



Director G. Happ

The Experimental Program to Stimulate Competitive Research, EPSCoR, was created a quarter century ago by the National Science Foundation. It is intended to help rural states with small populations build science disciplines that can reach world class excellence.

When Alaska became eligible to compete for EPSCoR in 2000, our first proposal focused on emerging areas of strength in engineering and biology. After we successfully competed for the EPSCoR Phase I award in 2001, NSF helped fund 14 new UA faculty to teach and conduct research in physiology, genetics, cold regions engineering, contaminants, and bioinformatics.

Phase II funding, starting in 2004, continues to build these disciplines. This newsletter emphasizes genetics and physiology. The common approaches are: 1) to use the latest technologies in molecular biology and computational science, 2) to address Alaska-based scientific questions about our animals, plants, and microbes, and 3) to engage Alaskans at all ages across the state in research projects that tell us more about life at high latitudes.

EPSCoR Phase II: NSF director announces \$13.5 million award

Arden L. Bement, director of the National Science Foundation (NSF), traveled to the University of Alaska Fairbanks Aug. 18 – 19, 2004 to announce a \$13.5 million award for Alaska EPSCoR, Phase II. The award, \$9 million from NSF and \$4.5 million from the state of Alaska, goes toward upgrading research capabilities in environmental physiology, population genetics of adaptation to arctic environment and mitigations of climate change effects on cold-regions infrastructure. “Since 2001 when Phase I was funded, this federal-state partnership has impacted science and engineering research and training on all three MAUs and helped us provide seed funding for new faculty, students, and facilities in emerging areas of emphasis,” said Craig Dorman, UA statewide Vice President for Research.



NSF Director Arden L. Bement

The press conference was held in the large, open lab area of the new West Ridge Research Building.

“I haven’t been in a lab since 7th grade,” one reporter was heard to say. “I had no idea anything like this existed in Alaska.”

Fungal metagenomics web site shares information



By Theresa Bakker

Fungi keep ecosystems healthy by decomposing organic material and turning it into food. Now a new web site developed by UAF researchers offers the largest regional database of fungal genome sequences available for public use. The creators hope the data will allow scientists to compare fungal diversity below and above the ground and discover new lineages, among other applications.

Tom Marr, one of the site’s creators, is the President’s Professor of Bioinformatics at the University of Alaska. It’s a five-year chair, funded by the UA Foundation. Before he came to Fairbanks, Marr helped define the new field of bioinformatics, which applies computing tools to biological problems.

It all started with the human genome program. “As the field expanded,” Marr said, “it became apparent that people with multidisciplinary training would be required to address these new biological problems. The problem is biologists aren’t trained to deal with large data sets.”

Continued on page 3

Research Focus Area Spotlight on – Population Genetics



Tracking Northern Alaska Balsam Poplar Populations

By Theresa Bakker

The balsam poplar is a dominant species of tree in Interior Alaska. Only a few varieties of trees grow in the region: aspen, birch, larch, poplars and spruce. But poplars grow farther north than any of them. Using a grant from EPSCoR, a team of UAF scientists is hoping to find out how the trees got there, among other things.

Matt Olson is an Assistant Professor of Biology at the Institute of Arctic Biology (IAB), UAF. He said balsam poplars are found on the North Slope, out on the tundra adjacent to perennial springs and the north-flowing rivers that they feed. The permafrost doesn't form there, so the trees have been able to colonize small areas of the tundra.

“It may be one of the sentinel species for showing climate change,” said Olson. “We may see their range expanding as the climate warms.

“We’ve also been wondering how they got there. Are they left over from

eleven thousand years ago when there may have been a more continuous forest? Or did they colonize more recently from south of the Brooks Range? We can get at those types of questions by looking at population genetics.”

Olson said you can ask all types of questions using population genetics, like whether certain genes have been selected in response to certain changes in the environment. “By looking at patterns in the DNA sequence,” he said, “you can look at gene flow or the spread of certain genes during the migration of individuals. So we can tell whether those populations north of the Brooks were colonized by the south.”

