Alaska EPSCoR

Winter 2006/07

From the Director
George Happ

EPSCoR programs were created to stimulate sustainable improvements in a state's research and development landscape and to advance science and engineering capabilities for innovation and overall knowledge-based prosperity.

In partnership with the Technology Research and Development Center (TREND) at UAA, Alaska EPSCoR awards Phase 0 grants to Alaska businesses for assistance in preparation of Phase 1 and Phase 2 Small Business Innovation Research (SBIR) proposals to federal agencies. As shown in our story at the right, marked success can be achieved through small but strategic investments.

In this issue, we also detail our continued advances in physiology as well as EPSCoR-like programs in other agencies. We are proud of the accomplishments of not only our faculty, but also graduate, undergraduate and even high school students.

Finally we note results from external advisory committee visits. They have summed it up well: "EPSCoR can work!"

Unique Alaska EPSCoR Partnership Produces Results

By Carolyn Pratt, Director TREND

Alaska EPSCoR and the Technology Research & Development Center of Alaska (TREND) share the common goal of helping small businesses throughout the state in securing federal research and development funding. That effort has reached out successfully to small business through the Alaska Small Business Innovation Research (SBIR) Bridge Grant program. Scientific Fishery Systems Inc. used $10,000 from this program to secure a $1,200,000 National Science Foundation contract. Triverus LLC used $20,000 to secure a $2,397,927 Department of Defense contract.

Scientific Fishery Systems, Inc. (SciFish) was established in 1992 and is located in Anchorage. The company designs advanced technology systems for government and commercial customers. SciFish won Phase I and II SBIR grants to develop a "Broadband Split-Beam Fish Tracker," a unique sonar system and processor that allows scientists to identify species, estimate their size and see targets up to 10 times smaller than conventional sonar. With many other applications of the technology still to explore, the company hooked a $10,000 Bridge Grant. The funds helped SciFish move their Phase II towards successful Phase III commercialization and a contract for $1,200,000.

Triverus LLC is an engineering and product development company located in Palmer, Alaska and another of Alaska's SBIR successes. Triverus was first introduced to the TREND program in 2002 at a SBIR proposal writing workshop. At that time, Triverus LLC was a pre-business venture and quickly submitted a Phase I proposal to the US Navy which successfully earned a $100,000 award. The project involved creating a process for cleaning the surface of aircraft carriers, which evolved into a "Mobile Cleaning Reclaim Recycle System" (MCRRS). After completion of their Phase I, Triverus submitted a Phase II and received notice of a $650,000 award in 2003. Soon after, Triverus applied for the Alaska Bridge Grant and received $20,000. The funds enabled Triverus to continue work on Phase II activities while strengthening Phase III commercialization plans. After four years of hard work and determination invested in the MCRRS, Triverus was recently awarded a $2,300,000 contract from the Navy to deliver 70 MCRRS.

Alaska EPSCoR and TREND salute both company successes and their vision to stimulate the development of new technologies in our state.

Research Focus Area Spotlight on –

Integrative Physiology

Bug Protein That's Super Cool

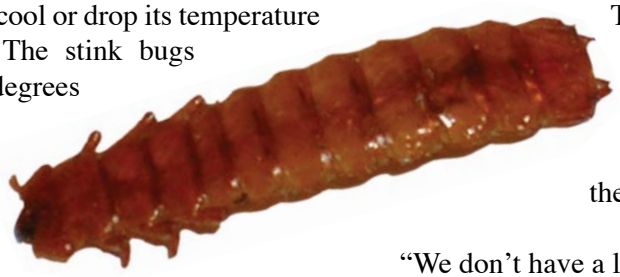
By Theresa Bakker

Someday doctors may be able to protect human organs from freezing in the extreme cold conditions necessary to keep them viable for future transplants. Scientists at the University of Alaska Fairbanks are trying to purify and isolate the antifreeze proteins found in stink bugs and beetle larvae. That could lead to a variety of medical uses.

Todd Sformo is a PhD student in the Biology and Wildlife program at UAF and an EPSCoR Graduate Fellow 2004-2006. He's investigating the bugs and beetles at the northern limit of their range to find out how they turn their blood into antifreeze.

