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Five Year Review of the WSU Arboretum & Wildlife Conservation Center: Mission, Goals, and Performance

R.D. Sayler, Project Director & WSU School of the Environment

Mission:

The WSU Arboretum & Wildlife Conservation Center (AWCC) is a new institution of public horticulture and university education and research, established by President Elson S. Floyd and the Board of Regents of Washington State University in January, 2008. The AWCC demonstrates WSU's commitment to life and land by engaging people of all ages in a deeper understanding of science. The center provides a gateway to an inspiring Palouse landscape, stewardship of a university arboretum, and public access to a wildlife conservation center showcasing WSU research of significance to understanding and sustaining our future global environment.

Goals:

- Provide a unique university landscape to engage and experience science.
- Honor, celebrate, and interpret the ever-changing landscape of the Palouse.
- Demonstrate the creative interaction of art, science, and culture.
- Inspire people to create a sustainable world.

Facilities:

To facilitate achieving these fundamental goals, the Arboretum & Wildlife Conservation Center will develop a number of important arboretum and programmatic features unique to our Palouse landscape and research expertise at Washington State University:

- Teaching and Research Arboretum - *a 170 acre campus arboretum and botanical gardens, including a Native American-themed Story Circle, that provides a naturalized landscape functioning as an outdoor classroom and environmental laboratory for engagement of students, faculty, community, and citizen scientists.*

- Wildlife Conservation Center - *core supporting laboratories and facilities on the arboretum landscape dedicated to wildlife and biodiversity conservation, education, and research, including the: WSU Bear Center, Wild Ungulate Facility, Large Carnivore Conservation Lab, and the Endangered Species Laboratory.*

- Biodiversity Discovery Center - *a planned future "nature science center" combining the above facilities and other university endeavors (e.g., Raptor Rehabilitation Program; campus ecology and sustainability demonstrations) to showcase research and environmental education for campus visitors, students, and faculty.*

Sustainable Design Goals:

The AWCC will be designed, built, and operated on a foundation of sustainability principles. Design elements that will be created to support facility and landscape operations and management as we implement our master plan include:

- Green Building & Living Machine Technology
- Ecological & Sustainability Demonstration Projects
- Illustrations of Intelligent Use of Site and Land
- Natural Environments Supporting Animals and Native Plants

The AWCC provides research and demonstration opportunities for many academic disciplines such as botany, conservation biology, endangered species conservation (plants and animals), environmental engineering, horticulture, landscape architecture and design, restoration ecology, and wildlife ecology. It also promotes educational activities related to ecology, environmental education, climate change and global change, sustainability, and the conservation of global biological diversity. The WSU Arboretum & Wildlife Conservation Center will be a living, breathing celebration of life and land on the WSU campus that embodies not just our science, but our joy and hope for the future.

Project Director's Statement:

Like a forest, an arboretum does not spring into existence overnight. Washington's Land-Grant College was established by the State Legislature on March 28, 1890, under authority of the federal Morrill Act of 1862 signed by Abraham Lincoln. During the first 118 year history of Washington State University as a major land grant university, we never successfully established a permanent, large public arboretum facility despite repeated attempts. That situation changed in 2008 after the fortuitous convergence of a faculty proposal, the unexpected availability of a suitable campus landscape, and a supportive and visionary President Elson S. Floyd. And despite the nation and WSU being forced to weather a major economic crisis and substantial budgetary cutbacks, the WSU Arboretum & Wildlife Conservation Center has recorded notable accomplishments in education and research and has achieved a solid foundation for continued growth and development of our visionary master plan.

Although it was formally established in 2008, the AWCC did not immediately begin functional operation. President Elson S. Floyd first established what was originally proposed as the WSU Arboretum & Botanical Gardens under the leadership of Dan Bernardo, Vice President for Agriculture & Extension and Dean, CAHNRS. We received $75,000 from President Floyd from a donation to WSU and used it to contract with the Portico Group to fund a public master planning project, which entailed planning by a diverse and large university committee, coupled with large-scale review and input by the entire WSU community. The conceptual master plan was finished in June, 2009, using a final name recommended by Provost and Executive Vice President, Warwick Bayly, as the Arboretum & Wildlife Conservation Center. In February, 2010, Dan Bernardo appointed me as project director, launched the administrative operation of the AWCC, and the arboretum committee began monthly planning and development meetings. On April 21, 2010, WSU held a land dedication ceremony in the arboretum with a celebration featuring tribal drummers and speakers. In late summer, 2010, construction was initiated for some simple infrastructure, including a basic trail system, the Story Circle, and several small gravel parking pads. The large construction zone resulted in the arboretum landscape being off limits for our general access and management until spring, 2011, when the first steps in landscape management actually began. Consequently, the arboretum did not begin actual physical operation until summer, 2011, and the first phase will not be completed until fall, 2013.

Since that time, we have focused our land development activities on the necessary restoration of old farm fields and weed control on the rough grassland and treed landscapes which were inherited from the USDA Plant Materials Center. Using donated seed and through collaboration with several WSU farming operations, we tilled and reseeded the old farm fields in fall, 2011 (see online - Fall Report 2011). Intensive weed control, mowing, and tree planting activities then were conducted in summer

and fall, 2012, resulting for the first time in an arboretum landscape that now looks like it is under active management and development.

AWCC Scholarly & Creative Activities:

The above summary illustrates that the AWCC operation has been initially focused on necessary development of a physical landscape to support our environmental education and research activities and set the stage for expanded future WSU science outreach. However, simultaneous with the practical demands of managing one of the largest land assignments on the WSU Pullman campus, we have also begun the initial phases of developing our education and science outreach programs.

The AWCC currently does not tabulate and report publications of the faculty participating in its operation, although this activity may begin in the future when we are ready to initiate high-profile fund raising. The AWCC has been consciously created and structured to avoid competition with other existing WSU research centers (e.g., CEREO) and formal academic programs (e.g., WSU School of the Environment). Rather, the AWCC is designed to provide: a) education and research support facilities and services, particularly for ecological, environmental, sustainability, and wildlife research, and b) a showcase for demonstration and science education projects for the public. However, as the AWCC landscape matures, and associated arboretum facilities (e.g., greenhouses, nature trails, ponds, botanical gardens, wildlife center, educational signage) are improved and constructed, the center will be a unique, university-wide vehicle for developing and supporting federal research projects that increasingly require interdisciplinary research teams accompanied by an educational and outreach component. In short, the AWCC is itself a unique demonstration project of Washington State University that supports science outreach and public use.

The core wildlife research facilities of the AWCC, including the WSU Bear Center (the only grizzly bear research facility of its kind in the world), the Wild Ungulate Facility, the Large Carnivore Conservation Lab, and the Endangered Species Laboratory, conduct significant nationally and internationally recognized research on biology, ecology, and conservation of:

- Grizzly bears, cougars, wolves, and other large carnivores.
- Mule deer, black-tailed deer, and other ungulates.
- Endangered species and species of special concern (e.g., Columbia Basin pygmy rabbits, Columbia sharp-tailed grouse, Sage grouse, northern leopard frogs, long-billed curlew, burrowing owls, western bat species, and native pollinators and butterflies).
- The affiliated Raptor Rehabilitation Program also is a well known public attraction.

The work of our participating, interdisciplinary faculty is continuously published in numerous scientific journal publications, but also quite frequently in many popular science outlets, such as the recent book by Dr. Jane Goodall, Hope for Animals and Their World, and in many newspaper, web, and magazine outlets (e.g., Return of the Mighty Pygmy Rabbit). Our scientific research efforts notably support both state and federal recovery programs for several threatened and endangered species and our research efforts are now increasingly focused on climate change biology, the forces of global change, and sustainability. Similar to publications, the AWCC does not yet sponsor research proposals directly under the center's name, however, this activity is likely to begin soon now that the closely affiliated academic program of the WSU School of the Environment has been formed and a number of new faculty positions in the ecological and environmental sciences have been hired.

Participating Ph.D. Faculty	Graduate Students[1]	Participating WSU Units
Keith Blatner - Natural Resources, SoE Matthew Carroll - Social Science, SoE Roger Chapman (retired) - Nat. Resources, SoE David Crowder - Entomology, CAHNRS Allan Felsot - Entomology, CAHNRS Linda Hardesty - Rangeland Ecology, SoE Heiko Jansen - College of Veterinary Medicine David Lin - College of Veterinary Medicine Virginia Lohr - Horticulture, CAHNRS Mark McClure - Natural Resources, SoE Daniela Monk - Avian Ecology, SBS Barry Moore - Aquatic Ecology, Limnology, SoE Lynne Nelson - College of Veterinary Medicine Charles T. Robbins - Wildlife Ecology, SoE Lisa Shipley - Wildlife Ecology, SoE Ole Sleipness - School Design & Construction Mark Swanson - Landscape Ecology, SoE Robert Wielgus - Wildlife Ecology, SoE Rodney D. Sayler - Wildlife Ecology, SoE Benjamin Zamora - Plant Ecology, SoE Univ. of Idaho: Craig McGowan - Dept Biological Sciences Janet Rachlow - Dept Fish & Wildlife Sciences Lisette Waits - Dept Fish & Wildlife Sciences Chantal Vella - Dept Movement Sciences	Laura Applegate (Ph.D.) Tiffany Baker (M.S.) Sidra Blake (M.S.) Holly Bowers (Ph.D.) Meghan Camp (Ph.D.) Susan Canwell (Ph.D.) Andrew Child (M.S.) Benjamin Cross (Ph.D.) Joy Erlenbach (M.S.) Scott Florin (M.S.) Jennifer Fortin (Ph.D.) Erim Gomez (Ph.D.) Emily Haeuser (M.S.) Tiana Luke (M.S.) Irena Neffeova (M.S.) Soren Newman (Ph.D.) Kyle Larson (M.S.) Jonathan Lucas (M.S.) Kaylie Peebles (M.S.) Ellen Preece (Ph.D.) Megan Skinner (M.S.) Kourtney Stonehouse (M.S.) Justin Teisberg (Ph.D.) Amy Ulappa (Ph.D.) Richard Whitney (M.S.)	Army ROTC Campus Landscape Advisory Committee Center for Civic Engagement College of Arts & Sciences CAS - Hudson Biological Reserve College of Agricultural, Human, & Nat. Res. Sci. College of Education Dept. of Crop & Soil Sci. Dept. of Entomology Dept. of Horticulture Dept. of Natural Resource Sciences (now in SoE) School of Biological Sciences School of the Environment Sustainability & Environment Committee WSU Student Organizations: - Environmental Science Club - Forestry Club - Student Chapter of The Wildlife Society - Fraternity & Sorority Groups - Student Volunteer Groups

[1]The total number of graduate students working at our teaching and research facilities or conducting field projects with faculty in the AWCC over the past 5 years is approximately 2 - 2.5 times greater than the number of current and recent graduate students listed here.

AWCC Organizational Structure:

The AWCC has a simple organization and operational structure and is primarily staffed through the project director's faculty position in CAHNRS with a nominal 25% time commitment for 9 months and a staff position for a facilities manager with a nominal 25% time commitment for 3 months during the summer. All other positions are student summer employees, student internships, student and community volunteers, and faculty and staff participating in the AWCC or appointed to the advisory committee. Fund raising is directed by CAHNRS Alumni and Friends.

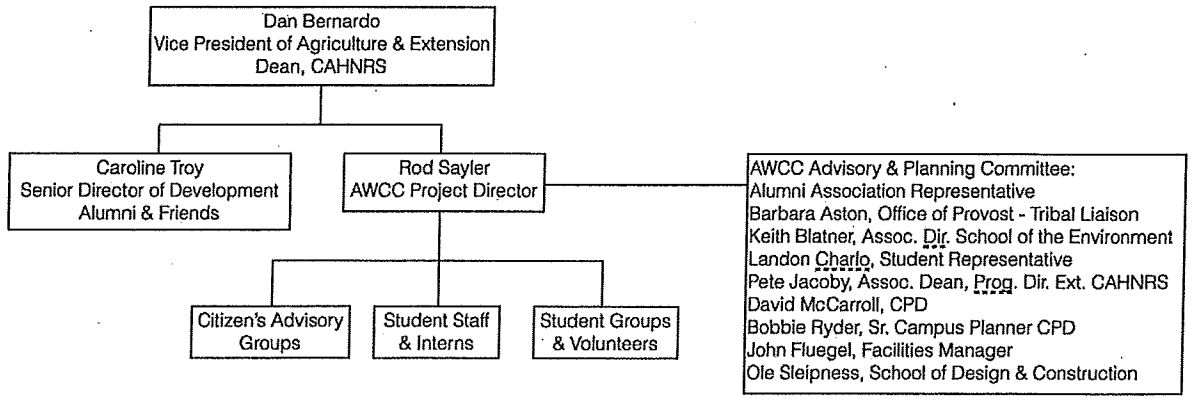

Fig. Organization chart of the WSU Arboretum & Wildlife Conservation Center

Clients of the AWCC:

The AWCC provides educational, outreach, and research services related to studies for wildlife ecology, environmental science, and sustainability, primarily to state and federal agencies and non-government organizations through faculty and graduate student research. Faculty research activities are supported by diverse funding sources and organizations, such as NSF, EPA, USDA, U.S. Fish and Wildlife Service, Bonneville Power Administration, Department of Ecology, Washington Department of Fish and Wildlife, Bullitt Foundation, and many other state, federal, and private organizations.

The AWCC provides guided tours and structured environmental education programs for school children, WSU recruiting activities, and the general public. The affiliated WSU Raptor Club gives many presentations to schools, student groups, and the public (e.g., football game day events). Outside of sporting events and entertainment in the Beasley Coliseum, the WSU Bear Center is one of the most popular attractions for thousands of campus visitors each year. Many local and regional schools from as far away as Oregon often bring bus loads of children to visit the Bear Center. Special wildlife facility tours and environmental education events are scheduled annually for local groups such as the Moscow Parks & Recreation Program, which brings over 40+ school-age children for a half day event that highlights deer in our Wild Ungulate Facility and amphibians and wetland ecology in our Endangered Species Laboratory each summer.

The AWCC provides use of our facilities and collaborates in research activities on other managed landscapes (e.g., Magpie Forest Ecological Reserve; Kramer Prairie) with conservation groups such as the Palouse-Clearwater Environmental Institute, and with Rare Care, University of Washington, for rare plant monitoring on our managed prairie landscapes. We also collaborate with the City of Pullman Fire Department and the WSU ROTC program for training activities on our managed landscapes.

AWCC - Key Metrics, Accomplishments, and Research:

Accomplishments & Activities	Sample of Current Faculty Research Projects
1) Reached agreement for land transfer to arboretum by USDA 2) Funded master planning exercise by Portico Group 3) Established AWCC administrative and operational structure 4) Constructed initial infrastructure of trails, Story Circle, and parking 5) Seeded old farm fields and started grassland restoration, weed control, mowing, and woodland management 6) Completed second-level ecological design planning through students and expert faculty contributions 7) Engaged over 120 undergraduate students in restoration ecology class planning and work on natural trails, pond development, educational signage, etc. <u>Ongoing Education & Research Activities</u>: • Manage 3 major wildlife research facilities: - monitor and provide animal care for bears, deer, rabbits, amphibians, etc., 365 days of the year - manage about 20+ students in paid positions, volunteer internships, and other support positions annually • Provide wildlife facility and arboretum tours and environmental education events for school children, visiting alumni, and the public; Support WSU recruiting activities • Manage WSU arboretum and also the Magpie Forest Reserve • Manage 4 botanical gardens, greenhouse, and tree nursery • Manage arboretum web site and Nature @ WSU science blog	• Cardiac Response in Hibernating Bears • Ecological Models Predicting Amphibian Populations in Palouse Prairie Wetlands • Salamanders and the Metrics of Climate Change Biology in Palouse Prairie Wetlands • Habitat Utilization of Long-billed Curlew Nesting in Shrub-Steppe and Agricultural Lands in the Columbia Basin • Modeling Survival of Columbia Sharp-tailed Grouse on Tribal Landscapes in Washington • Reproductive Behavior and Biology of Endangered Columbia Basin Pygmy Rabbits • Survival and habitat use of sage grouse in Washington • The role of hunting and cougar predation in structuring prey populations and landscapes • Monitoring gray wolves in Washington and the Pacific Northwest • Using Pattern Recognition Models to Monitor Survival of Endangered Northern Leopard Frogs • Maternal Roosting Colonies and Flight Times for Western Bats Using Underground Facilities at Hanford • Nutritional Ecology of Mule Deer and Black-tailed Deer • Conservation of rare native plants in Palouse Prairie • Landscape Ecology of Pollinators on Native and Restored Palouse Prairie Grasslands • Pollinator Gaps and Ecology of Late Season Floral Resources for Pollinators on Palouse Prairie.

The Next 5 Years:

While the WSU Arboretum and Wildlife Conservation Center has only been in actual operation for about half of the preceding 5 years, nonetheless, we have laid a strong foundation for program development over the next 5 years. Although we do not routinely tabulate publications and grants by the interdisciplinary faculty working in the AWCC, our participating faculty typically have more than $1 M in active grants and contracts, produce 30+ journal publications and scientific reports each year, train more than 20 graduate students, and just 5 of our faculty teach more than 300 undergraduate students in 5 classes directly using the dedicated laboratory classroom facilities and landscape of the AWCC each year. This basic productivity will only increase now that the new WSU School of the Environment has been formed and new faculty in the ecological sciences are being hired. The AWCC already receives large numbers of visitors every year, with the WSU Bear Center being the primary current public attraction. Our young arboretum web site and science blog series is already approaching over 75 k visitors. However, now that basic old field restoration has been accomplished on our 170 acre campus landscape, and staff and students have active work underway on landscape design, nature trails, pond development, educational signage, tree planting, and garden development, our attention turns toward significant development efforts for the next 5 years:

- Staffing: The AWCC will begin to grow its internal staffing needed to support expanded operations by expanding a paid student internship program already started in summer, 2012. Student interns will be hired to help manage the greenhouse, tree nursery, botanical gardens, and conduct necessary land management activities (e.g., weed control, mowing, trails and outdoor facilities maintenance), as well as run a guided tour and natural history program for the public. During the academic year, interns will be eligible for significant academic credit by completing projects and activities in the AWCC supervised by the project director. In this manner, the AWCC will begin to grow its own internal staff and eventually be closer to the point of hiring a small number of permanent staff. However, a strong focus always will remain on providing opportunities for WSU student engagement.