There’s another reason Olson is studying this species: its entire genome has already been sequenced. In fact, it’s the first tree that’s been completely sequenced by an international team lead by the US Department of Energy.

Using DNA sequencing robots to process data allows Olson’s team to monitor gene flow.

Now, using EPSCoR funding, Olson and EPSCoR Graduate Fellow Amy Breen Carroll and EPSCoR undergrad researcher Elise Glen hope to expand their knowledge of population genetics even further. “It will really help to build our program here and link different people’s research together. For example, IAB’s Lee Taylor studies fungi and we’re going to bring in a post doctoral candidate who works on poplar-fungal interactions.”

This field was what attracted Olson to UAF three years ago. “It was attractive because there are few people working on population genetics in the north. There’s a lot of opportunity to understand evolution and organisms in the north, like adaptations to cold. Not too many people are working on it.”



Matt Olson extracting a tree core to determine the age of the tree in a poplar grove along the Yukon river.



Amy Carroll processing balsam poplar samples in a makeshift field laboratory next to a balsam poplar stand in the Arctic National Wildlife Refuge.



Small isolated populations of balsam poplar can be found in the Kobuk sand dunes.

Fungal metagenomics web site shares information Continued

That's where the web site comes in. Researchers can copy and paste the fungal genome sequences right off their own desktops. And these are full length sequences, anywhere from several hundred to two thousand base pairs long. Marr said, "All you do is type in the e-mail address, paste the sequence and press go and it sends back results."

"There are endless applications from ecology through molecular biology. This web site is the first of its type in Alaska. We've got a computation cluster that people can log into from anywhere. The fungal page is just a very small view of a much larger set of programs."

The university didn't have a suitable computer center, so Marr and his associates built one. Using EPSCoR funding, they set up a high performance computing cluster, using a string of 18 Macintosh G5s.

"They are all wired together as a unit," he said. "We've got a couple of computer science engineers who make this work on a nuts and bolts level. We use it for a lot of things — anything to do with sequence analysis or protein analysis. And professors can log into it right from the classroom."

Lee Taylor is an Assistant Professor at the Institute for Arctic Biology at the University of Alaska Fairbanks. He said the fungal metagenomics web site is a unique way to make genome sequencing public, which is required since discovering the sequences themselves is financed by the federal government.

Taylor said, "All these barcode sequences will be made available to researchers and the public on our web site, which also implements new tools for matching up barcodes for fungal identification. This will be an important resource for all researchers who wish to identify unknown fungi in various ecological studies."

A fungal genome is all the genetic information that resides within a fungal individual. In Taylor's National Science Foundation-funded project, researchers aren't sequencing entire fungal genomes. Instead, they're only sequencing a tiny part of the genome, which identifies a particular fungal species, a kind of "genetic barcode."

"In our project, we are sampling soils all around Fairbanks and generating genetic barcodes," Taylor said. "We are collaborating with one of the centers that was involved in sequencing the human genome (the Broad Institute at MIT) to sequence barcodes from 30,000 fungi found in Alaskan soil and 4000 mushrooms collected in Alaska. A similar study in Colorado published recently in *Science* analyzed only 125 samples. We have also collected over 1500 soil samples for this study. Hence, our study is much broader and larger in scope than any prior studies."

The project was paid for by NSF, along with the National Institutes of Health through the Alaska INBRE program. Marr said this Mac cluster is essentially a supercomputer that not long ago would have cost \$10 million.

"We spent \$150,000 for everything, including memory," he said. "It's a very high performance and very cost-effective system, and fine for what we do. We've established collaborations, where we need supercomputers, with open facilities. That's the trend in general."

In the end, this kind of information-sharing enterprise will only lead to more discoveries. And in the world of fungi, Taylor said there's plenty of territory to explore.