"They have to avoid freezing to survive, so they produce this antifreeze protein," he said. "This protein coats any kind of ice crystal that may form and prevents other water from migrating on to the ice crystal and expanding further."

That allows the bug to supercool or drop its temperature below the freezing point. The stink bugs can get down to about -25 degrees Celsius. The beetle larvae can get even colder, down to the high -40s.



Sformo's research is an extension of a grant funded by the National Science Foundation. UAF Zoophysiology Professor Brian Barnes and Jack Duman, the chairman of the Department of Biological Sciences at Notre Dame University, are co-leaders of the study.

It turns out that lots of organisms have this antifreeze capability. Duman has been studying them for over 30 years. He started with fish in Antarctica and then found it in insects ranging from North Carolina to Wiseman, Alaska.

The two species Sformo is researching are distinctly different. The stink bug is a true bug that also goes by the name birch shield bug. Sformo said they don't really stink, but the smell does get annoying after awhile.

"Every fall we make a big collection of these insects right here on campus," he said. "You can just go up to the trees and take them off the leaves. If it's too late in the season, you have to crawl around on the ground and look under the leaves that have fallen."

The beetle larvae are paper thin and a tannish-gold color. They're flat because they live under the bark where there's not much room to crawl around. To collect the larva, Sformo and his crew have to find dead poplar trees.

"We go out with a chisel and pull back the bark," he said. "Then we put the larvae in little containers and retrieve them for whatever we need."

The research is a long and difficult process. Each insect has to be bled and then each sample must be passed through several different machines to extract the protein. After all that work, there never seems to be enough.

"We don't have a lot to work with yet," Sformo said.

"Once they start to over winter, they lose some of their body water, so it makes it harder to try to bleed them," he said. "You have to collect them and then let them cool to winter levels. The antifreeze is only produced seasonally."

In the meantime, Sformo is getting some recognition for his work. A crew from Animal Planet visited his lab for an episode of "Buggin' with Ruud." The cable television program will explore how modern science is using the survival adaptations of insects to create new technologies and medical applications.

Bugs Turn Student On To Science

Todd Sformo has a big job, but fortunately he's getting some help. Seventeen-year-old Fairbanks home school student Kennan Jeannet has been working on the antifreeze project for the last three years.

"I wanted to study tropical insects, but when I met Todd and he told me about the survival techniques of sub-arctic insects, I was hooked," she said. "I think it's fascinating how insects have the ability to avoid freezing even when exposed to subzero temperatures."

Since then, Jeannet has worked in the lab with Sformo. She's monitored the body water present in the beetle larva, measured the insect's antifreeze production and looked for heat shock proteins, which could enhance the activity of the antifreeze protein.

"We're also looking at the possibility of vitrification, which is a glass-like state," she said. "That's a phenomenon never before observed in animals. It would be an exciting discovery!"

"She's participating, not just doing busy work," Sformo said. "She's really been a part of the research."

In 2005 Jeannet placed second in the Alaska Science High School Symposium for her work with the beetle larva. She went on to place third in the National Junior Science and Humanities Symposium (JSHS) Program, sponsored by the U.S. Army, Navy and Air Force. But 2006 has been even more exciting for her. She placed first in the JSHS National competition, held in Albuquerque, NM, for her paper titled "Overwintering Physiology of *Cucujus clavipes*; Supercooling Points, Dehydration, Heat Shock Protein Transcript, and Silencing Antifreeze Protein Expression using RNA Interference." Each first place recipient won a $16,000 scholarship and was named as a representative to the London International Youth Science Forum, held July 26 - August 9 at London University. At the Intel International Science and Engineering Fair in Indianapolis May 12, where students from 40 countries participated, Jeannet's work took a second-place award for $1,500 in zoology.

Grad Students Discuss Physiology via Video

No matter where you are in the University of Alaska (UA) system this fall semester, you could participate in discussions ranging from "Using Plasmon Surface Resonance to Study the Actin Cytoskeleton" to "Sled Dog Physiology." The weekly seminar, organized by Assistant Professor Kristin O'Brien, is primarily for graduate students, post docs and faculty in the EPSCoR Integrative Physiology group and the IDeA Network of Biomedical Research Biomedical Research Excellence (INBRE).