- Director: The project director's position has only been part time over the first 5 years, with all work during the busy summer period being donated. As both education and research activities grow in the AWCC, along with a greater volume of interns and volunteer positions, the percentage effort will be increased to more closely match the actual requirements of managing the center's operation.

- Equipment: A maturing and more intensively managed landscape will require additional equipment, including specialized mowers and dedicated maintenance vehicles.

- Grants: Efforts are already underway to plan comprehensive research demonstration projects using interdisciplinary teams to secure significant competitive grants supporting larger team-based research directed at ecological and environmental sustainability studies.

- Communications: Student interns and others will expand the social networking, both on the web and in direct contacts with students, while faculty will publish more science engagement materials highlighting ecology and sustainability projects.

- Fund raising: Fund-raising activities will be increased as the landscape appearance and basic infrastructure (e.g., trails, benches, educations signs) matures and achieves needed features to support greater public access and enjoyment. Efforts to secure donations the the AWCC will become more high profile and involve targeted campaigns and communication efforts.

Conclusion:

A remarkable set of circumstances and the enthusiastic support of President Elson S. Floyd allowed the AWCC to come into existence as both a real physical landscape and an inspiring arboretum and wildlife center demonstrating WSU's commitment to helping solve future environmental and global sustainability issues.

In reality, the WSU Arboretum & Wildlife Conservation Center has been in effective operation for only about 3 years and faces the unusual challenge of developing and managing the physical landscape on one of the larger land assignments on campus. Our landscape restoration and AWCC program is maturing in 2013 and now sets the stage for phased implementation of facilities development and science program activities identified in our initial master conceptual plan and through subsequent more detailed ecological plans created by our staff, faculty, and students.

The education, research, and outreach provided by the AWCC are unlike any other program or center at Washington State University, and yet, it is not the purpose of the AWCC to be an independent entity, but rather it is an academic showcase, a demonstration project for the entire university, and a place to enjoy Nature by everyone associated with WSU.

A motivating premise behind faculty efforts to expand science communications and outreach at WSU through the AWCC is that we need to grow beyond just published journal articles and our typical news and information, marketing, and fund-raising efforts, as excellent as these may be. We need to blend the arts, social sciences, and diverse environmental sciences in creative ways to better engage all students and the public to increase our understanding and appreciation of the need to conserve the natural world. And so, having addressed your questions about the AWCC, we leave you with one of our own: Are Worms Natural?

Supporting Information:

AWCC Web Site: www.arboretum.wsu.edu
Original Faculty Proposal: http://www.arboretum.wsu.edu/resources/WSU-Arboretum-Proposal.pdf
AWCC History: http://www.arboretum.wsu.edu/history.html
Conceptual Master Plan: http://www.arboretum.wsu.edu/master_plan.html
Fall Report 2011: http://www.arboretum.wsu.edu/resources.html
Nature @ WSU: http://wsu-nature.org

Appendix: *Threatened and Endangered Species Research at Washington State University*

Threatened and Endangered Species Research in the School of the Environment at Washington State University

Washington State University has an extensive record and research program on threatened and endangered species conducted by faculty and research laboratories associated with: 1) the School of the Environment (SoE), 2) the WSU Arboretum & Wildlife Conservation Center (AWCC), (including the WSU Bear Center - the only bear research facility of its kind in the world, the Large Carnivore Conservation Lab, the Wild Ungulate Facility, and the Endangered Species Lab), and 3) other university research facilities, such as the Center for Environmental Research, Education, and Outreach (CEREO).

WSU has a large number of faculty focused on the conservation of biological diversity and conservation ecology of threatened and endangered species, with particular strengths in the areas of predator-prey interactions, population dynamics and landscape ecology, behavioral ecology, nutritional ecology, design and management of captive breeding, recovery, and reintroduction programs, and modeling of climate change biology and complex ecological systems. The area of spatial and landscape genetics and rapid eDNA sampling are newly emerging subjects of faculty research as well.

Individuals and groups of faculty have research programs focusing on large carnivores, ungulates, and predator-prey dynamics (e.g., cougars, bears, lynx, mountain caribou, bighorn sheep, mule deer, black-tailed deer), as well as the behavioral and reproductive ecology of other taxa of threatened and endangered species (e.g., aquatic and terrestrial invertebrates, amphibians, birds, butterflies, fish, lagomorphs, native bees / other pollinators, rare plants, western bats and other mammals). The ecological effects of introduced organisms, both plant and animal (e.g., zebra mussels), combined with investigations of the climate change biology of selected species represents another central thrust of current research.

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In addition, WSU is located in Palouse Prairie, one of the most endangered grassland ecosystems in North America, which is a focus of conservation research for rare or threatened and endangered plant species (e.g., Spalding's catchfly). Through its School of the Environment and the Arboretum & Wildlife Conservation Center, WSU manages and conducts research on a number of Palouse Prairie ecological reserves containing rare plants and native bees and butterflies.

Some of the threatened and endangered species (federal or state) currently being investigated in the Pacific Northwest includes Columbian sharp-tailed grouse, greater sage grouse, Columbia Basin pygmy rabbit, Fender's blue butterfly, Monarch butterfly, northern leopard frog, mountain caribou, gray wolves, and many other species of conservation concern, such as long-billed curlew, burrowing owls, and western bats. Historically, much of WSU's research funding on threatened and endangered species has come through collaboration with state agencies receiving federal endangered species funding, such as the Washington Department of Fish & Wildlife.

Endangered species research efforts are supported by core university laboratories in aquatic ecology, genetics and molecular biology, landscape and spatial ecology, nutritional ecology, and population modeling.

One of the most notable recent endangered species efforts at WSU includes intensive work conducted over 10 years on the federally-endangered Columbia Basin pygmy rabbit. Investigators at WSU played a central role in both designing and operating the captive breeding program, reintroduction field studies, population modeling, and the eventual adaptive redesign of the recovery program, which is now beginning to achieve results. In addition, WSU scientists recently have been working on the state-endangered Northern leopard frog recovery program in Washington State through captive breeding, field studies, and ecological modeling of the interactions of introduced species (e.g., bullfrogs, chytrid fungus, non-native fish), wetland ecology, and population dynamics of leopard frogs.

For more information:

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Dr. Robert Wielgus, Director, Large Carnivore Conservation Lab
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Clean Plant Center Northwest

Service Center CIL Application

Director: Ken C. Eastwell, Plant Pathologist
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Established: August, 2011

Organizational summary:

a. Mission, goals and function

THE MISSION of the Clean Plant Center Northwest (CPCNW) is to assist agriculture producers by providing propagation material of specialty crops free of targeted plant pathogens and pests that cause economic loss, and to ensure the global competitiveness of specialty crop producers.

The mission of CPCNW is accomplished through a coalition of programs operating at Washington State University – Irrigated Agriculture Research and Extension Center (WSU-IAREC) that function as an integrated unit to achieve CPCNW objectives.

THE GOALS of the CPCNW are:

1 Provide safe sources of public and proprietary propagation material from domestic and foreign sources.
2 Establish and maintain foundation plantings with a high degree of assurance from freedom of economically important pathogens representing perennial specialty crops; to provide this clean planting stock to state managed certification schemes, and to producers.
3 Establish and coordinate working relationships with and among appropriate entities that certify planting stock.
4 Develop and promote best management practices that will be used by industry to maintain pathogen-and pest-indexed status of planting stock.
5 Encourage, develop and engage all possible extension, education and outreach resources that will interact with and train key stakeholders, such as commercial nurseries and growers, to ensure the successful dissemination and use of CPCNW products and services.

FUNCTIONS OF THE CPCNW:

The CPCNW was formed by the formal consolidation of four programs in 2011 that had existed separately for many years. This provided better focus of expertise, resources and project goals on the development of specialty crops free of targeted pathogens.

- A fruit tree foundation program was established in 1955 at WSU-IAREC to relieve the economic burden of virus diseases on fruit production. It worked in unison with state-operated certification programs to deliver virus-tested planting stock for the replacement of virus-infected fruit trees. In 1988 the director of the program obtained a USDA-APHIS-PPQ departmental permit that allowed the program to receive propagation material directly from foreign sources. The fruit tree program now functions as a quarantine site and provides the primary route by which new temperate climate fruit tree cultivars (belonging to the following genera *Prunus*, *Malus*, *Pyrus*, *Chaenomeles* and *Cydonia*) are introduced into the U.S. Credibility of the virus-testing performed by the fruit tree program is recognized world-wide, and the program distributes propagation throughout the world on behalf of sponsors that wish to have their material retained in the program's screenhouses. The latter retention and distribution is the most rapidly expanding role of the program. The fruit tree program became the designated home of the National Clean Plant Network Fruit trees in 2009.
- A grape foundation program was established at WSU-IAREC in 1961 to provide virus-tested grapevines to Washington growers and the program embodied in Washington State Department of Agriculture regulations in 1976. The program was revitalized in 2001 as the NorthWest Grape Foundation Services in response to recognition that virus disease had become a serious threat to sustainable production in the Pacific Northwest. Since receiving Federal funds and becoming a funded center of the National Clean Plant Network in 2009, the geographic range of clientele receiving material from the program has expanded and includes most northern tier states of the U.S. and some regions of Canada.
- The Washington Certified (Hop) Planting Stock Program was created in 1964 to provide hop plants to certified nurseries in Washington State. With the discovery of the devastating hop stunt disease in 2004 in Washington State, it became a reliable source of disease free material for the industry. In 2010, it became the designated home of the National Clean Plant Network Hops and began supplying hop plants nationally and, more recently, to Canada.
- A separate virus testing service laboratory was created in 1980 at WSU-IAREC to provide virus identification to cherry growers so they could make informed decisions about disease management in their orchards. The principle test used in the laboratory for virus identification is a serological

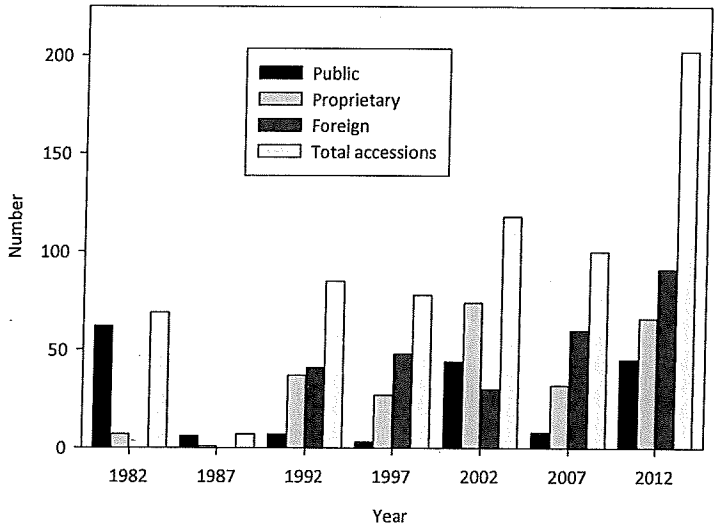
procedure known as ELISA (enzyme-linked immunosorbent assay). Services have since expanded to provide testing for many viruses that infect a wide range of fruit, vegetable, seed, forage and horticultural crops. This service is available for a fee to growers, fieldmen, consultants, county agents, regulatory agencies, researchers or anyone interested in virus diagnosis.

b. Effectiveness of the CPCNW

Since the four separate programs were integrated into the CPCNW, there is better utilization of resources, cross-training of personnel so that they can be used more efficiently. This is measured by increased output despite a smaller complement of staff.

CPCNW Fruit Trees: The CPCNW program is now the dominant route by which new fruit tree selections enter the U.S. industry. Since its inception, the WSU program has provided over 1.2 million buds of over 1000 virus-tested selections to nurseries and scientists for tree production. Trees from these buds are expanded in the nursery to yield thousands or millions of trees for subsequent use in the nation's orchards. The increases in the number of proprietary selections and in the number of selections entering from foreign sources shown below indicate the reliance of the fruit tree industry on this service.

CPCNW Grapevines: The CPCNW Grapevines foundation program is expanding rapidly to keep pace with



the demand to establish new nursery plantings for the production of certified planting stock. The CPCNW Grapevines program primarily responded to the needs of the grape industries in Washington, Oregon, and Idaho, but material from the program is distributed to many northern-tier states. The program currently has 340 selections at various stages in the program; of these, 228 have been released and are available to the industry. All available cuttings are sold and distributed each year; this currently (2013) represents 5,000 to 8,000 cuttings.

CPCNW Hops: The hop program currently has 58 selections at various stages in the program; of these, 31 have been released and are available to the industry. Since 2010, CPCNW has distributed 1,010 unrooted cuttings and 163 rooted plants to the industry; each of these units can be used to produce thousands of productive plants in a single growing season.

CPCNW ELISA Testing Laboratory: The ELISA Testing Laboratory provides virus testing to WSU researchers, and regional agriculture. In 2012, the laboratory performed over 55,000 virus tests. The CPCNW ELISA facility is the primary laboratory by which bean and pea seed is tested to meet Washington State quarantine regulations for seed planted in WA State, and provides virus testing required for exporting seed of beans, peas, peppers, asparagus and tomato. This service is used by several western states. In 2012, the WSU ELISA Testing Laboratory provided testing for 11,020 pea and bean samples for certification by state-operated certification programs and 1,400 asparagus seed tests for private breeding programs. The value of production of dry edible beans was $117M, $107M and $71M in WA, ID and CA, respectively, and production of peas was $22M and $8M in WA and ID.

The CPCNW ELISA laboratory provides needed national capacity for virus testing. In 2011 and 2012, the laboratory provided nationally needed testing capacity for surveys of *Plum pox virus* mandated by USDA-APHIS-PPQ. Other private and public facilities were unable to meet the sudden added demand. In each year, the laboratory performed more than 25,000 assays for the *Plum pox virus* surveys in addition to normal operational capacity. The laboratory was required to pass a proficiency test in order to participate in these surveys.

In 2012, the ELISA Testing Laboratory tested 750 samples to support Franklin County Pest Board mandatory control program for *Cherry leaf roll virus*. Some distributors of cherry pollen perform virus testing on a voluntary basis. The laboratory performed 165 assays of pollen for cherry viruses. The CPCNW is working with pollen companies to establish virus testing protocols for apple pollen in preparation for export to Mexico and European countries. In the first year of this program we tested 103 apple pollen samples. The program performed assays for 942 grapevine samples and 281 blueberry samples from private producers.

In 2012, the facility performed 1,380 assays to support the CPCNW Fruit Tree program and 7,142 assays in support of the CPCNW Grapevines program. This capacity is essential to the operation of the other components of the CPCNW. The testing facility also performed 33 assays to support the fruit tree pathology research program.

c. Explanation of changes New application, not applicable.

d. Nature and scope of activities

The primary focus of CPCNW is to develop propagation material of specialty crops that are free of economically important viruses and virus-like agents. This overarching objective involves many specialized tasks, which can be grouped into five major categories of activities:

1 Acquire material from around the world. The selections that are obtained are driven by the needs of the industries that the CPCNW serves. In the hop and grape foundation programs, the selections that enter the program are suggested by industry committee. In the fruit tree program, since the vast majority of material that the program processes is proprietary, the selections are driven by industry sponsorship.

2 Conduct virus testing and virus therapy. The regulatory nature of the program requires that testing procedures follow prescribed and approved protocols. If viruses are detected in vegetatively propagated perennial crops, they are eliminated through thermal therapy (fruit trees) or through meristem tissue culture (grapevines and hops). Work conducted by the CPCNW ELISA Laboratory is defined solely by sponsors submitting material to be tested.

3 Distribute propagation material free of economically important pathogens. The three perennial specialty crop programs maintain collections of economically important selections. These are maintained at a foundation phytosanitary status by maintaining the collections behind insect resistant screen and by annual testing of each plant for specified pathogens. From this facility, material is distributed throughout the state, the U.S. and the world. The success of domestic fruit tree growers is dependent on the international exchange of new cultivars. This process is facilitated by CPCNW Fruit Trees, which is poised to become *the* hub for the international exchange of fruit tree propagation material.

4 Facilitate development of improved and more efficient diagnostic methods. The program maintains a collection of pathogens that are available for distribution to researchers for the development of new detection methods. CPCNW also fosters research into the development of specific diagnostics that will improve the efficiency of operations of the CPCNW and other foundation programs.