"Since fungi are known and identified only from mushrooms, many species which rarely or never form mushrooms have likely been overlooked," he said. "The study in Colorado using molecular methods similar to ours identified several new families or orders of fungi. In other words, they found major ancient groups of fungi that were previously unknown to man. We expect to find additional unknown groups in Alaska."

<http://iab-devel.arsc.edu:16080/metagenomics/>

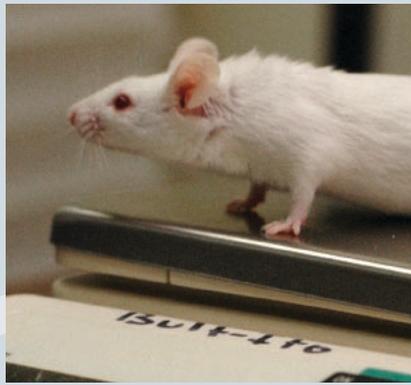


Amanita muscaria





Dana Greene (right) with undergrad student Kelsey Alexander.



Grad Student Spotlight – Dana Greene

EPSCoR graduate fellow Dana Greene has been busy mentoring undergraduates this last year, in addition to her research on obsessive compulsive disorder (OCD) in mice. In summer 2004, she worked with two undergraduate students: Traci Burrows (undergraduate EPSCoR award), and Crystal Duncan (INBRE ANSEP Award). Traci investigated the effects of fluoxetine on wheel-running behavior in mice, and Crystal investigated the effect of fluoxetine on mouse digging behavior. They also assisted in another study investigating the effect of clomipramine on nest-building behavior. Fall semester 2004 she mentored another undergraduate student, Adam McMahan. He investigated the possible pathways that control thermoregulatory nest-building behavior.

She received a travel award from Eli Lilly and SFN to attend the October 2004 **Society for Neuroscience Conference** in San Diego, based on the merit of the research she was to present at the conference. Only 43 graduate students nationwide were chosen for this award. Her poster introduced bi-directionally selected nesting mice lines as a possible model for obsessive-compulsive disorder in humans. Several labs expressed interest in collaborations, as did pharmaceutical companies interested in using these mice for novel drug testing. In addition to her own poster, two of Dana's Spring 2004 undergraduates, Heather Foltz and Mike Slater, presented another poster about digging behavior in the same mice.

Meetings & Presentations

EPSCoR Grad Fellow attends international meeting

Chris Hoffman, graduate research fellow for AY 2003-04, presented a poster on "The Occurrence of Chlorinated Fatty Acids in Sea Ducks from the Aleutian Islands Near Areas of Sewage and Seafood Waste Discharges" at the **4th International Conference on Marine Pollution and Ecotoxicology** in Hong Kong. "The conference was well worth the trip since it focused on marine pollution issues from around the world. It was interesting to learn how researchers from diverse geographic areas approach issues that are also common in Alaska. So far, I have detected chlorinated fatty acids in several tissues from ducks in my study area. The concentrations in certain duck samples are present at levels that correlate to deleterious effects in cultured cells" says Chris.

Jocelyn Krebs and two of her students presented talks at the **West Coast Chromatin and Chromosomes Meeting** in December 2004 in Asilomar, CA.

- Sara Dirscherl gave a talk titled: "Loss of ISWI chromatin remodeler results in neural defects and cataract formation"
- Hui-Ching Kuo gave a talk titled: "Histone H2A and Spt10 cooperate to regulate induction and autoregulation of the CUP1 metallothionein"

Krebs talk was titled: "Histone H2A modifications distinguish pathways of double strand break repair."

Sara Dirscherl defended her Ph.D. thesis on March 4, and Hui-Ching Kuo is defending her M.S. thesis on April 1; both graduate this May. Sara intends to go to a postdoc, and Ching is currently trying decide between Ph.D. programs (she is being actively recruited by several excellent programs).

Faculty Spotlight – Ian van Tets lab



EPSCoR fellow Kalb Stevenson in the lab (left) and in the field with Dr. van Tets and Becky Crabtree (right).