"Students and faculty at UAF and UAA wanted more interaction with colleagues on other campuses," said Sue Hills, outreach coordinator for INBRE and EPSCoR. "For years UAF had weekly Physiology Seminars but in Fall 2005, we began videoconferencing them to UAA. After fixing a few technological glitches, they have been quite popular."

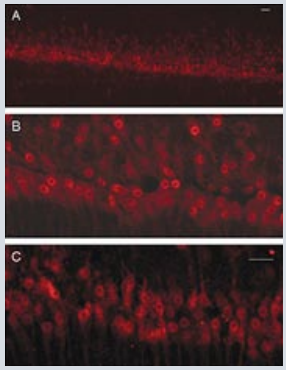
"The interactive video seminars provide both campuses with a much broader exposure to a variety of scientific presentations...than we could get at our separate campuses," said Dennis Valenzeno, Director of UAA's Washington, Wyoming, Alaska, Montana, Idaho (WWAMI) Biomedical Program, and Associate Dean of Medical and Premed Affairs at UAA.

You'd think that talking in front of a TV camera might be intimidating as grad students discuss complex topics. "At first, we were reluctant to use video conferencing because we feared that it would impact the informal nature of the seminar," said O'Brien. "We encourage students to present their research proposals and work in progress...[not] a polished presentation. Much to our surprise, the video conference has been a great success and asset to the seminar series. It has allowed us to interact with faculty and students at UAA on a weekly basis and provided us with an opportunity to share research ideas in a way that was not possible in the past."

Lesa Hollen, a graduate student with Associate Professor Kelly Drew, coordinates logistics and makes certain the technology works smoothly. Most importantly, she also makes sure plenty of hot pizza appears each week to keep the crowds coming.

For more information or to participate, contact Sue Hills at sue.hills@alaska.edu or Kristin O'Brien at ffko@uaf.edu.

Faculty Spotlight – Kelly Drew



Faculty story

By Ned Rozell, UAF Geophysical Institute

UAF Associate Professor Kelly Drew is studying an adaptation among arctic ground squirrels that could help medical researchers develop new treatments for stroke victims. Drew is a neuroscientist and Alaska EPSCoR faculty member in Integrative Physiology at the Institute of Arctic Biology.

Hibernating ground squirrels are a bit like humans who suffer a stroke. Strokes happen when a clot or ruptured vessel interrupts blood flow to the brain. Denied oxygen--and glucose-rich blood, cells within the brain die. Depending on what part of the brain expires, stroke victims lose control of various body functions. Stroke survivors often don't regain many of their work skills for up to seven years. Drew hopes her studies, which have received $2.4 million in funding, will dramatically reduce recovery time.

When in the deepest stage of hibernation, ground squirrels are cold, furry balls that seem more dead than alive. Besides a body temperature that may fall below 32 degrees Fahrenheit, a squirrel may take as few as two breaths a minute, and its heart may beat just twice a minute. Such a reduced trickle of blood flowing to a hibernating squirrel's brain should cause damage, but it doesn't. Drew thinks ground squirrels have several attributes that may prevent brain damage: they get very cold while hibernating, their blood doesn't clot, their white blood cells go into hiding, and--most relevant for possible human application--their blood is rich in ascorbic acid.

Arctic ground squirrel hibernating

Drew found that hibernating ground squirrels' blood has four times the amount of ascorbic acid than their blood contains when they are not hibernating.