5 Develop and promote best management practices that will be used by industry to maintain pathogen-and pest-indexed status of plants for planting. Specific virus testing offered by the CPCNW ELISA Testing Laboratory has allowed pathogen-specific disease situations to be recognized, and specific management programs to be developed and implemented.

e. Function relative to other units

The CPCNW Director is tenured in Department of Plant Pathology; the CPCNW is physically located at the Irrigated Agriculture Research and Extension Center in Prosser, WSU. The CPCNW interacts with both administrative units.

f. Impact on instructional programs

The associated research program in the Department of Plant Pathology has yielded opportunities for

five graduate students and two postdoctoral associates in the last ten years. The association of the research program with CPCNW has increased access to research funding, and indeed, USDA-APHIS through the National Clean Plant Network (NCPN) has provided a limited amount of direct research funding. CPCNW provides a unique teaching opportunity by exposing students to the complex world of international agriculture where pathology, regulatory and industry meet.

g. Impact on the university and other clients

The fruit tree program at WSU is known world-wide because of its prominence in international distributions. This increases the visibility of WSU for attracting researchers and potential students. The existence of the fruit tree program allows nurseries and breeders to access foreign markets and brings foreign developed cultivars to the U.S. for production. A study developed by WSU with CPCNW participation revealed that adoption of the CPCNW Fruit Tree program nationally would benefit the U.S. consumers by $227M annually in savings from improved farm productivity (Cembali *et al.*, 2003). This, in turn, improves the economic outlook of rural communities by improving farm income.

The grapevine and hop programs have regional visibility through the growing interest in planting clean stock. This is fueled by the relatively recent discovery that diseases of both specialty crops had gained a foothold in WA State production.

Grants and service fees brought $127,867 in F&A to WSU in 2013.

h. Strategic vision

Key targets of CPCNW activities for the next five years identified by CPCNW staff are to:

1 Implement new technologies where appropriate to speed the acquisition and release of new clones to industry. Industry access to new cultivars quickly is essential for the economic survival of propagators and growers.

2 Improve quality and quantity of material released from the programs. Material provided to clientele must be robust and in sufficient amounts to quickly meet market demands. This may be achieved by partnerships with other programs and institutions.

3 Ensure that material in the program is correctly identified. This has been the responsibility of the individual sponsors in the past, but it is becoming increasingly evident that genotyping of selections will be needed. This may be achieved by partnering with other programs and institutions.

CPCNW is at a pivotal point in its evolution. The vagaries of Federal funding requires that operations of CPCNW migrate to a more sustainable business model. The Center is currently (August 2013) engaged in a strategic planning process with stakeholders (industry, regulatory) to determine areas of focus to be strengthened or minimized, and how this could be accomplished in the current funding environment. Stakeholders will also provide input to identify different types of services and service delivery that would improve the ability of the CPCNW to achieve its goals. Advisory groups representing each of the three specialty crops (Appendix A: NCPN-Hops, and Appendix B for advisory committees for fruit trees and grapevines) will provide the platform for this discussion.

Organizational structure:

a. Director selection and Director's vitae

CPCNW deals with regulatory agencies and issues on a regular basis. Moreover, the director is responsible for maintaining the quarantine status and protocols of the facility. The director holds the NCPN Pest Permits required for receiving propagation material from foreign and from domestic sources outside of WA State. The material received is potentially infected with exotic pathogens, so the process is regarded as a high-risk activity. Therefore, the permitting agency (USDA-APHIS-PPQ) requires that the permit holder is a plant pathologist and can adequately supervise quarantine activities in a safe and compliant manner. Because of the complex nature of CPCNW activities requiring extensive knowledge in regulatory issues, plant pathology, specialty crop production and program management, legacy planning should be commenced immediately to identify succeeding directors for the CPCNW.

The current director has a split appointment with 50% as director of the CPCNW and 50% research appointment tenured in the Department of Plant Pathology. The current CPCNW leadership is the outcome of faculty attrition and program consolidation within WSU. The retirement of Dr. Paul Fridlund led to the consolidation of his fruit tree virology program and the legume virology program spearheaded by Dr. Gaylord Mink. Upon Dr. Mink's retirement, these combined responsibilities were then subsumed by Dr. Ken Eastwell. With the departure of Dr. Robert Wample, the grape foundation program fell to Dr. Eastwell and with the departure of Dr. Robert Klein, the hop foundation program also fell to Dr. Eastwell. Dr. Eastwell is currently the only faculty formally associated with CPCNW and is the appointed director of CPCNW.

In the present organizational model, CPCNW does not directly support graduate students. They are mentored by Dr. Eastwell, who retains a 50% research appointment tenured in the Department of Plant Pathology. CPCNW does provide very limited research support for Post Doctoral appointments. The CPCNW does provide facilities and expertise to assist and guide research. Additional research funding for graduate student and post-doctoral support is attracted to Dr. Eastwell's Plant Pathology program because of his association with the CPCNW.

The Director of CPCNW reports to the Director of the Agriculture Research Center of WSU (Dr. Jim Moyer). Operation of all NCPN funded centers receives significant direct input from the NCPN governing boards for each specialty crop (Appendix A). The fruit tree program also has a newly formed advisory committee (Appendix B). A vestige of the original organization of the grape foundation block is the "Foundation Block Advisory Committee" (Appendix B) formed as a subcommittee of the Washington Association of Wine Grape Growers' efforts to support the revitalization of the grape foundation program to serve the Washington grape industry.

Vitae: Kenneth Eastwell, Director CPCNW

EDUCATION

1981 Ph.D., Plant Biochemistry, University of Alberta, Edmonton, Alberta.
1974 B.Sc., Biochemistry, First class honours, University of Alberta, Edmonton, Alberta.

PROFESSIONAL EXPERIENCE

Current Plant Pathologist (50% Research; 50% Director – Clean Plant Center NW since August 2011)
Research Responsibilities: Development and application of methods to detect, identify, and eliminate virus-like agents that cause diseases of vegetatively propagated perennial crop plants.
Administrative Responsibilities: Provide technical and policy leadership to foundation programs for fruit trees, grapevines and hop plants, and provide leadership for the WSU-ELISA Testing Laboratory Service Center.

1997-11 Plant Pathologist (100% research; tenured March 2000; full professor 2008)
NRSP5 clean plant program for fruit trees – Working Director
Northwest Grape Foundation Service - Co-Director since March 2008
WSU-ELISA Testing Laboratory Service Center - Supervisor
Washington Certified (Hop) Planting Stock Program – Manager since August 2000
1988-98 Research Scientist, Agriculture & Agri-Food Canada, Summerland, B.C., Canada.
1990-96 Adjunct Professor, Dep't of Plant Science, Univ. of British Columbia, Vancouver, B.C., Canada.
1991-95 Adjunct Professor, Dep't of Biological Sciences, Simon Fraser Univ., Burnaby, B.C., Canada.
1988-89 Visiting Professor, Dep't of Biological Sciences, Simon Fraser Univ., Burnaby, B.C., Canada.
1984-88 NSERC University Res. Fellow, Dep't Biological Sciences, Simon Fraser Univ., Burnaby, B.C., Canada.
1982-84 AHFMR Research Fellow, Dep't of Biochemistry & Biophysics, University of California, Davis CA.
1981-82 NSERC Research Fellow, Dep't of Biochemistry & Biophysics, University of California, Davis CA.

GRADUATE STUDENT EDUCATION

Major supervisor/research advisor of one current Ph.D. student, four Ph.D. graduates and two M.S. graduates.
Member of supervisory committees of one current Ph.D. student, and six M.S. and six Ph.D. graduates
Currently supervising two Post Doctoral Fellows and five former Post Doctoral fellows

GRANTS & NON–OGRD FUNDING (in which K.C. Eastwell or subordinate is P.I.)

TEMPERATE FRUIT TREE PROGRAM:
Total tree fruit research funding since 1997 ..... $1,090,142
USDA-CSREES National Research Support Project-005 funding 1997 to 2008 ..... $2,605,007
Total FRUIT TREE SERVICE CENTER funding since 1997 ..... $1,565,117
Total other tree fruit service grants since 1997 ..... $1,388,036
HOP PROGRAM:
Total hop research funding since 2001 ..... $632,450
Total hop service activity funding since 2001 ..... $697,999
GRAPEVINE PROGRAM:
Total grapevine research funding since 1997 ..... $478,800
Total grapevine service activity funding since 2001 ..... $414,736
TOTAL RESEARCH FUNDING OF OTHER CROPS SINCE 1997 ..... $227,686
TOTAL ELISA SERVICE CENTER funding since 1997 ..... $1,455,225
USDA-APHIS Contract for Plum Pox Virus Testing (2011) $132,473
NATIONAL CLEAN PLANT NETWORK FOR GRAPEVINES, HOP PLANTS AND FRUIT TREES (USDA-APHIS)
Clean Plant Center Northwest (2009) $1,300,817
Clean Plant Center Northwest (2010) $1,238,034
Clean Plant Center Northwest (2011) $1,149,911
Clean Plant Center Northwest (2012) $1,201,903

PROFESSIONAL ARTICLES, REFEREED (63 total, those of the last 4 years are listed)

Mekuria, T., Smith, T.J., Beers, E.H., & Eastwell, K.C. 2013. Little cherry virus 2 is transmitted to sweet cherry by *Pseudococcus maritimus* (Ehrhorn), a new vector of this virus. *Plant Disease, in press.*

Villamor, D.E., Druffel, K.L., & Eastwell, K.C. 2013. Complete nucleotide sequence of a virus associated with rusty mottle disease of sweet cherry (*Prunus avium*). *Archives of Virology, in press.*

Mekuria, T., Druffel, K.L., Susaimuthu, J., & Eastwell, K.C. 2013. Complete nucleotide sequence of a strain of Cherry mottle leaf virus associated with peach wart disease in peach. *Archives of Virology, in press.*

Eastwell KC, Druffel KL. 2012. Complete genome organization of *American hop latent virus* and its relationship to carlaviruses. *Archives of Virology* 157:1403-1406.

Eastwell KC, Mekuria TA, Druffel KL. 2012. Complete nucleotide sequences and genome organization of a cherry isolate of *Cherry leaf roll virus*. *Archives of Virology* 157:761-764.

Eastwell KC, Villamor DV, McKinney CV, Druffel KL. 2010. Characterization of an isolate of *Sowbane mosaic virus*. *Archives of Virology* 155:2065-2067.

Eastwell KC, Howell WE. 2010. Characterization of *Cherry leaf roll virus* in sweet cherry in Washington State. *Plant Disease* 94:1067.

Crosslin JM, Eastwell KC, Davitt CM, Abad JA. 2010. First report of seedborne *Cherry leaf roll virus* in wild potato, Solanum acaule, from South America. *Plant Disease* 94:782-783.

Eastwell KC, Dutoit LJ, Druffel KL. 2009. *Helleborus net necrosis virus*: a new Carlavirus associated with 'black death' of *Helleborus* spp. *Plant Disease* 93:332-338.

Riga E, Larsen R, Eastwell KC, Guerra N, Guerra L, Crosslin JM. 2009. Rapid detection of *Tobacco rattle tobravirus* in viruliferous *Paratrichodorus allius* from greenhouse and field specimens. *Journal of Nematology* 41:60-63.

REFEREED PROFESSIONAL ARTICLES (16 total, those of the last 4 years are listed)

Eastwell KC plus various authors. 2013. *Diseases caused by viruses*. IN: Compendium of Apple and Pear Diseases and Arthropod Pests. Sutton T, Aldwinkle H, Walgenbach J, Agenllo A eds. APS Press, 22 sections in this book were written or revised. Accepted August 3, 2011, publication pending.

Eastwell KC. 2009. Lead author in four sections of: *Field Guide for Integrated Pest Management in Hops*. Gent DH, *et al.* eds. Washington Hop Commission, Moxee, WA.

Eastwell KC plus various authors 2009. Four sections in: *Compendium of Hop Diseases and Pests.* Mahaffee WH, Pethybridge SJ, Gent DH, eds. APS Press, St. Paul, MN.

BOOK CHAPTERS (10 total, those of the last 4 years are listed)

Jelkmann W, Eastwell KC. 2011. Little cherry virus -1 and -2, Chapter 31. IN: Virus and Virus-like diseases of pome and stone fruits. A Hadidi, M Barba, T Candresse, W eds APS Press, St. Paul, MN pp. 153-159.

Eastwell KC. 2008. Ilarviruses (*Bromoviridae*). IN: *Encyclopedia of Virology, 3rd edition, Volume 3*. Mahy BWJ, Van Regenmortel MHV, eds. Elsevier, Oxford, UK, pp. 46-55.

DEPOSITIONS TO PUBLIC NUCLEIC ACID DATABASE (GenBank): 86

SCHOLARLY SCIENTIFIC PRESENTATIONS SINCE 1997: 34

PROFESSIONAL SERVICE ACTIVITIES

2012	Peer review panelist to evaluate project plans of USDA-ARS National Program 303 Plant Diseases NP 303 Panel 14 - Vegetable Crops.
2011	Member, USDA-APHIS Plum Pox Virus Technical Working Group
2010	Chair, National Clean Plant Network – Hops
since 2008	Chair, National Clean Plant Network – Fruit Tree
since 2008	Board member, National Clean Plant Network - Grapevines
2007	Group leader at the National Clean Plant Network Workshop (APHIS Headquarters, Riverdale, MD) that laid the foundation for the NCPN and invited panelist at a Farm Bill listening session sponsored by Senator Murray to address the rationale for creation of NCPN
2006-2008	Member, National Clean Plant Network strategic planning committee to develop a framework for the proposed NCPN that significantly changed historical approaches to disease management.
since 2002	Appointed member, Washington State Department of Agriculture Seed Advisory Council.
since 2000	Managed and revitalized the hop certified rootstock program after its dormancy for 15 years. In 2010, the program became part of the NCPN-Hops and integrated into CPCNW in 2011.
since 1999	USDA-APHIS Departmental Permit Holder for importation of foreign clones of deciduous fruit tree cultivars; transitioned to the more rigorous NCPN Pest Permit in 2011; hops added in 2013.
since 1998	USDA-APHIS/APS Plant Virology Committee Member. With State officials and representatives, prepare lists of widely distributed viruses in WA, OR, HI, MT, ID, and WY.

b. Other participating faculty members

There are no official participating faculty members at this time although the CPCNW assists many faculty by providing virus testing for their research materials. At the creation of the NCPN, Drs. Keller (Hort) and Rayapati (Plant Pathology) were included in the NCPN Cooperative Agreement, but in 2011 at the formation of the CPCNW, Dr. Eastwell was designated at the director for the CPCNW, but coordination with other faculty is welcomed.

c. Criteria for membership in the CPCNW

This is not applicable to the service center at this time. Future membership will be those that contribute to the CPCNW mission and goals.

d. Graduate student, postdoctoral appointments and visiting scholars

The associated research program in the Department of Plant Pathology has yielded opportunities for five graduate students and one postdoctoral associate in the last ten years. CPCNW provides a unique teaching opportunity by exposing students to the complex world of international agriculture where pathology, regulatory and industry meet. The students are fully associated with tenure appointment of the Director, that is, Plant Pathology.

The CPCNW currently carries one full-time Postdoctoral appointment. The individual reports to the Director of the CPCNW. Because of the dual appointment of the Director, the post doctoral appointment is also recognized by the Department of Plant Pathology.

The progenitors of the CPCNW have attracted short term visiting scholars from several countries. These have been administered as members of the home department. In future endeavors, they will be associated with the CPCNW.

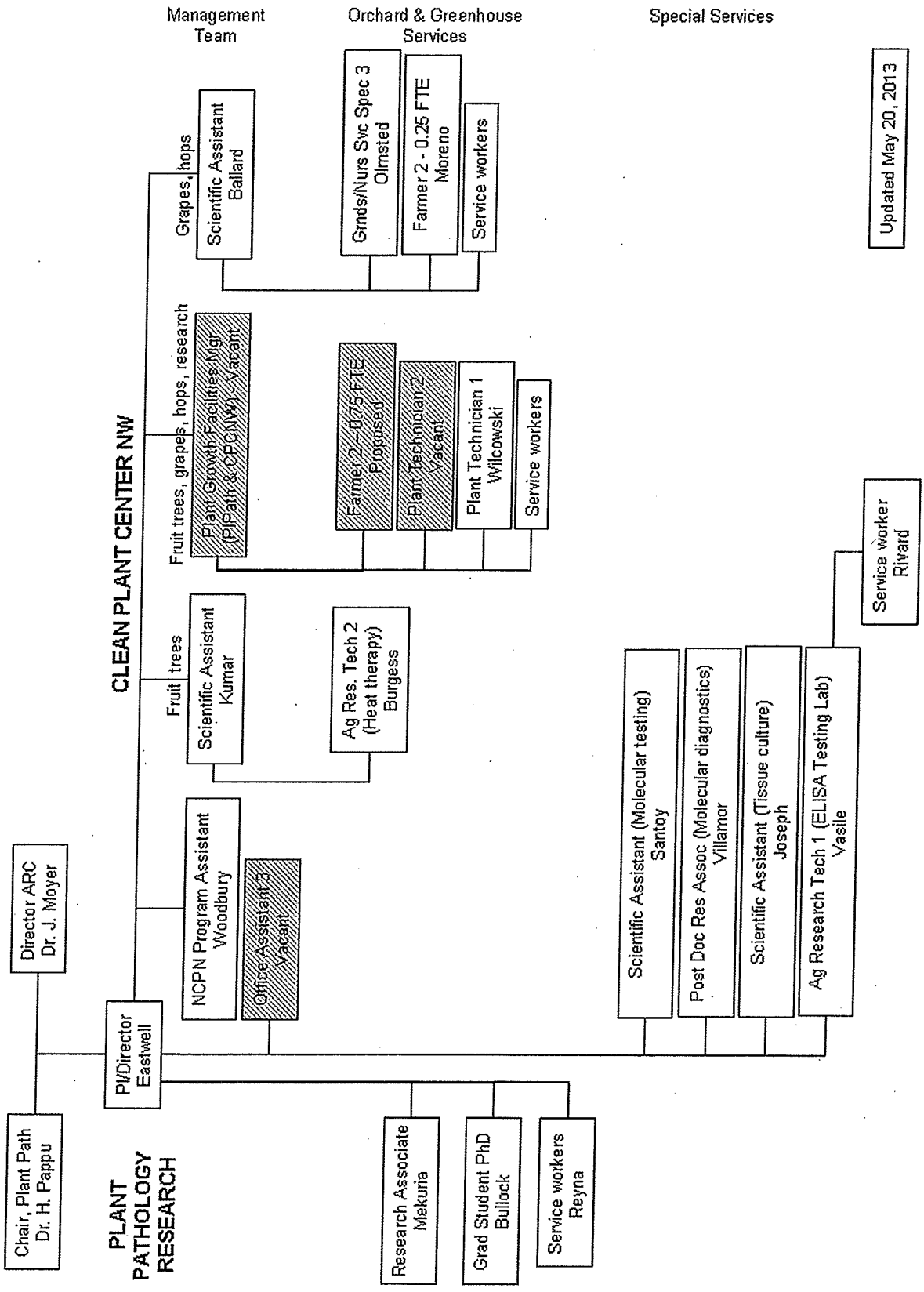
e. College responsible for support

The CPCNW is housed within the College of Agricultural, Human, and Natural Resource Sciences.

f. CIL's advisors and administrative officer

The Director of CPCNW reports to the Director of the Agriculture Research Center of WSU (Dr. Jim Moyer) and all center activities are approved by the ARC Director. Operation of all NCPN funded centers receives significant direct input from the NCPN governing boards for each specialty crop (Appendix A). The fruit tree program also has a newly formed advisory committee (Appendix B). A vestige of the original organization of the grape foundation block is the "Foundation Block Advisory Committee" (Appendix B) formed as a subcommittee of the Washington Association of Wine Grape Growers' efforts to support the revitalization of the grape foundation program to serve the Washington grape industry.

