS REU. I am getting fantastic experience here, now know more about marine science/oceanography, and finally feel like I may be headed in the right direction in terms of the type of research I want to do.

Hope your fall term is going well. ***Thank goodness for MB311. I am doing DNA extractions, T-RFLP on 82 samples - thankfully I've had a bit of experience coming from class!***

Craig Carlson from UCSB and ***Bob Morris*** *from UW (a former grad student of* ***Steve Giovannoni****'s) are here teaching a course, and have piqued my interest in grad school. I've gotten to learn a lot, work with them, go out to sea several times for sampling, make presentations, and will being writing my final paper soon. Both my mentors think my work will be publishable, as we are three REU students working on different aspects (chemical, ecological, and my microbiological) of the same body of water.*

Thank you again. Attached is a picture of BIOS where I am living/working.

Sincerely, Carmen"

Dr. Ream was the 2007 recipient of OSU's Richard M. Bressler Senior Faculty Teaching Award, received in part in recognition of his meticulous interest in keeping MB311 an experimentally up-to-date writing intensive course.

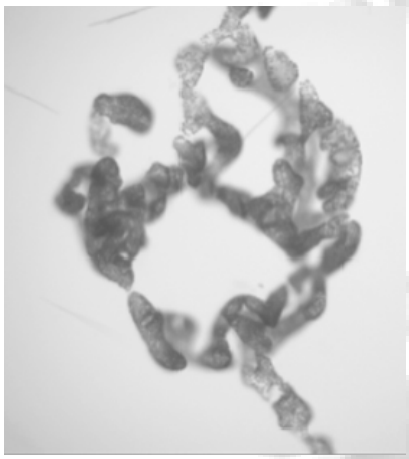
Carmen Denman is a recipient of the Middlekauf, Kathryn Tinnesand Memorial and the Eleanor G. Ford Memorial Scholarships.

CYANOBACTERIAL BLOOM RESEARCH INVOLVING UNDERGRADS AND HIGH SCHOOLERS

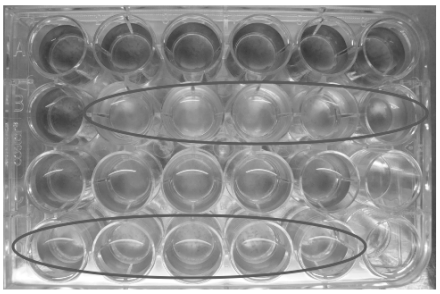
THEO DREHER LAB

Over the last 18 months, the Dreher lab has initiated a new project investigating cyanobacterial blooms in Oregon and the Klamath River basin.

These blooms are also commonly described as Harmful Algal Blooms (HABs) or blue-green algal blooms and are becoming increasingly common with increased nutrient run-offs from human activities and climate change (warming). This year, blooms posted as public health hazards have included those in Willow Creek and Wickiup Reservoirs in Eastern Oregon; the Tualatin River in the Portland Metro area; Odell, Lemolo and Lost Creek Lakes and Hills Creek Reservoir in the Cascade western foothills; Dorena and Dexter Reservoirs in the Willamette Valley; and Devil[1]s and Siltcoos Lakes on the Pacific coast.



Upper Klamath Lake and all of the reservoirs on the Klamath River experience persistent blooms over the summer and into fall. There are two main concerns associated with cyanobacterial blooms. First, they are often toxic, due especially to hepatotoxins such as microcystin produced by a range of genera including Microcystis and Anabaena, and neurotoxins such as anatoxin produced by Anabaena. Second, blooms that populate lakes with visible masses of colonial aggregations of cyanobacteria can rapidly die, releasing nutrients that drive heterotrophic bacterial growth to result in oxygen depletion that can kill fish. In the Klamath Basin, very high microcystin levels are a concern in Copco and Iron Gate Reservoirs in Northern California, while anoxic events following Aphanizomenon blooms are a threat to two threatened sucker fish in Upper Klamath Lake. The lab is studying the genotypic variation in these blooms and studying the natural viruses (cyanophages) that may be involved in regulating bloom growth..



Lysis of liquid culture of UTEX2386 *Microcystis aeruginosa*, by cyanophage from Copco reservoir 9 Sep 08
Studies of Nathan Brown

The Dreher lab is also developing genetic means for identifying local blooms. There is a strong need to improve identifications, which are currently based on morphology observed in the microscope. There is great opportunity in making accessible to lake managers and ecologists the results of genetic techniques that are well established for academic studies. To that end, the lab is developing a web-based database of genetic descriptions of Oregon blooms.