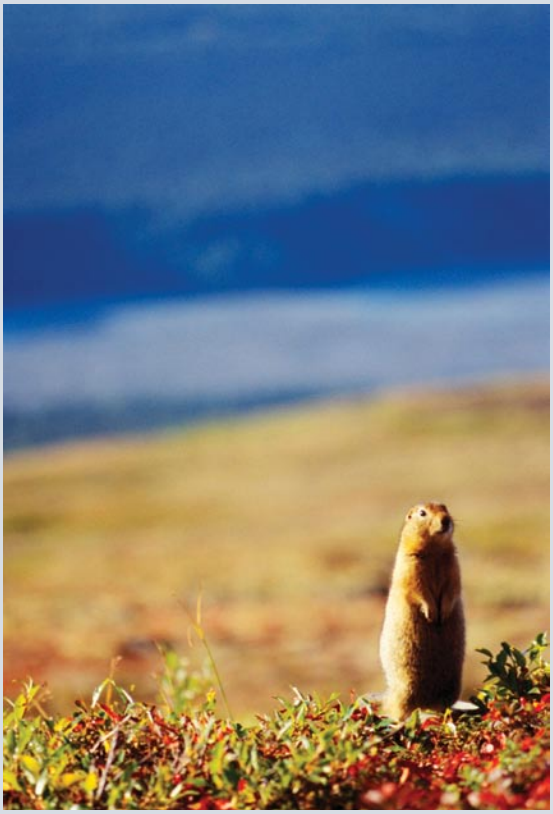
Ascorbic acid, better known as vitamin C, is produced in the livers of mammals other than humans. One of the benefits of vitamin C is that it eliminates free radicals from the bloodstream. Free radicals attach themselves to electrons of useful molecules within a cell and destroy them. Vitamin C molecules and other "antioxidants" easily lose electrons; because of this trait, antioxidants eat free radicals before they can wreck other molecules vital for good health.

Drew found that hibernating ground squirrels' blood has four times the amount of ascorbic acid than their blood contains when they are not hibernating. When the ground squirrel stirs from the deepest stages of hibernation, the Vitamin C content of their blood quickly returns to normal. Drew wants to find out if the Vitamin-C rich blood of hibernating squirrels is actually protecting the squirrel's brains.

If she finds the connection to be valid, the ground squirrels' method of protecting their brains might be applied to humans. In people, damage from a stroke has two stages--the immediate destruction caused by the lack of blood flow, and the death of cells when blood flow resumes, a period that can last up to a week after the stroke.

A patient's recovery during that crucial seven days might be enhanced by the intravenous injection of ascorbic acid or a similar free-radical scavenger. If the method works as well as it appears to on ground squirrels, stroke patients may not suffer as much brain damage. Their symptoms may even improve rather than decline in the first week after the stroke.

For her contributions, Drew has received the Sven Ebbesson Award for Excellence in Neuroscience and the Emil Usibelli Distinguished Teaching Award, two of UAF's most prestigious awards.



Arctic ground squirrel Photo © Ryan Wilson

Raise Your Hand for Research

By Theresa Bakker

After trying unsuccessfully to work in a lab his sophomore year as an exchange student, Mike Wilkinson was ready for an opportunity. So when he attended his first animal physiology class with UAF Assistant Professor Diane O'Brien, an Alaska EPSCoR faculty member in Integrative Physiology, and she opened the floor to questions, he asked about her research.

"She mentioned she might be starting a project related to human nutrition," he said. "I was already impressed with her teaching style and to hear she was thinking about something related to human health was exciting."

After class he asked if she needed help. That conversation led to Wilkinson playing a pivotal role in evaluating the use of stable isotope signatures as diet-pattern biomarkers in a study of age-related dietary differences in Yup'ik populations.

Using diet assessment data collected by the Center for Alaska Native Health Research (CANHR), they were able to compare the isotope signatures of certain foods with the types of diet shared by people in different age groups. "Because foods have different isotope signatures, we thought that if people eat those foods, the nutrients would be incorporated into their tissue and blood cells, so they should look isotopically more like those foods."

It turns out you are what you eat. "If somebody was eating a lot of fish, you would expect a sample of blood or maybe hair to look similar," he said. "If you eat lots of corn, like corn-fed chicken and high fructose corn syrup, the isotope signatures in your blood look more and more like a piece of corn."

Someday instead of relying on biased self-reported food diaries or invasive measures like drawing blood, Wilkinson hopes researchers will be able to ask participants for a few pieces of hair. That's something they would probably be far more willing to donate.