Organizational flow chart:



a. Leadership positions directly supported by the unit

None

b. Indirect administrative positions

The CPCNW relies on WSU and WSU-IAREC personnel to assist in grant submission and administration. The PI is salaried through WSU Department of Plant Pathology and ARC:

Plant Pathologist (Ken Eastwell)

- directing research projects, staff and funding
- mentoring graduate students and Post Doctoral Research Associates
- establishing research priorities

Director CPCNW (Ken Eastwell)

- setting policy for CPCNW within context of guidelines established by USDA-APHIS (quarantine and NCPN funding)
- liaison with industry (NCPN fruit tree, hop and grape governing boards, Foundation Block Advisory Group, and the WSDA Seed Advisory Committee)
- providing leadership and direction for ELISA laboratory
- insuring that quality control standards are met
- providing scientific leadership to development and trouble shooting new diagnostic tests
- determining needs for new testing procedures, and facilitating their introduction and validation
- providing oversight for the production and distribution of propagation material
- managing budgets, facilities and equipment
- providing cooperative greenhouse and field-based research support to assist investigations conducted by pathologists and horticulturists

c. Technical services positions

All technical support positions are funded by CPCNW:

Office Assistant 3 (Vacant)

- shipment of fruit tree, grapevines and hops
- obtaining phytosanitary certificates where needed and insure they are correct
- invoicing and payment follow-up with clientele
- preparing budget summaries
- maintaining computer records; mapping and inventory of all plantings

Scientific Assistant (Syamkumar Sivasankara Pillai):

- managing CPCNW Fruit tree program
- supervising program staff
- anticipating needs for virus testing and communicating with management team members
- providing assistance and advice to growers and scientists, regulatory agencies in the development and distribution of virus-tested fruit tree cultivars
- evaluating technology for virus detection and virus elimination
- performing herbaceous indexing
- observing and recording outcomes of herbaceous and woody plant indexing
- insuring all relevant tests are completed in a timely fashion and in compliance with regulations

Plant Growth Facilities Manager (Vacant):

- providing oversight for research and service work orchards, greenhouses, shade house and screenhouse using best management practices.
- coordinating with project leader and senior project personnel to ensure plant material and supplies are available when needed by research and service programs, including the production of seed and budwood for contract work performed by nurseries on behalf of the program, and the production of greenhouse plants.

- coordinate and communicating with project leader and senior project personnel to ensure that specific needs of each unit in the program are met (for example, insect control, adherence to quarantine regulations, irrigation and nutrition needs, frost protection).
- coordinating and overseeing maintenance of all relevant equipment.
- maintaining thorough and accurate records of tree locations and histories, and spray records.
- supervising program staff in all aspects of virus testing and elimination, plant propagation and maintenance, and plant use in research programs. This includes work allocation, training, problem resolution, performance evaluation, recommendations for personnel actions, motivation of employees to achieve peak productivity and performance.
- working with senior project personnel to coordinate staff for the collection and distribution of budwood and samples for analysis.
- inspecting and recording health status and responses to horticultural practices.

Scientific Assistant (Gary Ballard):

- managing operations of the CPCNW Grapevines program
- supervising program staff for grapevine and hop programs
- anticipating needs for virus testing and communicate with other management team members
- performing herbaceous and woody indexing of grape foundation material
- observing and recording outcomes of herbaceous and woody plant indexing

Ag. Research Technician 2 (Jan Burgess):

- performing heat therapy, micro-grafting and re-adaptation of fruit tree plants to greenhouse culture
- assisting in maintenance of fruit tree screen house and greenhouse operations
- conducting experiments on heat therapy

Grounds/Nursery Service Worker 3 (Rae Olmsted):

- collecting and storing hardwood grape cuttings and rootstocks for biological indexing
- budding grape samples onto woody hosts, accurately labeling, and lining out in the vineyard where appropriate
- propagating biological herbaceous hosts for indexing of grapes
- assisting in daily/weekly/seasonal facility maintenance.
- monitoring potted plants daily and water, fertilize and implement insect and disease control as needed
- monitoring vineyard and orchard for foliar diseases and insect and mite pests, and apply pesticides as needed

Grounds/Nursery Service Worker 1 (Vacant):

- maintaining greenhouse and screenhouse plants
- training hop plants
- herbaceous indexing

Farmer 2 (0.25 FTE Antonio Moreno; 0.75 FTE Proposed):

- collecting and storing hardwood cuttings and rootstocks for biological indexing
- budding sample material onto woody hosts, accurately labeling, and lining out in vineyard where appropriate
- weekly monitoring for disease and insect pests; control as needed
- maintaining screenhouse and greenhouse irrigation and fertilization programs
- collecting and accurately labeling tissue samples for analysis, and hardwood or green cuttings from greenhouse, screenhouse, vineyard, and orchard as directed

Plant Technician 2 (Vacant):

- pest control in greenhouses and screenhouses
- budding for fruit tree woody plant indexing

- fruit tree greenhouse and screenhouse management, potting, pruning
- routine facility maintenance

Plant Technician 1 (Elmer Wilcowski):

- potting and budding for fruit tree woody plant indexing
- fruit tree field plot and screenhouse maintenance, pruning for budwood production
- routine facility maintenance

Service Workers:

- assisting with heat therapy and plant maintenance
- assisting with woody plant indexing
- pruning

Scientific Assistant (Martin Joseph):

- performing meristem culture of grapevines and hop plants to establish virus-free tissue cultures
- re-adapting plants to greenhouse culture and coordinate testing to insure freedom from designated pathogens
- clearly identifying each tissue cultured plant and its relationship to sources in the program
- evaluating media and methods for the production of virus and viroid-free meristem cultures
- collecting and evaluating research data in preparation of published research and service accomplishments to support service and research programs

Post-doctoral Research Associate (Dan Villamor)

- complex molecular assays
- improving diagnostics in fruit tree virology
- -providing data to support pest permit modifications

Scientific Assistant (0.875 FTE; Shannon Santoy):

- tissue extraction for PCR for phytoplasma and miscellaneous viruses
- research on fruit tree viruses under direction of Eastwell.

Ag. Research Technician 1 (Tina Vasile):

- supervising ELISA testing for CPCNW and other programs
- follows prescribed protocols for virus testing
- invoicing for ELISA Testing Laboratory services
- supervising timeslip workers in laboratory

d. Other positions

Funding from USDA-APHIS NCPN Cooperative Agreement programs provides funding for an administrative assistant

Coordinator (Debbie Woodbury)

- assisting NCPN administration
  - receiving and assembling grant application information from participating institutions for review by NCPN committees
- developing and maintaining public web sites to disseminate information about NCPN activities and products nationally for NCPN-FT and NCPN-Hops
  - liaison with NCPN outreach and education committees
- providing educational material and responding to general inquiries
- assisting with meeting arrangements, travel arrangements and reimbursement for Tier 2 members

Organizational resources three year history:

a. current and expected support	**FY2011**	**FY2012**	**FY2013**
a. university			
- Director's salary and benefits (50%)	$63,565	$63,507	$63,142
b. state			
CPCNW Grapevines			
- Virus testing (WSU-IAREC operations)	-	-	$61,560
c. external awards (grants, service contracts and sales)			
CPCNW Fruit Trees			
- USDA-APHIS NCPN	$647,055	$814,484	$684,326
- CA Dept of Food & Agriculture	$20,000	$20,000	$30,000
- Sales and contracts	$151,501	$461,998	$277,242
CPCNW Grapevines			
- USDA-APHIS NCPN	$347,657	306,381	$347,868
- WA Wine Industry Foundation	$20,400	-	-
- USDA-NIFA grant	$142,433	-	-
- WSDA Grape assessment funds	-	$160,000	$47,230
- Sales	-	$23,285	$23,298
CPCNW Hops			
- USDA-APHIS NCPN	$155,199	$146,169	$169,709
- WA Hop Commission	$10,516	$7,872	$6,092
- Hop Research Council	$19,106	$19,106	$18,866
- Sales	-	-	$45,342
WSU ELISA Testing Laboratory			
- Service fees	$79,944	$188,869	$96,492
- CA Dept of Food & Ag (Plum pox testing)	-	$167,000	-
d. gift grants – None			
TOTAL SUPPORT:	**$1,657,376**	**$2,378,671**	**$1,871,167**

b. Current and needed support

a. Space requirements

- Current occupancy

  Greenhouse: 9,849 ft^2 for Fruit Trees; 1,994 ft^2 for Grapevines; 1,341 ft^2 for Hops
  Screenhouse: 20,103 ft^2 for Fruit Trees; 4,600 ft^2 for Grapevines; 2,895 ft^2 for Hops
  Shadehouse: 1,127 ft^2 for Fruit Trees
  Orchard and vineyard: 10.99 acres Fruit Trees; 6.08 acres for Grapevines
  Cold storage: 768 ft^2 for Fruit Trees; 187 ft^2 for Hops
  Laboratory space: 1,906 ft^2 for ELISA Testing Lab; 1,399 ft^2 for other CPCNW programs
  Office space: 810 ft^2 for CPCNW

- Additional space needs

  Screenhouse space: 4,600 ft^2 each for Grapevines and Hops (immediate); 23,000 ft^2 for Fruit Trees (starting immediately and expanding over next 3 years)
  Laboratory space: Tissue culture facilities are currently divided between two locations (building 2022 and building 2068, room 123). It is proposed to consolidate the laboratories into a single unit (building 2068, room 224) with a total of 455 ft^2 (50% space assigned to CPCNW) (within one year)

b. Staff support (refer to Organizational Flow Chart)
   - Current support:
     0.50 FTE CPCNW Director, funded by WSU
     1.00 FTE NCPN Program Assistant, funded by NCPN
     4.87 FTE A/P positions, funded by NCPN
     3.25 FTE classified staff, funded by CPCNW
   - Additional staffing needs:
     0.30 FTE Director, funded by WSU (increase commitment from 0.50 FTE to 0.80 FTE) to improve management of fruit tree retention and distribution, and to meet growing regulatory demands
     1.00 FTE A/P position, jointly funded by WSU & CPCNW (industry) to increase production
     2.75 FTE classified staff positions, funded by CPCNW to maintain planting stocks and to assist in invoicing, shipping and inventory control

c. Equipment
   - Current equipment:
     The CPCNW contains all of the advanced instrumentation for advanced molecular techniques. Most of the equipment was purchased with funding from research grants.
   - Additional equipment needs:
     - Much equipment for nucleic acid extraction and analysis is reaching the end of its useful life and will need to be replaced (budget $15,000/yr).
     - Multicore processor: with the rapid movement to deep sequencing for pathogen detection, the added computer power and software is becoming critical
       Processor - $10,000; Analytical software - $14,000
     - Plant incubator/growth chamber: required to accommodate newly acquired ability to import hop material from foreign sources -$11,000
     - Farm trucks (2): required for picking up and delivering fruit trees, hop plants - $32,000
     - Computer upgrades: three PC's require replacement to utilize on current operating systems and software, to be compatible with other program CPUs - $10,000

d. Other external or institutional support needed:
   - Stable baseline funding: Insecurity in funding increases the difficulty of recruiting and retaining staff. The cost of recruiting and retraining adds considerably to operating costs
   - Increased institutional support for two positions:
     - Director position - to allow this position to focus on the CPCNW and to give the program the needed attention since this program is becoming increasingly critical for the international fruit tree industry
     - Production manager – to partner with industry to increase the quality and quantity of propagation material being produced by the CPCNW

Organization's services:

Programs and industries not associated with the CIL that utilize the services provided by CPCNW (past three years)

a. WSU department, schools, colleges, regional campuses

Department of Plant Pathology (3 faculty)
Department of Horticulture
Department of Crop and Soils
Puyallup Plant & Insect Diagnostic Laboratory
Department of plant pathology Plant Pest Diagnostic Clinic
County Extension in Yakima, Benton, Franklin, Chelan, Grant Counties

b. Non-WSU companies, industry, associations

CPCNW Fruit tree:
- Domestic (89) and foreign (53) nurseries
- USDA-APHIS-PPQ-PHP

CPCNW Grapevines
- Nurseries (9) in WA, TX, CA, UT, NY, OR and CO including 2 in Canada
- University researchers (2) in WA and WY
- Growers (13) in the U.S.

CPCNW Hop plants
- Germplasm programs: 2 (Cornell and Corvallis National Germplasm Repositories)
- Domestic growers and nurseries: 32 in 7 states

WSU ELISA Testing Laboratory
- Washington grape growers (6)
- Pollen Companies (3)
- Orchards/growers (25)
- Miscellaneous samples (8)

c. Other

USDA-ARS scientists (2)
USDA-APHIS-PPQ scientist (1)
California Department of Food and Agriculture
Washington State Department of Agriculture (for 29 producers of peas, beans and blueberries)
Idaho State Department of Agriculture (for 6 pea and bean seed producers) USDA-APHIS-PPQ

Organizational evaluation and support statement

The CPC-NW is an essential unit in the CAHNRS Agricultural Research Center. The Center is the premier source of pathogen-tested, genetically uniform planting material for the tree fruit, grape and hop industries. Collectively, they account for over $1.5 billion in revenue to the state of Washington. In addition to serving Washington agriculture, the Center serves as the site for introduction of international tree fruit germplasm into the United States. Washington leads the nation in the production of apples, sour cherries, pears and hops and is second in grapes. The Center can trace its roots back to the 1950s when it served the growing industry in the PNW and has played a crucial role in the success of these industries. The Center also serves growers from around the US and the world as a source of reliable plant material.

The Center, through no fault of its own, has been challenged the past 3 years by the lapse in the normal flow of funding from the USDA to the Center due to repeated Continuing Resolutions and the unique wording in the Farm Bill for the US-Clean Plant Network. As a result of the continued discontinuities of the federal funding, Dr. Eastwell initiated a strategic analysis of the operations of the Center in May of 2013. We delayed submission of this application in order to be able to accurately assess the Center in light of the strategic activities that are still in progress.

Dr. Eastwell is convening strategic advisory groups for each of the three commodities. In addition, he has engaged is conservative cost savings initiatives for the short term, with the goal of restaffing following the strategic planning process and under the new funding model. It should be noted that inspite of short term disruptions, the USDA program supporting CPC_NW is strongly supported with an increase in funding in both the House and Senate versions of the Farm Bill and significant progress has been made regarding increased industry support. Based on progress to date, we believe that the CPC-NW will emerge as a more modern, nimble organization capable of providing leadership in the area for the foreseeable future.