These studies are mainly being conducted by research associate Connie Bozarth, but she has been assisted by students from several levels: high school, undergraduate and graduate. The combination of field collections and relatively simple genetic techniques makes the project interesting and accessible to a range of students. Such early involvement in research provides exposure that can shape careers. Andrea McHugh and Nathan Brown are two Microbiology undergraduates who are participating in this research.

NATHAN BROWN

Nathan Brown, an engaging young man with twinkling blue eyes, positively glows when he talks about bacteriophage, viruses that infect bacteria. He can even tell you about them in two different languages, English or Russian. That's because Nathan, an undergraduate microbiology major, spent 9 months living in Russia, translating articles on bacteriophage therapeutic applications in medicine for his International Degree thesis.

Nathan went to Russia through the University of Arizona Russian Study Abroad Program, with which OSU is affiliated. He had 3 years of Russian language instruction while at OSU, before he went abroad. Once in Russia he worked on translating articles about the use of bacteriophage to treat or prevent bacterial infections ("phage therapy"), interspersed with visits to various cultural sites such as Lenin's tomb and the Kremlin armory.

Nathan first looked into bacteriophage when it was suggested by his faculty mentor, Dr. Theo Dreher, and then got hooked when he read William Summers' book on Felix d'Herelle, one of the discoverers of bacteriophage. Nathan says that he likes the "dramatic history involved in their discovery and development." According to him it's full of intrigue, international friendships, and even murder. All of this is linked together by some really interesting science.

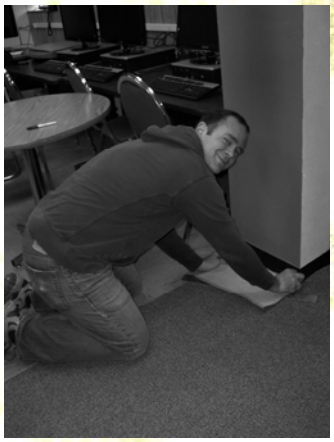
Nathan enthusiastically cites some of the promising data, which suggests that bacteriophage could be used to supplement antibiotic regimens, particularly for MRSA, the Methicillin Resistant *Staphylococcus aureus* that's becoming more prevalent. Or its possible use as a prophylactic, to prevent infections from occurring. When asked what he thinks about the potential for phage therapy, Nathan bobs his head excitedly. "Oh yes, I think there's great promise there." The same can be said for Nathan himself.

— Linda Bruslind, Ph.D, Senior Instructor.

DON OVERHOLSER COMPUTER LAB

Student Computer Laboratory/Meeting Room Renamed and Upgraded

The Microbiology student computer lab that is located in Nash 330 has been renamed the Don Overholser Microbiology Student Computer Lab in honor of former Head Advisor and Senior Instructor, Don Overholser. Don wore many hats during his 30 years at the department; Microbiologist, Head Advisor to Microbiology students, Senior Instructor and Building Manager were all part of his duties until his retirement. His concern and caring for Microbiology students earned him the OSU Dar Reese Excellence in Advising Award in 1989. Don was the first and only occupant of Nash 330 and used the room as his office. Don's friendly welcome would go out to whom ever appeared at his office door no matter how busy he was at the time. His office was the gathering place for students and staff alike to come in and chat for awhile. World problems were solved and wisdom was dispensed through the stories that were told; making it an oasis from one's troubles for a short time during the day. The office was eventually turned into a student computer laboratory and meeting room for Microbiology undergraduate students after Don retired.



Thanks to the efforts of Linda Bruslind, Theo Dreher, Cindy Fisher and Janine Trempy, the department was awarded a Technology Resource Fund grant of $22,000 in June to replace the original equipment in the computer lab with new computers, flat panel monitors and a laser printer and also upgrade the AV equipment in the teaching labs and the 4th floor conference room. During fall term 2008, members of the Microbiology Student Association painted the walls of the student computer room before the new computers and flat panel monitors arrived. The newly refurbished room also has a carpeted area with a couch and a small table and chairs for students to do group studying or simply relax and talk with friends. A cabinet of antique equipment and a framed picture of bacterial vaccines and sera remain in the room as pleasant reminders of the past and the man that once used this room.

A gathering is planned to celebrate the naming of the renovated lab and the new computers in the near future. The room is once again a warm and friendly meeting place for students and a fitting tribute to a wonderful advisor and supporter of past and present Microbiology students.

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