"I am amazed by the way this opportunity presented itself," he said. "I didn't know where to start looking for research. If I hadn't raised my hand in Diane's class and asked, I wouldn't have known she was starting something with human nutrition or followed up like I did. It really makes me thankful."

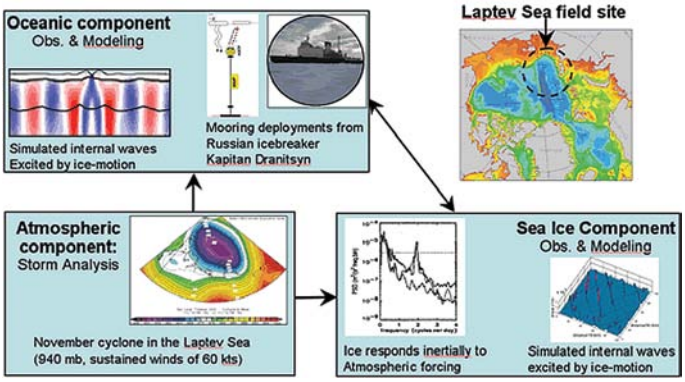
Hondolero Selected for NOAA's Hollings Award

UAF Biology undergraduate Dominic Hondolero has been chosen for the prestigious National Oceanic and Atmospheric Administration (NOAA) Ernest F. Hollings Undergraduate Scholarship Award Program. Hondolero is an EPSCoR ANSEP (Alaska Native Science and Engineering Program) student working in the marine biology lab of Brenda Konar and Katrin Iken for the past year. The Hollings Program is designed to recruit and prepare students for public service careers with NOAA and other natural resource and science agencies at the federal, state and local levels of government. Besides the scholarship for full-time study during the academic year; the Hollings Scholarship Program includes a 10-week, full-time summer internship position at a NOAA or affiliated partner facility. The internship between the first and second years of the award provides the Scholars with ''hands-on''/ practical educational training experience in NOAA-related scientific, research, technology, policy, management, and education activities.

DEPSCoR Awards $1M to UAF Sea-ice Group

The Defense Experimental Program to Stimulate Competitive Research (DEPSCoR) awarded over a million dollars to the International Arctic Research Center (IARC) at the University of Alaska Fairbanks for the Ice Covered Ocean Response To Atmospheric Systems (ICORTAS) study. DEPSCoR awards are competitive and designed to improve the capabilities of universities to conduct research and education in areas important to national defense or the Office of Naval Research.

The ICORTAS principal investigator is Harper Simmons, with co-investigators: William Hibler, Vladimir Ivanov, Jennifer Hutchings, Andrew Roberts, Igor Polyakov, David Atkinson, and Igor Dmitrenko. ICORTAS is designed to quantify the energetic response of the upper ocean to atmospheric weather systems by integrating observations and modeling analyses of ocean properties and processes with storm analysis and sea-ice dynamics.



For the observational component, ICORTAS will operate in cooperation with the IARC Nansen and Amundsen Basins Observational System (NABOS) on the 2006 and 2007 cruises aboard the Russian Icebreaker Kapitan Dranitsyn. The ICORTAS observational system will be built from an array of moorings that will be deployed in the Russian Laptev Sea and will measure currents, sea-ice drift, temperature, and salinity.

The modeling component of the study is designed to inform field operations and to make direct use of the observed sea-ice-deformation to verify and calibrate sea-ice/ocean models. This combination of field and numerical investigations provides an unprecedented opportunity to relate ice characteristics at motion to underlying ocean energy levels.

ICORTAS hopes to improve simulations of the upper ocean with benefits for real-time prediction systems for ship navigation and submarine surfacing in seasonally ice-covered regions such as the Arctic Ocean, the Sea of Okhotsk in the Western Pacific Ocean, and the Labrador Sea/Gulf of St. Lawrence in the Northwestern Atlantic Ocean.

External Advisory Committees Praise Progress

In March and April, External Advisory Committees (EAC) met with Alaska EPSCoR's three research focus areas (RFA) of Population Genetics, Cold Regions Engineering and Integrative Aspects of Environmental Physiology. Meetings took place over two days in Anchorage and Fairbanks. In addition, Population Genetics held a weekend retreat in Fairbanks.