Appendix A – National Clean Plant Network Governing Board membership:

NCPN-Fruit Tree Tier 2

University Representatives

Ken Eastwell, Research, Professor of Plant Pathology, WSU (Chair)
Simon Scott, Research, Professor of Fruit Virology, Clemson University (Vice Chair)
Bill Shane, Extension, Southwest Michigan Research & Extension Center

Regulatory

Christel Harden, Department of Plant Industry, Clemson University
Nancy Osterbauer, Oregon Dept. of Agriculture, Commodity Inspection Division
Ruth Welliver, Bureau of Plant Industry, Pennsylvania Dept. of Agriculture

Industry

Chalmers Carr, Fruit Producer, Titan Farms, Ridge Spring, SC
Robert Woolley, Dave Wilson Nursery, Hickman, CA
Wanda Heuser Gale, International Plant Management, Inc., Lawrence, MI
Phil Baugher, Adams County Nursery, Aspers, PA
Bill Howell, Northwest Nursery Improvement Institute, Prosser, WA
Jim Bittner, Singer Farms, Appleton, NY

Non-Voting Members

Margarita L. Bateman, APHIS Observer, Plant Germplasm Quarantine Program, Beltsville, MD
Joseph Postman, National Clonal Germplasm Repository Representative, Corvallis, OR

Joseph Bischoff, American Nursery and Landscape Association, Washington, DC
Erich Rudyj, NCPN National Coordinator, Riverdale, MD
Debbie Woodbury, NCPN-FT Program Coordinator, WSU-Prosser, WA

NCPN-Grapes Tier 2

University Representatives

Deborah Golino, Foundation Plant Services, UC Davis, CA
Marc Fuchs, College of Agriculture & Life Sciences, Cornell University, Geneva, NY

Industry Representatives

Eric Amberg, Grafted Grapevine Nursery, LLC, Clifton Springs, NY
Cathy Caldwell, Bailey Nurseries, Inc., Yamhill, OR
Phillip Freese, Vilafonte (owner) and WineGrow (consultant), Healdsburg, CA and South Africa
Jonathan Held, General Manager, Stone Hill Winery, Hermann, MO
Dan Martinez, Owner, Martinez Orchards, Winters, CA
Dennis Rak, Owner, Double A Vineyards, Fredonia, NY
Fred Merwarth, Winemaker, Hermann J. Wiemer Vineyard, Dundee, NY
Vicky Scharlau, Washington Association of Wine Grape Growers, Cashmere, WA

State Regulatory Representatives

Mike Colvin, Nursery, Seed & Cotton Program, CA Depart of Food & Agriculture, Sacramento, CA
Jan Hedberg, Oregon Department of Agriculture, Salem, OR
David Johnson, Missouri Department of Agriculture, Jefferson City, MO
Margaret Kelly, New York Department of Agriculture & Markets, Albany, New York
Liz Vavricka, Idaho Department of Agriculture, Boise, ID

Research and Extension Representatives

Mark C. Black, Texas AgriLife Extension Service (Texas A&M System), Uvalde, TX
Ken Eastwell, Washington State University-IAREC, Prosser, WA
Marc Fuchs, College of Agriculture & Life Sciences, Cornell University, Geneva, NY
Robert Martin, USDA-ARS Horticulture Crops Research Unit, Corvallis, OR
Tim Martinson, Department of Horticultural Sciences, Cornell University, Geneva, NY
Rhonda Smith, University of California Cooperative Extension, Santa Rosa, CA
Fritz Westover, Texas Agri-Life Extension Service Harris County, Houston, TX

NCPN Hops Tier 2

Private Hop Breeding Program

Jason Perrault, Perrault Farms, Yakima, Washington

Oregon Hop Commission

Gayle Goschie, Goschie Farms, Inc., Silverton, OR

Idaho Hop Commission

Nate Jackson, Caldwell, ID

Washington Hop Commission

Reggie Brulotte, Brulotte Farms, Toppenish, WA

At-Large Grower

Bernard Gamache, Virgil Gamache Farms, Toppenish, WA

Brewer

Ed Atkins, Elk Mountain Farm, Inc., Bonners Ferry, ID

Hop Merchant

Paul Matthews, SS Steiner, Inc., Yakima, WA

Public Research Plant Pathologist

David H. Gent, Oregon State University, Corvallis, OR

State Regulatory Agency

Tom Wessels (confirmation pending), WSDA

Non-Voting Members

Erich Rudyj, NCPN National Coordinator, USDA-APHIS-OOQ-PHP, Riverdale, MD
Kim Hummer, National Clonal Germplasm Repository, USDA-ARS-NCGR, Corvallis, OR
Robert (Sam) Johnson, Director, USDA-APHIS (PPQ), USDA-APHIS, Riverdale, MD
Stephen Kenny, University Public Hop Breeding Program, WSU, Prosser, WA
Subject Matter Expert, Ken Eastwell, Plant Pathologist, WSU, Prosser, WA

Appendix B - CPCNW advisory committee membership:

CPC-Fruit Tree Advisory Committee

Lauri Guerra, WSDA, Prosser, WA
Wanda Gale, International Plant Management, Lawrence, MI
Dale Goldy, Stemilt Ag Services, Gold Crown Nursery, Wenatchee, WA
Bob Ludekens. L. E. Cook Company, Visalia, CA
Cathy Caldwell, Bailey Nursery, Yamhill, OR
Nnadozie Oraguzie, WSU, Prosser, WA
Tom Auvil, Washington Tree Fruit Research Commission, Pasco, WA
Ken Adams, Willow Drive Nursery, Ephrata, WA

Grape Foundation Block Advisory Committee

Grower Representatives

Rick Hamman (WA)
Dale Jeffers (ID)
Tom Mortimer (OR)

Winery Representatives

Joy Andersen (WA)
Martin Fujishin (ID)
Herb Quady (OR)

Other grapes

Keith Oliver (WA, Concord grapes)
Tom Elias (ID, Table grapes)
Ray Ethell (OR, Table grapes)

Nursery Representatives

Tom Thornton (WA-Western)
Kevin Judkins (WA-Eastern)
Cathy Caldwell (OR)

At-Large Representatives

Andy Schilperoot (WA)
Brian Carter (WA)
Mike Means (WA)
JP Valot (OR)
Kevin Chambers (OR)

Department of Agriculture Positions

Tom Wessels or Lauri Guerra (WA)
Mike Cooper (ID)
Jan Hedberg (OR)

WSU Advisory Positions

Ken Eastwell
James Harbertson
Thomas Henick-Kling
Gwen Hoheisel
Markus Keller
Michelle Moyer
Naidu Rayapati
Patty Skinkis
Vaughn Walton
Debbie Woodbury

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Center for Sustaining Agriculture & Natural Resources

APPLICATION

a. Center for Sustaining Agriculture & Natural Resources (CSANR)

b. Research Center (Budget is 50% Research/50% Extension Split)

c. Chad Kruger, Director

Director's Address: WSU TFREC, 1100 N. Western Ave., Wenatchee, WA 98801
509-663-8181 x242 (campus 5-digit = 63242)
cekruger@wsu.edu
http://csanr.wsu.edu

Administrative Office: WSU CSANR, 2606 W. Pioneer, Puyallup, WA 98371
253-445-4626 (campus 5-digit = 84626)
csanr@wsu.edu

d. Established by legislation in 1991 (RCW 15.92). First year of operation was 1992.

A four-page organizational summary:

a. Mission, purpose, goals and functions:

Mission: CSANR leads efforts in sustainable agriculture, food, and natural resource systems that are economically viable, environmentally sound, and socially responsible.

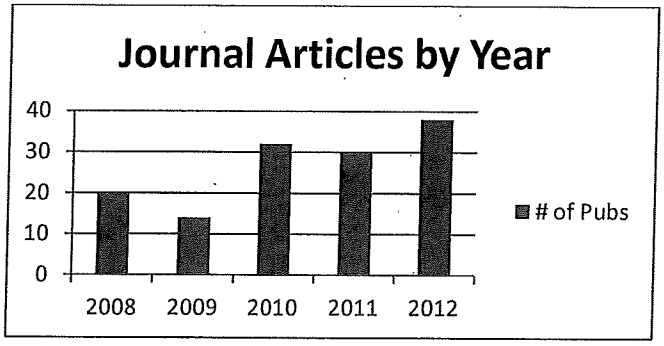
Purpose: From RCW 15.92.020. *The center shall provide statewide leadership in research, extension, and resident instruction programs to sustain agriculture and natural resources.*

Goals: To catalyze, support and extend scientific research to improve the sustainability of agriculture, natural resources and food systems in the state of Washington and the Pacific Northwest.

Functions: CSANR functions as a catalyst within WSU for the development of research and extension programs and projects focused on addressing complex sustainability challenges facing agriculture, food and natural resource management. CSANR provides seed funding to WSU Faculty through project and planning grants to support the development of extramural research and extension proposals; manages a broadly representative external advisory committee that provides guidance on investment priorities and goals; leads trans-disciplinary programmatic initiatives and projects to address identified and emerging challenges in our mission area; and facilitates the delivery of research-based solutions to communities and industries in the state and region.

b. Summarize the unit's effectiveness in achieving goals and functions

- CSANR has engaged more than 170 "Faculty Affiliates" (includes post-doctoral, visiting faculty, and collaborating faculty at nearby institutions) through seed grants (126 grants provided to date) and Center-led initiatives and Programs in the past decade. Approximately 75 Faculty (current grantees or co-Investigators/Collaborators on current projects) are currently active CSANR Affiliates.
- More than $7.3m in extramural grants/contracts were awarded to CSANR from January 2010 – May 2013. In addition, CSANR investments helped leverage more than $43m in extramural grants and contracts to WSU faculty and external collaborators from 2010 - 2012.
- 134 journal publications were supported in part by CSANR from 2008-2012. In addition, more than 100 project reports, formal Extension publications, and other industry- and community-oriented outreach articles and multi-media products have been published.



- While it is extremely difficult to comprehensively assess the community impact of CSANR, documented impacts of research and extension supported by CSANR include implementation of

improved management practices on hundreds of thousands of acres of agricultural land; an estimated $125m in capital investments in environmental technology and infrastructure in the Pacific Northwest; installation of 25 megawatts of on-farm renewable energy capacity; providing scientific guidance for the recent EPA dairy water quality agreement to reduce more than $500m in fines and litigation in the Yakima Basin; supporting installation of Electronic Funds Transfer technology at 20 farmers' markets, allowing for use of food stamps; direct research-based outreach to thousands of farmers, resource managers, industry and regulatory agency personnel; and significantly increased understanding and appreciation for agriculture and food sustainability concerns amongst the citizens of Washington.

- Awards/Recognition: CSANR Programs and Initiatives, specifically the three longest-standing program areas: Climate Friendly Farming, Biologically Intensive and Organic Agriculture (BIOAg), and Small Farms, are nationally known and have been formally recognized by WSU and CAHNRS as well as USDA NIFA. Specific recognition include USDA NIFA's most prestigious award to a Land Grant University - the Partnership Award for Innovative Program Models; CAHNRS Interdisciplinary Team Award; twice recognized with WSU Extension's Big Cat Team Award; and the honor of having CSANR Programs and Faculty featured as WSU Innovators and in the National Association of State Universities and Land Grant Colleges Capitol Hill Exhibit.

c. **Changes to unit goals/functions in past 5 years**

CSANR has undergone significant transition and growth over the past five years, due to new core operating investment beginning in 2006 followed by significant budget reductions beginning in 2009. The state legislature supported the establishment and funding of the BIOAg Program (3 positions and ~$400k competitive grant program) as part of the WSU Unified Agriculture Initiative in 2006. Implementation of the grant program began in 2007 and the three positions were filled by early 2008. Budgetary reductions and other personnel transitions resulted in the loss or conversion of all three faculty positions (one was permanently *converted* into the CSANR Director position in 2010) by mid-2012 and the grant program is now slightly less than $250k annually. In spite of the reductions, it is clear that the BIOAg grant program continues to support significantly increased capacity within WSU to prepare for and respond successfully to emerging opportunities for federal, regional and state research and extension funding in organic agriculture, climate change, and specialty crop related programs.

d. nature and scope of activities;

CSANR has long-standing programming in organic agriculture, integrated pest management/pesticide alternatives, conservation, cover-cropping/alternative cropping systems, organic waste treatment, small and limited-resource farms, and alternative markets – all of which are focused primarily on implementing practical and sustainable production, marketing systems and practices by farmers and industry. More recent programmatic initiatives and activities include climate change (mitigation and adaptation), energy, agricultural/environmental nutrient management (particularly nitrogen), water (quantity and quality), and human health – all of which are focused more on "societal grand challenges" and bridge basic research, technology development, public-policy relevant information, and the implementation of practical solutions. Emerging programs/initiatives in development include emerging food system research needs identified by the maturing sustainable food economy (e.g. assessing the health benefits of quality food, environmental food-print assessment).

e. CIL's function relative to other units in the university community;

While CSANR has a limited amount of designated faculty capacity for program leadership, the majority of our influence and function is through catalytic support of Affiliated Faculty in the broader WSU system in

our mission area. CSANR has supported Affiliated Faculty in 29 different WSU units (21 CAHNRS/Extension Units, 8 units in other Colleges) with seed grants or collaborations on initiatives and projects. CSANR contributes to all four areas of CAHNRS Areas of Pre-eminence (basic plants sciences, horticultural production/processing, dryland production systems, biologically intensive and organic agriculture), the Bioproducts/Bioprocessing Emerging Area of Excellence, and three of the potential CAHNRS Unifying Themes (Water, Agriculture in a Changing Climate, and Foods for Health) identified in a May 2013 college retreat. In addition, CSANR has made significant contributions to WSU's Clean Tech initiative.

f. contribution to and impact on instructional programs;

While CSANR has a legislative mandate to support resident instructional programs, it does not receive any direct budget dedicated to supporting instructional programs. Therefore, CSANR has focused on making targeted investments in "value-added" experiences for undergraduate students that tie together instructional programs with research and/or extension activities. These include early support and investment in developing the Eggert Family Organic Teaching Farm, funding the annual Field Course in Sustainable Agriculture, sponsorship of the Spring For Action – Break for Change service learning project, supporting student internships in sustainable and organic agriculture, and sponsoring student participation in industry conferences (e.g. Tilth Producers Conference). As described below, CSANR grant funding and initiatives have been used to support assistantships in several WSU graduate programs.

g. contribution to and impact on the university and other clients; and

One of the greatest strengths CSANR brings to the university is the breadth and depth of state and region-wide community relationships, including farmer/resource manager, industry, environmental and community groups, and government agencies. CSANR has an excellent reputation as a very successful "Gateway to WSU" for clients in the state and region. In addition to providing seed funding, brokering partnerships between WSU faculty and community clientele has been a critical factor in the growth and success of extramural funding and productivity at WSU in the CSANR mission areas – particularly organic food and agriculture, climate change, bioenergy and water resources. In several cases, federal review panels have noted the importance of *existing* community stakeholder partnerships as a key strength of WSU proposals supported by CSANR.

h. strategic vision of what the CIL will be five years in the future.

CSANR has undergone significant maturation as a university center in the past five years, firmly establishing its reputation as a catalyst and incubator for trans-disciplinary and integrated research and extension in sustainable and organic agriculture. In recent years, CSANR has significantly increased its investment in WSU's basic and translational research capabilities in recognition that increasingly sophisticated scientific discoveries are necessary for addressing the "wicked problems" facing our food and agriculture system. CSANR is now a unit that invests in and catalyzes activity all along the research-to-commercialization continuum.

In the next five years, it is anticipated that several of the program initiatives developed in recent years (e.g. climate change, agricultural bioenergy, water) will be *institutionalized* as priorities across WSU and CAHNRS, and CSANR will remain a core player in these areas. In response to increasing demand for research and extension that addresses the sustainability of food consumption, CSANR has been working to establish and develop new program initiatives focused on increasing the sustainability of "food systems" (post-farmgate) including assessment of consumer needs, enhancing alternative food systems and enterprises, measuring the environmental footprint of food, and exploring the connections between

agriculture, food and public health. Finally, while significant progress has been made in improving agricultural resource conservation and reducing the flow of agricultural toxics to the environment over the past 20 years, there are still significant improvements that can be achieved through further investments in research and extension focused on improving agricultural systems and management. Our strategy for supporting continued research and extension investments for improving production sustainability is to focus on cross-system "issues" such as improving soil quality, increasing cropping system diversity, and integrated pest management (as opposed to focusing on commodity-specific needs).

To implement this strategy over the next five years, CSANR has a critical goal of increasing core resources available to initiatives and projects led by Affiliated Faculty. The primary strategy to increase the resource base is through development funding for seed grants and graduate assistantships. CSANR is included as a core element of the CAHNRS Organic and Sustainable Agriculture Campaign – with a goal of creating a $5m endowment which would produce sufficient revenue to match the current BIOAg grant program resources.

A three-page summary of organizational structure that includes:

a. From RCW 15.92.040

Administrator. The center is managed by an administrator. The administrator shall hold a joint appointment as an assistant director in the Washington State University agricultural research center and cooperative extension.

Functionally, the Director is a faculty member appointed by the Dean of the College of Agriculture, Human and Natural Resource Sciences for a 4-year term, renewable term.

Chad Kruger is the 4th Director for CSANR. Current vita attached.

b. Participating Faculty Members

Faculty Member	**Home Unit**
Core Faculty	
Chuck Benbrook	Crop & Soil Sciences
Doug Collins	ANR Program Unit
Craig Frear	Biological Systems Engineering
David Granatstein	ANR Program Unit
Chad Kruger	CSANR
Andy McGuire	ANR Program Unit
Marcia Ostrom	School of the Environment
Faculty Leadership Team	
Chris Benedict	ANR Program Unit
Ian Burke	Crop & Soil Sciences
Lynne Carpenter-Boggs	Crop & Soil Sciences
Lindsey du Toit	Plant Pathology
Jessica Goldberger	Crop & Soil Sciences
Scot Hulbert	Plant Pathology
Vicki McCracken	School of Economic Sciences
Carol Miles	Horticulture
Don Nelson	Animal Sciences
Dave Sjoding	Extension Energy Program
Bill Snyder	Entomology
Steve VanVleet	ANR Program Unit

Affiliated Faculty: See http://csanr.wsu.edu/db2011/Browse_By or http://www.tfrec.wsu.edu/pages/CSANR2010/pubs

c. Criteria for Selecting Faculty Members

CSANR has three "groupings" of faculty member participants: Core Faculty, Leadership Team, and Faculty Affiliates.

CSANR Core Faculty. There are currently 7 WSU Faculty members who are *programmatically assigned* to CSANR via Position Description or Memorandum of Agreement with responsibility for leadership of either research or extension programs associated with CSANR. Appointments are determined at time of hire and reviewed annually. All Core Faculty have departmental/Extension Program Unit tenure homes or are non-tenure faculty with Departmental Affiliations.

The CSANR Leadership Team is a voluntary committee assignment for Affiliated Faculty with representation of multiple CAHNRS Departments and Extension Program Units that provide guidance for CSANR research and extension initiatives and investment through project and activity leadership, service on proposal review panels, and other advisory opportunities. Leadership Team Members are appointed by the CSANR Director, with agreement from the tenure unit administrator, on a 3-year, renewable term.