UAA, Alaska Zoo and Barrow cooperate on lemming and vole research

If you've been out skiing lately, you've probably seen delicate little tracks on the snow. Ever wonder how those little guys make it through the winter? Dr. Ian van Tets and Ph.D. students Kalb Stevenson (2004 Alaska EPSCoR fellow) and April Brennan from the UAA Biology Department are finding out. They're looking at the physiological challenges faced by non-hibernating arvicoline rodents (lemmings and voles) in Alaska.

"We are interested in the nutritional and reproductive physiology of these rodents. They do not hibernate, staying awake through the winter in tunnels and burrows beneath the snow, and in some cases are known to breed successfully in winter despite the harsh and cold conditions," says van Tets. "At present, we are taking measurements of live-trapped animals to answer questions related to breeding strategies, body composition, diet preference, energy availability, energy expenditure, and reproductive cues. In addition to more traditional measuring techniques,

we are using dual energy x-ray absorptiometry to enhance the detail and accuracy of our body composition measurements."



Their small-mammal research team is associated with the environmental physiology lab at UAA and collaborates with various groups in both Anchorage and Barrow. The team has two major research sites. In Chugach State Park near Eagle River they study northern red-backed voles (*Clethrionomys rutilus*). At the Barrow Environmental Observatory, they study Brown Lemmings (*Lemmus sibiricus*).

They have developed new partnerships between UAA and the communities. In Anchorage, they are working with the Alaska Zoo to develop suitable animal holding facilities, laboratory space, quarantine areas, and even on-exhibit housing with posters to help explain the research to the public. It is the first major research partnership between UAA and the zoo.

In Barrow, van Tets and his group have been working closely with the Barrow Arctic Science Consortium (BASC). Under a cooperative agreement with NSF, BASC provides extensive logistical support including lodging, meals, vehicles, tools, workshop, laboratory space, and even a small mobile laboratory for field work. BASC has arranged for van Tets to meet and speak with the local teachers – both formally as part of the NSF's Schoolyard Science program and informally. "As a result we have developed a good working relationship with the faculty at the Kiita Learning Community, an educational facility in Barrow that helps non-traditional students to complete high school and find employment," said van Tets. "The teachers and students at Kiita enjoy helping us by checking traps, making bait, and having me visit the school to discuss both our projects and lemming biology in general. We have had the opportunity to build friendships with many of the teachers and students and are thankful for their lemming 'scouting reports' while we are working on projects."

Outreach

High School Genetics Projects Give Rural Students A Competitive Edge

By Theresa Bakker

Nicole Jeffery is a high school senior from Barrow. When she applies to the college of her choice, she'll be able to profile her science project called "Genetic Variability and Heterozygosity in the DRB1 Gene of the Major Histocompatibility Complex in Farmed and Wild Chinook Salmon and Wild Sockeye Salmon."

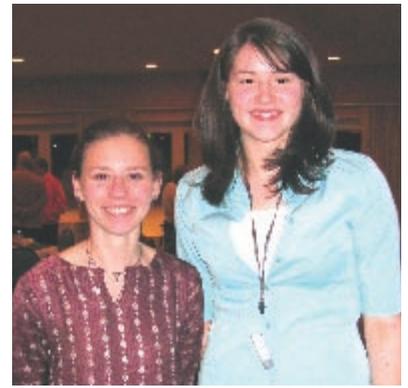
That's a title many college graduates wouldn't comprehend, but Jeffery can speak genetics like a pro because she's participating in the EPSCoR-funded Alaska Rural Research Partnership (ARRP). The outreach project aims to engage students in science research and prepare them for college.

"I got involved through an Advanced Biology class at my school," Jeffery said. "Since I'm a commercial and subsistence fisherman I wanted to do something about the differences between farming and wild salmon. It was something that was important to me. Since so much effort goes into the project, you want it to be something you enjoy and are interested in."