Each EAC examined its respective research focus area to assess whether Alaska EPSCoR is fulfilling its goal of building research capacity in Alaska. They met with administrators, faculty members and graduate students. They looked at CVs detailing new collaborations, publications, and outreach, as well as the 80 federal, state and private grants totaling over $20 million these RFAs have been awarded so far in this Phase 2 program. In their reports, all three EACs gave the RFAs high marks.

"...extraordinarily successful at recruiting and nurturing the careers of talented young faculty..."

"...high quality of work and enthusiasm"

Dr. Toby Bradshaw of the University of Washington and Dr. Michael Whitlock of the University of British Columbia noted that "the EPSCoR RFA in Population Genetics has been extraordinarily successful at recruiting and nurturing the careers of talented young faculty. Measures of this success include numerous publications in top-tier scientific journals, major research grants from the National Science Foundation (as well as other federal, state, and private sources), training of graduate students and postdoctoral fellows, and strong records of undergraduate teaching and mentoring undergraduate research."

Dr. Jerry Brown of the International Permafrost Association, Dr. Joan Gosink of the Colorado School of Mines and Dr. Ted Vinson of the Oregon State University noted in their review of Cold Regions Engineering "the high quality of work and enthusiasm by EPSCoR faculty and students. It is obvious that Prof. Doug Goering has ensured that EPSCoR funds are being used to promote and provide "seed" money for Cold Regions research in a number of areas at UAA and UAF. The success of the research focus area is obvious and an unquestionable credit to Prof. Goering and his research team."

Finally, Dr. Hannah Carey of the University of Wisconsin, Dr. Craig Heller of Stanford University and Dr. John Wingfield of the University of Washington noted in their examination of Integrative Aspects of Environmental Physiology that they were "impressed by what has been accomplished by the IAEP program at UA with NSF EPSCoR support. This is a highly successful program that has built a significant foundation on which UA can build."

Sudkamp New Executive Officer

Anne Sudkamp joined Alaska EPSCoR in January, 2006. She brings experience most recently as the associate director of the UAF International Polar Year office; other positions have included executive officer of the International Arctic Social Sciences Association and editor of the *Russian Far East News*. She holds a Master's Degree in Russian from Middlebury College and completed graduate-level training in Anthropology and Education at UAF.

Besides administering the last two years of the Alaska EPSCoR Phase 2 program, Sudkamp has been working closely with Project Director Designate Peter Schweitzer to complete the Phase 3 proposal, entitled "Resilience and Vulnerability in a Rapidly Changing North: The Integration of Physical, Biological and Social Processes," which was submitted to the National Science Foundation in early October. The process began in autumn 2005 with a university-wide call for proposals from research teams. The proposals were reviewed and a subset selected for incorporation into the overall proposal. Results are anticipated in April, 2007.

Ataian Takes First Place at National EPSCoR Meeting

Alaska EPSCoR Ph.D. student Yeganeh Ataian at UAA won first place in the student poster competition at the National EPSCoR Meeting held November 7-10 in Lexington, Kentucky. Her poster, "Histone Modifications in UV Repair," focused on the roles of histone modifications in UV-induced DNA repair pathway using genetic assays in the yeast *S. cerevisiae*. Specifically, she is interested in the physiological response to UV damage at the cellular and molecular level, and wished to identify the particular histone modifications that act as a code to signal the DNA damage, which ultimately leads to the UV repair pathway chosen by the cell. Ultraviolet irradiation is a ubiquitous environmental threat that causes DNA damage in both plants and animals. The effect of UV irradiation in the polar north has raised recent concern since the ozone layer in the stratosphere that absorbs ultraviolet light is being depleted by pollution, resulting in an arctic 'ozone hole.' Her research showed that there is a specific histone code for UV-induced DNA damage, and that UV-induced histone code is different from that which signals DNA double-strand breaks.

Ataian is a student at UAA working with Assistant Professor Jocelyn Krebs. She received an Alaska EPSCoR graduate fellowship for 2005-2006.

Alaska EPSCoR:
Experimental Program to Stimulate Competitive Research

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