CSANR Affiliated Faculty includes any faculty member who receives funding from a CSANR Program, including competitive grants (BIOAg and Organic), planning grants, and professional development grants. In addition, any faculty member that participates in a CSANR led initiative or extramurally funded project is designated as an Affiliated Faculty Member.

d. Graduate Students, post-doctoral appointments, Visiting Scholars, and Program Staff

CSANR provides funding through internal competitive project and planning grants to faculty members who may partially support a graduate student or post-doctoral appointment. Support for graduate education is a consideration in the review criteria for these awards. In addition, extramural funding leveraged by CSANR grants or program/project initiatives frequently support graduate students. Graduate students are informally affiliated with CSANR, but are housed in Academic Departments and Programs. In specific cases, post-doctoral appointments have been made within CSANR for specific, large programmatic/project initiatives. CSANR supports Visiting Scholars on an ad-hoc basis depending on specific projects. In addition to Grad Students, post-doctoral students and visiting scholars, CSANR uses Associate in Research and Research Intern temporary appointments to support specific, extramurally funded projects and initiatives.

e. Responsible College/Unit

College of Agriculture, Human, and Natural Resource Sciences (Agricultural Research Center and WSU Extension)

f. Advisory Committee

CSANR has an external Advisory Committee representative of affected groups for Washington agriculture and natural resource management in accordance with legislation. Members are appointed by the Dean of CAHNRS (or the designated Associate Dean) at the recommendation of the CSANR Director. The Advisory Committee provides guidance to the CSANR Director, Leadership Team, and Program Faculty on research and extension priorities, review of competitive grants, and advising on sustainable agriculture and natural resource management concerns in the state and region. From RCW 15.92.040

(1) A committee shall advise the administrator. The dean of the Washington State University college of agriculture and home economics shall make appointments to the advisory committee so the committee is

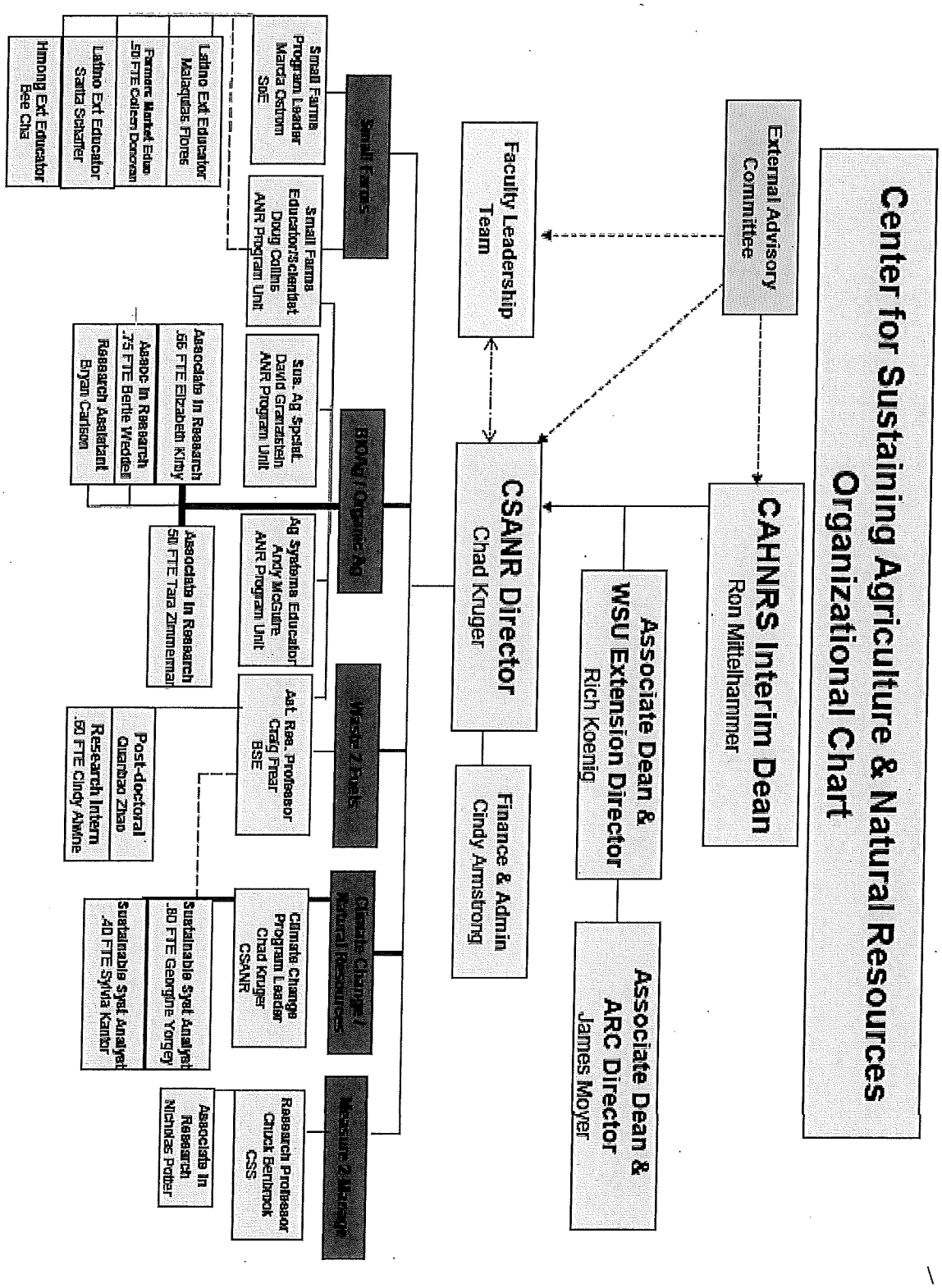
representative of affected groups, such as the Washington department of social and health services, the Washington department of ecology, the Washington department of agriculture, the chemical and fertilizer industry, food processors, marketing groups, consumer groups, environmental groups, farm labor, and natural resource and agricultural organizations.

(2) Each appointed member shall serve a term of three years, and one-third are appointed every year. The entire committee is appointed the first year: One-third for a term of one year, one-third for a term of two years, and one-third for a term of three years. A member shall continue to serve until a successor is appointed. Vacancies are filled by appointment for the unexpired term. The members of the advisory committee shall serve without compensation but shall be reimbursed for travel expenses incurred while engaged in the business of the committee as provided in RCW 43.03.050 and 43.03.060.

(3) It is the responsibility of the administrator, in consultation with the advisory committee, to:
(a) Recommend research and extension priorities for the center;
(b) Conduct a competitive grants process to solicit, review, and prioritize research and extension proposals; and
(c) Advise Washington State University on the progress of the development and implementation of research, teaching, and extension programs that sustain agriculture and natural resources of Washington.

CSANR Advisory Committee	**2013**
Member	*Affiliation*
Jim Baird	Baird Orchards
Paul Benz	Lutheran Public Policy Office
Trudy Bialic	PCC Natural Markets
Brenda Book	WSDA Organic Food Program
Michele Catalano	Tilth Producers of Washington
Kirk Cook	WSDA
Kevin Corliss	Ste. Michelle Wine Estates
Laurie Davies	WDOE Waste 2 Resources Program
Nicole Embertson	Whatcom Conservation District
Guy Evans	Sunshine Farm & Tunnel Hill Winery
Dale Gies	Gies Farms
Ellen Gray	Washington Sustainable Food & Farm Network
Randy Honcoop	Honcoop Raspberries
Alec McErlich	Earthbound Farms
Rhod McIntosh	McIntosh Farms
Kay Meyer	Pacific Northwest Direct Seed Association
Warren Morgan	Morgan Orchards/Double Diamond Fruit
Maurice Robinette	Lazy R
Anne Schwartz	Blue Heron Farm
Jill Smith	Pure Eire Dairy
Amy Snover	University of Washington
Bill Warren	Warren Farms; Farm Bureau; Blue Mtn. Station

An organizational flow chart



A two-page summary of organizational resources:

a. Current and expected levels of support during the last three fiscal years:

The period from 2010-2012 can be characterized by significant reductions in core institutional funding to CSANR due to state budget reductions (more than 50% reduction over FY08 baseline), but *dramatic* increases in leveraging of extramural grant and contract funding (compared to a baseline from 2003-2007 of approximately $2m/year). Factors that contributed to this increase in leveraged funding have included implementation of competitive seed grant programs (BIOAg and Organic Crop Research), increased institutional capacity generated by $3.75m gift to CSANR from the Paul G. Allen Family Foundation in 2003, and increased focus on strategic program initiatives and priorities that aligned with extramural funding programs at federal and state agencies.

University (current and expected allocation):

- Permanent Budget Line Personnel = $142,768 (50% ARC, 50% WSU Extension)
- Permanent Budget Line Operations = $296,329 (48% ARC, 52% WSU Extension)
- 4.0 additional FTE in Faculty Positions are designated as "CSANR Core Faculty" with responsibilities specific to a CSANR Program. Funding for these 4.0 FTE is budgeted in their tenure unit homes

State:

- There is no direct state support for CSANR separate from University PBL allocation or competitive grants and contracts from state agencies. However, CSANR's BIOAg Grant Program (~$250k annually of the PBL Operations reported above), supported widely by community and industry partners, was formally approved by the state legislature as part of WSU's Unified Ag Initiative beginning in 2006. Two legislative allocations were approved in successive years ($400k in 2006 and $200k in 2007), but has been reduced significantly through university budget cuts beginning in 2009.

External Awards:
Assessing CSANR's extramural awards is not straight-forward due to the fact that CSANR is the fiscal management unit for only a fraction of the funded awards secured through catalytic investment by CSANR.

- $7,377,876 ($5,974,352 ARC, $1,403,524 Extension) in extramural grants and contracts were awarded to CSANR (as fiscal management unit) from January 1, 2010 – May 29, 2013.
- CSANR Core Faculty are co-investigators on more than $25m in additional extramural grants and contracts from 2010-2012 that are *managed by other units/institutions.*
- As reported by CSANR Affiliated Faculty, more than $43m in extramural grants and contracts were leveraged in part with seed grants or other programmatic investments from CSANR during 2010-2012. Most of these awards are managed by other WSU units or collaborating institutions.
    - *There is overlap between the $25m and $43m reported above.*

Gift Sources:

- CSANR has two small, historical endowments: the Lauzier Endowment for Sustainable Agriculture Systems Education and the Verle Kaiser Endowment for Conservation Education. Each of these generate between $10k and $15k annually. The Lauzier Endowment has been "under-water" during the period from 2010-2012 and therefore income has been suspended for the period.

- In FY13, several corporate donors jointly committed to $150k annually for three years through gift-grants to support the establishment of the Measure 2 Manage Program (M2M) within CSANR. This funding is used to support a non-tenure track faculty Program Leader and operations for M2M.
- CSANR is a designated part of the Organic and Sustainable Agriculture campaign as part of CAHNRS portion of the WSU Big Ideas Campaign. The goal is to build endowment and major gifts to support a competitive internal grants program and graduate fellowships.

b. Current and Needed Space, Staff support, and Equipment

- CSANR space and equipment needs have been moderate to date. CSANR is a "virtual center" in that we do not have "core facilities" at any location and our faculty and staff are housed throughout the state at other CAHNRS/WSU Extension units (e.g. campus departments, R&E Centers, county extension offices, or through other arrangements). In cases where a CSANR faculty member or program requires laboratory or research site support, that is provided by partner units through formal Memoranda of Agreement between CSANR, the collaborating unit, and the faculty member.
- CSANR has historically supported facility and equipment investments on an "as needed basis" throughout the CAHNRS/WSU Extension system to ensure the existence of facilities and equipment (e.g. plots at research farms, instrumentation, etc.) necessary for conducting research or extension programs focused on sustainable agriculture. Examples include organic research plots at the Puyallup and Wenatchee REC's, equipment for the Eggert Family Organic Teaching Farm in Pullman, a center-pivot irrigation system on the Othello Research Farm (Prosser REC), instrumentation at the Cook Agronomy Farm, and bioprocessing and analytical equipment in Biological Systems Engineering.
- CSANR is a full-service administrative management unit with standing capabilities for all facets of pre- and post-award administrative service. We have 1.0 FTE in permanent university administrative professional support for pre-award proposal processing and post-award administrative management (fiscal, personnel, travel, contracting, accounts payable, etc.). In addition to formal university administrative support, CSANR has standing capabilities (soft-funded) for providing significant levels of *project management support* for large, multi-investigator grant awards, including project coordination, reporting, communication and stakeholder support, and publication support among other functions. CSANR has successfully managed several multi-million dollar, multi-investigator projects in the past decade. In response to demand from Affiliated Faculty, CSANR has invested in project management over the past three years to increase post-award support for Affiliated Faculty serving as Project Directors for research and extension projects in program areas related to CSANR's mission.

C. Other External or Institutional Support

- CSANR is the unit designated by WSU Extension to manage the USDA Western SARE Professional Development Program. This program provides $18k annually for professional development in the topical area of sustainable agriculture to support training and capacity-building opportunities for Extension Faculty and Professionals in Washington. All new Extension Faculty hires are eligible for "New Faculty" development grants and all WSU Extension personnel can compete for professional development awards.

A one-page list of those not associated with the CIL using the organization's services:

WSU Units

College of Agriculture, Human and Natural Resource Sciences:

Departments:
Animal Sciences
Apparel, Merchandising, Design and Textiles
Biological Systems Engineering
Entomology
Crop & Soil Sciences
Horticulture
Plant Pathology

Schools:
School of Economic Sciences
School of the Environment
School of Food Science

Other CAHNRS Units:
Impact Center
Inst. for Biological Chemistry
Int'l Ag Res. & Dev.
Mt. Vernon REC
Puyallup REC
Prosser REC
Wenatchee Tree Fruit REC

WSU Extension Program Units:
Ag & Natural Resources
Community & Economic Development
Energy Program
Youth & Families

Other WSU Colleges/Units:
CEREO
College of Pharmacy
College of Vet Med
College of Engineering & Architecture
Dept. of Civil & Environmental Engineering
Dept. of Veterinary Microbiology and Pathology
Lab for Atmospheric Research
State of Washington Water Research Center

Other Academic/Research Institutions:
Bellingham Technical College
Oregon State University
USDA Agricultural Research Service
University of Idaho
University of Washington

Government Agencies:
EPA Region 10
Oregon Department of Agriculture
USDA Natural Resource Conservation Service
USDA NIFA
USDA Western SARE Professional Development Program
Washington State Department of Agriculture
Washington State Department of Commerce
Washington State Department of Health
Washington State Department of Natural Resources
Washington State Department of Ecology
Various Conservation Districts & RC&D's
Various Municipal Government Agencies

Industry Associations/Companies/Non-governmental Organizations:

CSANR partners with dozens of industry associations, companies and NGO's depending on program and project needs. *Representative examples include*: Washington Sustainable Food & Farm Network, Tilth Producers of Washington, Puget Consumers Cooperative, Washington State Dairy Federation, Andgar Corporation, Vander Haak Dairy, Pacific Northwest Direct Seed Association, Blue Heron Farm, Gies Farm, Climate Solutions, Paul G. Allen Family Foundation, Bullitt Foundation, One Pacific Coast Bank

Chad Kruger
Director
Center for Sustaining Agriculture & Natural Resources
Washington State University

Professional Preparation

Northwest College, Kirkland, WA	Interdisciplinary Studies	B.A. 1997
University of Wisconsin, Madison	Land Resources	M.S. 2003

Appointments

2011 – Present	Washington State University Center for Sustaining Agriculture & Natural Resources, Director
2008 – 2010	Washington State University Center for Sustaining Agriculture & Natural Resources, Interim Director
2006 – 2010	Washington State University Center for Sustaining Agriculture & Natural Resources, BIOAg Educator
2004 – 2006	Washington State University Center for Sustaining Agriculture & Natural Resources, Climate Friendly Farming Director of Outreach and Communication
2003	The Evergreen State College, Visiting Faculty in Ecological Agriculture.
1999 – 2004	University of Wisconsin – Madison Center for Integrated Ag Systems / Consortium for Sustainable Agriculture Research & Education, Membership Coordinator and Executive Assistant

Publications (selected)

Miller, M., Anderson, M., Francis, C., Kruger, C.E., Barford, C., Park, J., & McCown, B., (submitted). Critical Research Needs for Successful Food Systems Adaptation to Climate Change. *Journal of Agriculture, Food Systems and Community Development.*

Huggins, D.R., Kruger, C.E., & Uberuaga, D. (submitted). Site-Specific Trade-offs of Harvesting Cereal Residues as Biofuel Feedstocks. *Biomass and Bioenergy.*

Allen, E., Kruger, C., Leung, F.Y., & Stephens, J. C. (in press). Diverse Perceptions of Stakeholder Engagement within an Environmental Modeling Research Team. *Journal of Environmental Studies and Science.*

Eigenbrode, S., Capalbo, S., Houston, L., Johnson-Maynard, J., Kruger, C.E., & Olen, B. (in press). Agriculture. In P. Mote, A. Snover (Eds.), *Northwest Climate Assessment Report.* Island Press.

Barber, M.E., Adam, J.C., Brady, M.P., Chinnayakanahalli, K.J., Rajagopalan, K., Dinesh, S., Kruger, C.E., Stockle, C.O., & Yorgey, G.G. (2013). Global Change Implications on Long-Term Water Supply and Demand Forecasts in the Columbia River Basin. In H. Bjornlund, C.A. Brebbia (Eds.), *Sustainable Irrigation and Drainage IV: Management, Technologies, and Policies* (pp 77-86). Southampton, UK: WIT Press.