EPSCoR Program Director George Happ said the ARRP was created to involve students in real research. "We wanted



Vicky Phillips (left) with her science teacher Susette Carroll.



UAF Research Tech Heather Cox (left) with Nicole Jeffery.

to involve them deeply enough that they could actually get results that were modern molecular biology. We decided to do genetics on the animals that native kids and rural kids eat.

"My lab is already doing research on immunity, so we use the techs in my lab, who are already using these genes, to help kids amplify them."

UAF Research Technician Heather Cox is an ARRP mentor. She's been involved in the partnership for the last three years, visiting rural communities and working with high school students and their teachers on genetics.

"Mostly it's to engage the students in science research and have them interested, prepare them for college," she said. "They don't have to go into genetics specifically; we just want to encourage them to go to college at all."

Cox sets up a complete genetics lab in the schools. "They have the same thing you'd see at my lab," she said. "Like a centrifuge, which is a spinning device used to isolate DNA samples. There's also a thermal cycler. We supply the pipettes

Alaska Statewide High School Science Symposium 2005

Barrow: Teacher — Leslie Pierce

Student — Nicole Jeffery presenting "Genetic Variability and Heterozygosity in the DRB1 Gene of the Major Histocompatibility Complex in Farmed and Wild Chinook Salmon and Wild Sockeye Salmon"

- 1st in the Molecular Biology & Genetics Session, \$200
- 5th for overall finals which entitles her to 1 full year UAF tuition and trip to observe the National Junior Science Symposium in San Diego this April
- Best Microbiology-based Presentation from the Alaska Branch of the American Society for Microbiology and a \$200 Savings Bond
- Best Aquatic Project with \$200 from the Alaska Student branch of the National Fisheries Society
- Alaska EPSCoR scholarship for \$1500 for university of student's choice (this is the second year of participation and scholarship for Nicole)

Noatak: Teacher — Susette Carroll

Student — Victoria Phillips presenting "The Genetic Diversity of the Western Arctic Caribou Herd: A Test"

- 3rd in the Molecular Biology & Genetics Session, \$100
- National Parks Service Award for presentation and invitation to work with NPS this summer in her choice of the lab or field
- Alaska EPSCoR scholarship for \$1500 for university of the student's choice

Students — Neayuk Ahvakana and Janet Katie Barger awarded EPSCoR scholarship for \$750 for participation and assistance in projects

Mekoryuk: Teacher — Tom Beaucage, Chaperone — Muriel Amos

Students- Sara Amos, Shara Davis, Jacqueline Ivanoff: recently started genetic research of the MHC in reindeer on Nunivak Islands, observed the symposium

During the UAF visit this year, students participated in a UAF campus tour, the Discovery Lab, met with members of the Rural Student Services, and toured the genetics and core lab in WRRB.



Noatak students Roger Mitchell (left) and David Walton help ADFG biologists sample caribou in the Kobuk River.



Shara Davis, Sara Amos, Jackie Ivanoff and Heather Cox (left to right).



Shara Davis (left) and Sara Amos (right).

and racks, all of that kind of stuff. They also have vortex and a heating block in their labs.”

Cox instructs the teachers and students in genetics protocols, and reviews their papers and presentations for science symposiums and other competitions. In fact, Jeffery recently competed in the Alaska Statewide High School Science Symposium and took first place in the Molecular Biology and Genetics Session, earning her a \$200 prize. She also earned an additional \$400 worth of individual prizes and a second \$1500 EPSCoR scholarship to the university of her choice.

Jeffery is planning to continue her education, but she’s not sure where she’ll go or what she’ll do. She is leaning towards a science degree, though. “I mean, this has taken over my life. I had to write an English paper and the teacher said, ‘I can tell you’ve done a lot of science writing lately.’ It’s the kind of thing where you can just stay on the surface, but I really dove into it.”