Collins, H., Streubel, J.D., Alva, A., Frear, C.S., Chen, S., Fransen, S.C., Kruger, C.E., & Granatstein, D.M. (2011). Greenhouse gas emissions from an irrigated silt loam soil amended with anaerobic digested dairy manure. *Soil Science Society of America Journal.* 75(6), 2206-2216.

Streubel, J.D., Collins, H., Garcia-Perez, M., Tarara, J.M., Granatstein, D.M., & Kruger, C.E. (2011). Influence of contrasting biochar types on five soils at increasing rates of application. *Soil Science Society of America Journal.* 75(4), 1402-1413.

Kruger, C.E., Yorgey, G.G., & Stockle, C.O. (2011, June). Climate change and agriculture in the Pacific Northwest. *Rural Connections: Climate Change Adaptations in the Rural West,* 5(2), pp 51-54.

Logan, UT: Western Rural Development Center.

Yorgey, G.G., Kruger, C.E., Frear, C.S., Shumway, C.R., Bishop, C., Chen, S., & MacConnell, C.B. (2011). Anaerobic digestion in the Pacific Northwest. *Rural Connections: Climate Change Adaptations in the Rural West*, 5(2), pp 33-38. Logan, UT: Western Rural Development Center.

Collins, H.P., Fransen, S.C., Smith, J.L., Granatstein, D.M., Kruger, C.E., & Boydston, R.A. (2010). Carbon sequestration under irrigated switchgrass (Panicum virgatum) production. *Soil Science Society of America Journal.*

Stockle, C.O., Nelson, R.L., Higgins, S., Brunner, J.F., Grove, G.G., Boydston, R.A., Whiting, M.D., & Kruger, C.E. (2010). Assessment of Climate Change Impact on Eastern Washington Agriculture. *Climatic Change.*

Kruger, C., G. Yorgey, S. Chen, H. Collins, C. Feise, C. Frear, D. Granatstein, S. Higgins, D. Huggins, C. MacConnell, K. Painter, C. Stöckle. 2010. Climate Friendly Farming: Improving the Carbon Footprint of Agriculture in the Pacific Northwest. CSANR Research Report 2010-001. Washington State University: http://csanr.wsu.edu/pages/Climate_Friendly_Farming_Final_Report/.

Wang., Z; S. Chen; C. Frear; C.E. Kruger and D. Granatstein. (2009). Advanced small-scale anaerobic digester design tailored for household user living in cold climate area. WSURF 994 Invention Disclosure.

Brown, S., Kruger, C.E., & Subler, S. (2008). Greenhouse Gas Balance for Composting Operations. *Journal of Environmental Quality* 37: 1396-1410.

Kruger, C.E., Chen, S., Harrison, J.H., Macconnell, C.B., Shumway, C.R., & Bowers, K. (2008). High Quality Fiber and Fertilizer as Co-Products from Anaerobic Digestion. *Journal of Soil and Water Conservation.* 63(1), 12A-13A.

Kruger, C.E., & Cook, K. (2008). Recommendations for the Development of Agricultural Sector Carbon Offsets in Washington State. *Washington Climate Action Team* http://www.ecy.wa.gov/climatechange/2008FAdocs/Ag_Offset_Recc_Pkg_FINAL.pdf.

Synergistic Activities

- Extension Lead for USDA Funded Projects: (1) Regional Approaches to Climate Change for Pacific Northwest Agriculture - $20m and (2) BioEarth - $3m (3) Anaerobic Digestion Systems ($750k).
- Project Director and Principal Investigator for the "Climate Friendly Farming Project: Moving from Source to Sink." (2004-2011). This $3.75M project involved engineers, soil scientists, economists and extension educators from WSU and USDA ARS. Programmatic efforts included multiple spin-off and companion projects totaling more than $40M in additional research funding to date.
- Gubernatorial Appointee to the State of Washington's State Energy Strategy Technical Advisory Committee (2010-2011), Working Lands Climate Change Technical Working Group (2010), Climate Action Team – 2007 – 2008, (Co-Chair of the 2008 Washington Agricultural Sector Carbon Market Workgroup)
- Co-PI for multi-disciplinary projects assessing the potential impact of climate change on agriculture in Eastern Washington (2007-2009) and Columbia River Supply & Demand Forecast (2010-2012).

Graduate Committees / Post-doctoral Sponsorship

- Post-doctoral sponsorship: Jason Streubel (PhD Soils 2011)
- Graduate committees: Elizabeth Allen (PhD Environmental Science), Tabitha Brown (PhD Soils), Kirti Rajagopalan (PhD Civil & Environmental Engineering)

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APPLICATION FOR FACULTY SENATE APPROVAL
OF THE *CAHNRS Food and Environmental Quality Laboratory Analytical Facility*

The Food and Environmental Quality Laboratory analytical facility (FEQL-Lab) located at the WSU Tri Cities campus was state-mandated in 1991 (RCW 15.92.050) to "conduct pesticide residue studies in/on fresh and processed foods, in the environment, and for human and animal safety." This laboratory is a CAHNRS *service facility* that conducts regulatory science research under CFR 40 Part 160 Good Laboratory Practice standards. GLP laboratory evaluations are highly specialized studies that support US EPA dietary risk assessments for pesticide registrations for the vast array of specialty crops grown in Washington State and the Pacific Northwest. To serve the legislative mandate, FEQL participates in Interregional Research Project #4 (IR-4) and other projects that generate data in support of pesticide registrations. Besides conducting GLP food protection studies, our regulatory science team also conducts; 1) agrochemical product understanding studies, 2) human pesticide exposure assessments, 3) rapid site assessments for environmental contaminant releases, and 4) pesticide aquatic exposure assessments on threatened and endangered species. In accordance with the founding legislation, the FEQL analytical lab is advised by a board of stakeholders representing a number of distinct functions pertaining to Washington State agriculture and environmental health.

The FEQL analytical lab program leader is:

Dr. Vincent Hebert
Associate Scientist and Extension Specialist
Department of Entomology
vhebert@tricity.wsu.edu
http://feql.wsu.edu

Dr. Hebert does not have an administrative appointment but serves as the laboratory research director and is responsible for overseeing funding, infrastructure improvements, facility operations, staffing, science deliverables, and regulatory compliance under 40CFR Part 160. Professor Steve Sheppard, Chair Department of Entomology reports to the CAHNRS Dean Mittelhammer in regards to the effectiveness of this service unit (see Organizational Flow Chart).

Organizational Summary

Historical Overview and Mission:

In 1991, the Washington Legislature created the Food and Environmental Quality Lab (FEQL) at the WSU Tri-Cities campus to conduct pesticide residue studies in foods and in the environment, to assist agriculture with registration of crop protection technologies while contributing to human and animal safety. The Legislature was motivated by recognition of public concerns about environmental contamination and the possibility that the federally mandated pesticide re-registration program would reduce the availability of pest control products to Washington State crops. At the same time, the Legislature recognized a need for focusing on the future and sustaining the tremendous productivity of Washington State agriculture. The Legislature mandated the FEQL to conduct work in the following areas:

(1) *Evaluate regional requirements for minor crop registration through the Federal IR-4 program;*
(2) *Study fate of pesticides on crops and in the environment, including soil, air, and water;*
(3) *Improve pesticide information and education programs;*
(4) *Assist federal and state agencies with questions regarding registration of pesticides which are deemed critical to crop production;*

(5) *Assist in the registration of biopesticides, pheromones, and other alternative chemical and biological methods.*

The FEQL is comprised of four faculty members in Entomology (see Organizational Flow Chart) who cooperate in an integrated research, extension, and teaching program. This application specifically highlights the specialized regulatory science service conducted at the FEQL analytical laboratory (FEQL-Lab) under the research direction of Dr. Hebert.

Unit Functions: The FEQL-Lab functions to provide regulatory science seek solutions to complex agricultural issues with extension-based research and provide outreach for the community and region in accordance with the above legislative mandates.

Unit Effectiveness: The FEQL-Lab generates dietary risk information through an exacting regulatory science mechanism known as EPA Series 860 "*Magnitude of the Residue*." The regulatory science in support of *Magnitude of the Residue* studies must be conducted under federally mandated Good Laboratory Practice Standards (GLPs) guidelines (40CFR Part 160). The building blocks of this federal program require that there be an IR-4 Research Laboratory Director (Elizabeth Culbert, Entomology AP), an independent QAU Specialist function that is served by staff at the UC Davis IR-4 program, and site management (Vince Hebert). The GLP Scientist/Data Reviewer (Jane LePage, Research Analyst) positions were additionally created and are partially funded through the USDA IR-4 Project to insure good science, program maintenance, and federal regulatory compliance. GLP deliverables to federal EPA stakeholders from2007 are as follows:

- Culbert, E.; Hebert, V. Flumioxazin: Magnitude of the Residue on Clover (Seed). Analytical summary report, FEQL 0512 USDA IR-4 minor crop clearance GLP Report PR A10605, 2013, 55 p. (2013)
- E. Culbert, Hebert V. Penoxsulam: Magnitude of the Residue on Pome Fruit. Analytical Summary Report, FEQL Report No. 0213 USDA IR-4 Minor Crop Clearance GLP Report, pp.90. (2013).
- E. Culbert, Hebert V. Penoxsulam: Magnitude of the Residue on Stone Fruit. Analytical Summary Report, FEQL Report No. 0113 USDA IR-4 Minor Crop Clearance GLP Report, pp.105. (2013)
- E. Culbert, Hebert V. Emamectin benzoate: Magnitude of the Residue on Basil and Chives. Analytical Summary Report, FEQL Report No. 0611 USDA IR-4 Minor Crop Clearance GLP Report, pp.639 (2013)
- E. Culbert, Hebert V. Emamectin benzoate: Magnitude of the Residue on Artichokes. Analytical Summary Report, FEQL Report No. 0612 USDA IR-4 Minor Crop Clearance GLP Report, pp.410. (2013)
- E. Culbert, Hebert V. Emamectin benzoate: Magnitude of the Residue on Cherry. Analytical Summary Report, FEQL Report No. 0112 USDA IR-4 Minor Crop Clearance GLP Report, pp.500 (2012)
- E. Culbert., Hebert V. Azoxystrobin: Magnitude of the Residue on Caneberry. Analytical Summary Report, FEQL Report No. 0211, USDA IR-4 Minor Crop Clearance GLP Report, pp. 168. (2012).
- E. Culbert, Hebert V. Azoxystrobin: Magnitude of the Residue on Cranberry. Analytical Summary Report, FEQL Report No. 0311, USDA IR-4 Minor Crop Clearance GLP Report, pp.157. (2011).
- E. Culbert, Hebert V. Flumioxazin: Magnitude of the Residue on Clover (seed). Analytical Summary Report, FEQL Report No. 0111, USDA IR-4 Minor Crop Clearance GLP Report, pp 99 (2011).
- E. Culbert, Hebert V. Flonicamid: Magnitude of the Residue on Alfalfa and Red Clover. Analytical Summary Report, FEQL Report No. 0409, USDA IR-4 Minor Crop Clearance GLP Report, pp 297 (2011).
- E. Culbert, Hebert V. Flonicamid: Magnitude of the Residue on Canola. Analytical Summary Report, FEQL Report No. 1407, USDA IR-4 Minor Crop Clearance GLP Report, pp 192 (2010).
- E. Culbert. Hexythiazox: Magnitude of the Residue on Peppers. Analytical Summary Report, FEQL Report No. 0109, USDA IR-4 Minor Crop Clearance GLP Report, pp 80, (2010).
- E. Culbert, V. Hebert. Quinclorac: Magnitude of the Residue on Rhubarb. Analytical Summary Report, FEQL Report No. 0210, USDA IR-4 Minor Crop Clearance GLP Report, pp 60, (2010).
- E. Culbert, V. Hebert. Hexythiazox: Magnitude of the Residue on Tomatoes. Analytical Summary Report, FEQL Report No. 0307, USDA IR-4 Minor Crop Clearance GLP Report, pp 79, (2010)

- LePage, J.; Hebert, V. Pendimethalin: Magnitude of the Residue on Kiwifruit. Analytical summary report FEQL 0209, USDA IR-4 minor crop clearance GLP Report PR A6681, 2010, 79 p..
- E. Culbert, V Hebert. Imidacloprid: Magnitude of the Residue on Oysters. Analytical Summary Report, FEQL Report No. 0707, USDA IR-4 Minor Crop Clearance GLP Report, pp 82, (2009).
- E. Culbert, V. Hebert. Kasugamycin: Magnitude of the Residue on Apple. Analytical Summary Report, FEQL Report No. 0407, USDA IR-4 Minor Crop Clearance GLP Report, pp 137, (2009).
- E. Culbert, V. Hebert. Pendimethalin: Magnitude of the Residue on Mustard. Analytical Summary Report, FEQL Report No. 0108, USDA IR-4 Minor Crop Clearance GLP Report, (2009).
- E. Culbert, V. Hebert. Pendimethalin: Magnitude of the Residue on Lettuce. Analytical Summary Report, FEQL Report No. 0607, USDA IR-4 Minor Crop Clearance GLP Report, pp 110 (2008).
- E. Culbert, V. Hebert. Kasugamycin: Magnitude of the Residue on Pear. Analytical Summary Report, FEQL Report No. 0706, USDA IR-4 Minor Crop Clearance GLP Report, pp 99 (2007).

The above GLP analytical technical reports are comprehensive documents independently peered reviewed for science and regulatory compliance before submission to the US EPA Office of Pesticide Programs for PNW crop registrations. The agro-economic commodity value of these fungicide, insecticide, herbicide, antibiotic, and bio-pesticide registrations for Pacific Northwest agriculture is difficult to accurately assess but is in the high millions of dollars.

Besides GLP food protection studies, the FEQL regulatory science team headed by Jane LePage Research Analyst III has been effective in evaluating; 1) region-wide human exposures to soil fumigants, 2) off-target herbicide injury to wine vineyards, 3) bioactive plant/insect volatile emissions that may prove useful in enhancing conservation biological control, and 4) sublethal pesticide aquatic exposure assessments for estimating impacts on threatened and endangered species. The FEQL-Lab has developed systems to provide pheromone dispenser manufacturers with detailed summary reports on chemical release for effective biological control. As a measure of unit effectiveness, the FEQL-Lab has completed ca. thirty human and environmental regulatory science technical reports since 2007. Outcomes from the following regulatory science reports have led to sizable benefits for public health, improved agricultural practices, and informed regulatory decision-making:

- Hastings, N.; LePage, J.; Hebert, V. 2012 MITC Residential Community Air Assessment; Franklin County, Washington. Analytical summary report FEQL 0412-MITC, 2013, 77 p. (2013)
- LePage, J.; Hastings, N.; Hebert, V. 2012 MIC Residential Community Air Assessment; Franklin County, Washington. Analytical summary report FEQL 0412-MIC, 2013, 47 p. (2013)
- Culbert, E., Hebert, V. Rynaxypyr: Magnitude of the Residue in Water Samples. FEQL Technical Report, pp 42. (Technical report FEQL 0212). In support of Stark WSU Puyallup (2012).
- LePage, J., Hebert, V. 2010 evaluation of release rates from field-aged pheromone dispensers by volatile collection. FEQL 0510 , pp 27. Technical report FEQL 0510 (2011).
- LePage, J., Hebert, V. Quantitation of Ethoprop and Malathion in Water. NOAA Technical Publication, pp 23. Technical Report FEQL 0511 (2011).
- LePage, J., Hebert, V., & Black, R.A. (2011). Evaluation of Picloram in Soil. PNNL document in concert with Dr. Alan Black FEQL 0312 19 pp. (2011)
- LePage, J., Hebert, V. Evaluation of release rates from field-aged pheromone dispensers by volatile collection. FEQL Technical Report pp 30. Technical report FEQL-0709 (2010).
- LePage, J.,Hebert, V. Quantitation of ethoprop and malathion in water. NOAA Fisheries FEQL Technical Report 0310 (2010)
- LePage, J., & Hebert, V. Temperature dependent emission loss of MITC following surface application of metam sodium. FEQL-0809, pp 90. WSPC Technical report FEQL-0809 (2010).
- LePage, J., Gross A., Hebert V. FEQL Report 1008. 2008 MITC Residential Community Air Assessment; Franklin County, Washington. 98 pp. [WA-DOH] (2009)
- Littke M., Hebert V. FEQL Study No. 0808 "Estimating Methyl Isothiocyanate Emission Rates following Soil Incorporated Shank and Modified Center Pivot Chemigation Metam Sodium Applications." 69 pp. [WSPC-USEPA-OPP] (2009).