Cox is also working with the school in Mekoryuk, where students Sara Amos, Shara Davis and Jacqueline Ivanoff recently started genetic research of the major histocompatibility complex (MHC) in reindeer on Nunivak Island. Ivanoff said

she’s just starting to realize how special this opportunity is.

“I think I’ll use this genetics project for something related to my major in college,” the high school sophomore said. “Our principal is trying to excite us, to get us motivated. They’re reminding us that not even kids in Anchorage get to be involved in something like this.”

“I think I’ll use this genetics project for something related to my major in college”

Jacqueline Ivanoff, Mekoryuk, AK

Cox has been surprised by how much she’s gotten out of the program, too. “I enjoy teaching, so it’s nice to have both. I have my research in the lab and then I have this whole teaching component, this outreach. I get to see places in Alaska most people don’t get to see. I’ve met great people and learned much about the culture.”

Happ said the program has definitely been working. “EPSCoR is supposed to change the culture in the state, increase science literacy in new and different ways. We want to not only bring the research in, but to train students at all levels, too. That includes the kids in the pipeline, kids in high school.”

“These are bright kids,” he said. “They’re doing very well. I’m astounded to see it be so successful. I didn’t know if we were going to get kids to go to college, but we have.”

Awards

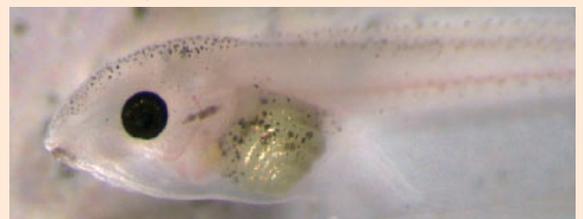
Frogs with Cataracts Help Scientists See

Jocelyn Krebs, an EPSCoR-sponsored biology faculty at UAA, was awarded a \$213,000 R15 grant from the **National Eye Institute, NEI** for her project “Three ISWI remodeling complexes in eye development.” The NEI is one of the 17 institutes within the National Institutes of Health, the leading funding source for biomedical research in the US. Funding from NIH is extremely competitive. Her research is on the role of the Imitation Switch (ISWI) gene in eye development and cataract formation.

Morpholino or dominant negative injection



Control injection



EPSCOR Graduate Fellow Grant Awards for FY 06

| Student | Faculty Sponsor | Student | Faculty Sponsor |
|---------|-----------------|---------|-----------------|
|---------|-----------------|---------|-----------------|

Focus Area: Cold Regions

| | |
|------------------|------------------|
| Bai, FeiFei | Dr. Helen Liu |
| Bray, Matthew T. | Dr. Yuri Shur |
| Kim, Kouji | Dr. Scott Huang |
| Li, Hui | Dr. Gang Chen |
| Xu, Jianfeng | Dr. Doug Goering |
| Zhu, Deju | Dr. Z. Yang |

Focus Area: Integrated Environmental Physiology

| | |
|-----------------------|--------------------|
| Brennan, April M. | Dr. Jennifer Burns |
| Dempsey, Thomas | Dr. A. Kitaysky |
| Sformo, Todd | Dr. Jack Duman |
| Shultz, Michael T. | Dr. Alex Kitaysky |
| Stevenson, Kalb | Dr. Ian Van Tets |
| Tavernier Jr., Ronald | Dr. Abel Bult-Ito |
| Williams, Corey | Dr. Loren Buck |
| Zhao, Huiwen | Dr. Kelly Drew |

Focus Area: Population Genetics

| | |
|-----------------|----------------------|
| Carroll, Amy | Dr. Matt Olson |
| Garvin, Michael | Dr. Anthony Gharrett |
| Lanier, Hayley | Dr. Link Olson |
| Timling, Ina | Dr. L. Taylor |

Visit the Alaska EPSCoR web site for grad student study titles, faculty info, and links to completed studies.

www.alaska.edu/epscor/

Watch for the new Alaska EPSCoR site coming soon!

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