- LePage J and V Hebert. Isomeric Composition of Codlemone from Field-Aged Pheromone Dispensers. FEQL Report 1408. 18 pp. [WTFRC in assoc. with J. Brunner, WSU-TFREC] (2009)
- LePage J and V Hebert. FEQL 1608-2008 Evaluation of Release Rates from Field-Aged Pheromone Dispensers by Volatile Collection. 27 pp [WTFRC in assoc. with J. Brunner, WSU-TFREC] (2009)
- Trott D., V Hebert. Assessing Near–Field Naturally Occurring Isothiocyanate Emissions after Mustard Green Manure Cover Crop Incorporation 2008, Benton County, Washington. FEQL Report 1508. 45 pp. [WA-DOH] (2009).
- E. Culbert, V. Hebert. Quantitation of Malathion and Diazinon in Water. Analytical Summary Report, FEQL Report No. 0508, pp 35 (2008).
- E. Culbert, V Hebert, and J. Stark. Quantitation of Imidacloprid in Water. Analytical Summary Report, FEQL Report No. 0308, pp 28 (2008).
- LePage J and V Hebert (Dec 12 2009) Evaluation of Pyrethroid Pesticides from Field-Aged Pesticide Impregnated Netting – 2008. FEQL Report 0509. 39 pp [preliminary research support in assoc. with D. Walsh WSU-Prosser] (2009).
- LePage J and V Hebert. Quantitation of organophosphorus pesticides in water. FEQL Report 0609. 92 pp. [NMFS-NOAA in assoc. J.Stark WSU-Puyallup] (2009).
- LePage, J., Hebert, V. 2007 Evaluation of Release Rates from Field-Aged Pheromone Dispensers by Volatile Collection. Analytical Summary Report, pp 27.Technical report FEQL-0608 (2008).
- Merriman, J., Hebert, V. 2007 MITC Residential Community Air Assessment; Franklin County, Washington. Analytical Summary Report, pp 96. Technical report FEQL-1207A (2008).
- LePage, J., Hebert, V. Near Field Emissions of MITC Following Shank Injection and Chemigation Metam Applications. Analytical Summary Report, pp 42. Technical report FEQL-1207B (2008).
- LePage, J., Hebert, V. Quantification of MITC in Activated Charcoal Air Cartridges from Two Chemigated Circles in Eastern Washington State. Analytical Summary Report , pp 27. Technical report FEQL-0708 (2008).
- LePage, J., Hebert, V. Methyl Isothiocyanate Air Sampling Breakthrough Evaluation. Analytical Summary Report, pp 13. Technical report FEQL-0208 (2008).
- Felsot, A. S. Reduction of insecticide use in orchards and implementation of no-spray zones through alternative spraying practices. FEQL Project No. 0405, Final Project Report for EPA Grant # PE-960001-01. January 8, 2007 (2007).
- LePage, J, Hebert, V. Optimizing Fumigant Efficacy While Minimizing Off-target Volatile Emissions. Analytical Summary Report, pp 78. Technical report FEQL 1106 (2007)
- LePage, J., Hebert. Butterfly Osmeterium Extract and Whole Gland Analysis by GC/MS. Analytical Summary Report, pp 17. Technical report FEQL-0107 (2007).
- LePage, J., & Hebert, V. 2007 Evaluation of Release Rates form Field-Aged Pheromone Dispensers by Volatile Collection. Analytical Summary Report, pp 19. Technical report FEQL -0807 (2007).
- LePage, J., Hebert, V., Brunner, J.F. Year 2006 Evaluation of Release Rates from Field-Aged Pheromone Dispensers by Volatile Collection. Analytical Summary Report Technical report FEQL-0806 (2007).
- LePage, J., Hebert, V. Evaluation of Release Rates from Pheromone Dispensers by Volatile Collection. Analytical Summary Report, pp 18. Technical report FEQL-0207 (2007).

The FEQL analytical lab also provides study direction oversight, system design, state of the art trace-level instrumentation (multiple GC/LC chromatographic detection and MS platforms) together with expert user capability (Culbert and LePage) fostering collaborative research in environmental toxicology and chemistry. Recent publications (*2007-present*) in collaboration with WSU units, other land grant institutions, and federal agencies (USDA and NOAA) include:

- Lu Z, Hebert V, Miller G. Gas-phase reaction of methyl isothiocyanate and methyl isocyanate with hydroxyl radicals under static relative rate conditions. *J.Agric. Food Chem*. (in review)
- Laetz C, Baldwin D, Hebert V, Stark J, Scholz N. Elevated temperatures increase the toxicity of pesticide mixtures to juvenile coho salmon. *Aquatic Toxicol.* http://dx.doi.org/10.1016/j.aquatox.2013.10.022 (2013).
- Laetz C, Baldwin D, Hebert V, Stark J, Scholz N. The interactive neurobehavioral toxicity of diazinon, malathion, and ethoprop to juvenile coho salmon. Environ Sci Tech 47, 2925-2931. (2013)

- Peck G, Fergurson H, LePage J, Hebert V, O'Neal S, Walsh D. Evaluation of sunlight-exposed pyrethroid-treated netting for the control of face fly and housefly (Diptera:Muscidae). *Pest Manag Sci* DOI 10.1002/ps3537 (2013).
- James D, Hebert V, LePage J. The prosternal gland in Pacific Northwest butterfly larvae with preliminary chemical analyses of emissions. *J. Lepidop. Soc.* 66(3) 137-142 (2012),
- Littke, M., LePage, J., Hebert, V. Methyl isothiocyanate flux following changes in fumigant field application practices. *Pest Manage. Sci.* DOI 10.1002/ps.3414 (2012).
- Trott, D., LePage, J., Hebert, V. Assessing natural isothiocyanate air emissions after field incorporation of mustard cover crop. *Bull. Environ. Contam. and Toxicol.* 88:482–485. (2012).
- Knight A, Stelinski L, Hebert V, Gut L, Light, D. Pear Ester Plus Sex Pheromone Dispensers for Mating Disruption of Codling Moth (Lepidoptera: Tortricidae). *J. Applied Ento.* 136 (2011)
- Chen, XD, Culbert E, Hebert V, Stark J. Mixture effects of the nonylphenyl polyethoxylate, R-11 and the insecticide,imidacloprid on population growth rate and other parameters of the crustacean, Ceriodaphnia dubia. *Ecotoxico and Environ.Safety* 73 132–137(2010)
- Laetz C, Baldwin DH, Collier T, Hebert V, Stark J, and Scholz NJ. The synergistic toxicity of pesticide mixtures: implications for ecological risk assessment and the conservation of threatened Pacific salmon. *Environ. Health Perspecs.*117 (3) 349-353 (2009).
- Merriman, J, Hebert VR. Methyl Isothiocyanate Residential Community Air Assessment; South Franklin County, Washington. *Bull.Environ. Contam. & Toxicol.* 78(1), 17-21 (2007).

Change in Goals/Functions in Preceding Five Years: The primary functions as a state-mandated facility remain in place. However, over the next five years there will be a concerted effort to encourage joint appointments with preeminent researchers at Pacific Northwest National Laboratory to enhance both graduate research opportunities and competitive sector funding.

Nature and Scope of Activities: The narrative provided in subsection *Unit Effectiveness* describes the nature and scope of activities of the FEQL analytical facility.

The function of the FEQL Analytical Laboratory in relation to other University Units: The FEQL-Lab is unique as a laboratory unit in that it is the only university research facility in the Pacific Northwest capable of providing defensible regulatory science for policy setting and pesticide registrations. We are also uniquely positioned to immediately respond to and assess environmental releases of organic contaminants in air, water, and land surfaces. In regards to research in areas of trace-level atmospheric environmental fate of organics, there are areas of similar research interest with the WSU-LARS facility that have led to collaborative grant efforts in the recent past. The FEQL-Lab has also participated with the University of Washington's School of Public Health on an Omnibus funded two year state-wide trace-level pesticide air monitoring program.

Laboratory contribution to and impact on instructional programs: The following referred publications and regulatory science technical reports (2007-present) highlight significant graduate student contributions *as lead authors* in FEQL-Lab natural product and atmospheric fate research projects:

- **Littke, M.**, LePage, J., Hebert, V. Methyl isothiocyanate flux following changes in fumigant field application practices. *Pest Manage. Sci.* DOI 10.1002/ps.3414 (2012).
- **Trott, D.**, LePage, J., Hebert, V. Assessing natural isothiocyanate air emissions after field incorporation of mustard cover crop. *Bull. Environ. Contam. and Toxicol.* 88:482–485. (2012).
- **Merriman, J**, Hebert VR. Methyl Isothiocyanate Residential Community Air Assessment; South Franklin County, Washington. *Bull.Environ. Contam. & Toxicol.* 78(1), 17-21 (2007).
- **Hastings, N.**; LePage, J.; Hebert, V. 2012 MITC Residential Community Air Assessment; Franklin County, Washington. Analytical summary report FEQL 0412-MITC, 2013, EPA-R10 Tech. Report 77 p. (2013)

- **Littke M.**, Hebert V. FEQL Study No. 0808 "Estimating Methyl Isothiocyanate Emission Rates following Soil Incorporated Shank and Modified Center Pivot Chemigation Metam Sodium Applications." 69 pp. [WSPC-USEPA-OPP] (2009).
- **Trott D** and V Hebert. Assessing Near–Field Naturally Occurring Isothiocyanate Emissions after Mustard Green Manure Cover Crop Incorporation 2008, Benton County, Washington. FEQL Report 1508. 45 pp. [WA-DOH] (2009).

The FEQL-Lab provides research opportunities and financial assistance to WSU-Tri Cities Environmental Science and Chemistry graduate students in completing research towards their respective degrees through Service Center 15T and 17A gift accounts. *All* graduate students who have worked under the direction of the FEQL Lab faculty have completed their degrees and 75% of those students authored research publications in refereed journals. Moreover, the FEQL-Lab supports undergraduate interns and has provided undergraduate scholarships in agricultural research. FEQL-Lab faculty and staff are also highly involved in the development of lab intensive undergraduate-graduate course offerings for the WSU-Tri Cities campus. Starting in 2007, the FEQL-lab introduced as a special topics offering Chemical Analysis of Juice and Wine (Special Topics Hort 499/600). This intensive lecture-lab course will be offered in spring 2015. Currently, a special topics Hort 490 advanced chromatographic analysis techniques of juices and wines laboratory course is offered (spring 2014) for seniors in the Viticulture and Enology program. In spring 2013, Analysis of Environmental Contaminants (Environ_Sci 592) was delivered FEQL-Lab faculty/staff providing a "hands on" experience for students to state of the art separation techniques and instrumentation for investigating trace-level environmental contaminants of current regional and national importance. The expert teaching capability and analytical resources of the FEQL-Lab will continue to foster undergraduate/graduate analytical and regulatory science research and training.

FEQL-Lab contribution and impact on the university and other clients: The FEQL analytical lab has built strong partnerships with many investigators at WSU, at other land grant and academic institutions, with state/federal agencies, and with private industry scientists. The continued success in professional relationships has been a direct result of open communication, planning, timely execution, and delivering quality science.

<u>WSU University-wide Collaborations (*2007 – present*)</u>

- Dr. Patricia Butterfield, Dean and Professor, WSU College of Nursing. *TERRA Nursing Actions Promoting Rural Low Income Children Environmental Health. 2013-2016*
- Dr. Steve Sheppard, Professor Entomology and Dr. Tim Lawrence WSU Extension, *Comparative evaluation of neonicotinoid residues in/on brood and stored pollen from PNW apiaries and rural landscapes*. 2012- 2014
- Dr Lynell Tanagioshi, Professor Entomology Mt. Vernon. *International export implications of pesticides found in US commercial blueberries production*; Developing alternative application approaches to control a recent invasive pest. OR-WA Multistate 2012-2014.
- Dr. Zhang, Xiao, Assistant Professor, Engineering BSEL. *A green conversion process to produce high value phenolic compound from biorefinery lignin*. 2011-2015.
- Dr. Douglas Walsh, WSU Entomology. *Evaluation of sunlight-exposed pyrethroid-treated netting for the control of face fly and housefly* (Diptera:Muscidae) (2009-2013).
- Dr. David James: WSU Entomology. *Improving conservation biological control of insects and mites by exploiting the chemical language of plants* 2005-2011.
- Dr. David James: WSU Entomology. *The prosternal gland in Pacific Northwest butterfly larvae with preliminary chemical analyses of emissions* (2008-2012)
- Dr. Thomas Henick Kling, Director WSU Viticulture and Enology Program Director. *Survey of Biogenic Amines in Washington Wines* (2012).
- Dr. Jay Brunner: Research Center Director WSU Tree Fruit Research and Extension Center. *Evaluating the efficacy of hand-applied dispenser technology for various mating disruption agents of codling moth 2001 to 2012.*

- Dr. John Stark: WSU Research Center Director, Puyallup WA. *Neurobehavioral effects from sublethal concentrations of pesticide mixtures in surface waters*. 2005 to present.
- Dr. John Stark: WSU Research Center Director, Puyallup WA. *Mixture effects of the nonylphenyl polyethoxylate, R-11 and the insecticide,imidacloprid on population growth rate and other parameters of the crustacean, Ceriodaphnia dubia (2008-2010)*
- Dr. Dennis Johnson: *Metam sodium Verticilium sp. field efficacy trials* (2008-2011).
- Drs Brian Lamb. WSU-LARS. *Decision support system for fumigant management*. 2010.
- Dr. Mike Kahn, ARC Associate Director. *Impacts-implications of the use of chemical alternatives to carbaryl for PNW shellfish. 2006-2012*
- Dr Kim Patten: WSU Horticulture, Long Beach. *Impacts-implications of the use of chemical alternatives to carbaryl for PNW shellfish. 2009-2012*

Collaborations and with other Land Grant and Academic Institutions

- Dr Matt Hengel: University of California, Davis. *USDA IR-4 Magnitude of the Residue programs. 2000 to present*
- Dr. Glenn Miller: University of Nevada. *Gas-phase reaction of methyl isothiocyanate and methyl isocyanate with hydroxyl radicals under static relative rate conditions (2010-2014)*
- Dr. Wei Qiang Yang, Associate Professor, Oregon State University North Willamette Research and Extension Center. *International export implications of pesticides found in US commercial blueberries production; Developing alternative application approaches to control a recent invasive pest. (2012 to present)*
- Professor George C Lognay, Gembloux Agricultural University Gembloux, Belgium. *PhD chemical ecology Exchange program* for Ms. Stéphanie Heuskin visit July-Sept 2008
- Dr. Phil Hamm: OSU Extension and Research Center, Hermiston OR, *Metam sodium Verticilium sp. field efficacy trials* (2008-2011).
- Dr Linda McCauley: University of Pennsylvania: *Developing chemical biomarkers to determine pesticide exposure in children living near tobacco fields.* OHSU collaboration as part of a NIH Center grant 2003-2005.
- Dr Joan Rothein: Oregon Health Sciences University. *Developing chemical biomarkers to determine pesticide exposure in children living near tobacco fields.* OHSU collaboration as part of a NIH Center grant 2003-2005.
- Dr. Glenn Miller: University of Nevada. *Atmospheric reaction chamber experiments for determining chemical oxidation rates of insect pheromones. 2003*
- Dr. John Middleton, Department of Veterinary Medicine, University of Missouri. *Direct determination of chlorhexidine residues in milk after intramammary infusion.* 2001 to 2004.
- Dr Richard Fenske School of Public Health and Community Medicine, UW. *Near-field farm-family pesticide exposure and biomarker evaluations. 2002 to present.*
- Dr. Robert Kreiger: UC Riverside, *Dislodgeable foliar worker exposure residue evaluations of Guthion and Sevin residues on Apple and Cherry Orchards*. 2002.

Federal/State Agency and Private Sector Research Collaborations

- Dirk Helder, EPA Region 10: WSU- FEQL 2012-2013 *Franklin Co. Residential Air Monitoring Program*. (2011-present).
- Dr. James Conca, Director of the Center for Laboratory Science; RJ Lee Group. *Development of proton mass transfer mass spectroscopy applications for evaluating residential air quality from soil fumigation*. (2010-present)
- Dr. Cynthia Lopez/Barb Morressey. Washington State Department of Health 2007-2009 WSU-FEQL *State-wide Fumigant Air Monitoring Program*. 2006- 2011
- Chris Voigt, Director, Washington State Potato Commission, *Understanding soil surface temperature dependent surface volatilization for the fumigant methylisothiocyanate*. 2008-2011.
- Frank Tiggs with Crop Production Services. *Assessing Near–Field Naturally Occurring Isothiocyanate Emissions after Mustard Green Manure Cover Crop Incorporation* 2008-2009.
- Dr Cathleen Hapeman, USDA-ARS Beltsville, MD: *Physical-chemical processes controlling odors and VOCs from agricultural operations*. (Intramural funded USDA project)
- Dr. Alan Knight, USDA-ARS Wapato, WA: *Pear Ester Plus Sex Pheromone Dispensers for Mating Disruption of Codling Moth (Lepidoptera: Tortricidae)*. 2008-2011.

- Dr. Nat Scholtz, National Oceanographic and Atmospheric Administration. *Neurobehavioral effects from sublethal concentrations of pesticides in surface waters* NOAA Fisheries, Seattle WA. 2005-present.
- Wilbur Ellis. *Evaluation of airborne pesticide residues in air: Wilbur Ellis Pesticides Warehouse Fire Study*. 2005.
- Jim Ossman, Western Farm Services. 2005 -2008 metam sodium field emission investigations. 2004 – 2012)
- Pacific BioControl Corporation: *Improving release rate characteristics of codling moth mating disruption products;* Mr. Jack Jenkins. 2001 to 2007.
- Washington State Department of Ecology: *Evaluation of airborne pesticide residues in air:* Wilbur Ellis Pesticides Warehouse Fire Study; Dr. Harriet Armman. 2005.
- Washington State Department of Health: *Evaluation of airborne pesticide residues in air*: Wilbur Ellis Pesticides Warehouse Fire Study; Dr. Barbara Morressey.2005.
- Suterra LLC: *Improving release rate characteristics of codling moth mating disruption products*; Mr. Tom Larson. 2002 to 2005.
- Syngenta Crop Protection. *Determination of lambda-cyhalothrin in/on asparagus*. Syngenta Crop Protection product understanding report. 2005.
- Dr. Greg Patton. Battelle Northwest Laboratories, Hanford WA: *Aerial pesticide sampling*. 2003.
- Dr. Karl Arne., EPA Region 10: *Pacific Northwest Off-target herbicide monitoring*; 2002 to 2004.
- DuPont Crop Protection. *Terrestrial field dissipation assessments for fungicide candidates*. 2003
- Washington State Department of Agriculture: *Endangered Species Act and salmon protection*; 2002 to present.
- Washington State Department of Agriculture: *Of-target herbicide monitoring*; Mr. Robert Arrington, WSDA Assistant Director. 2001 to 2003.

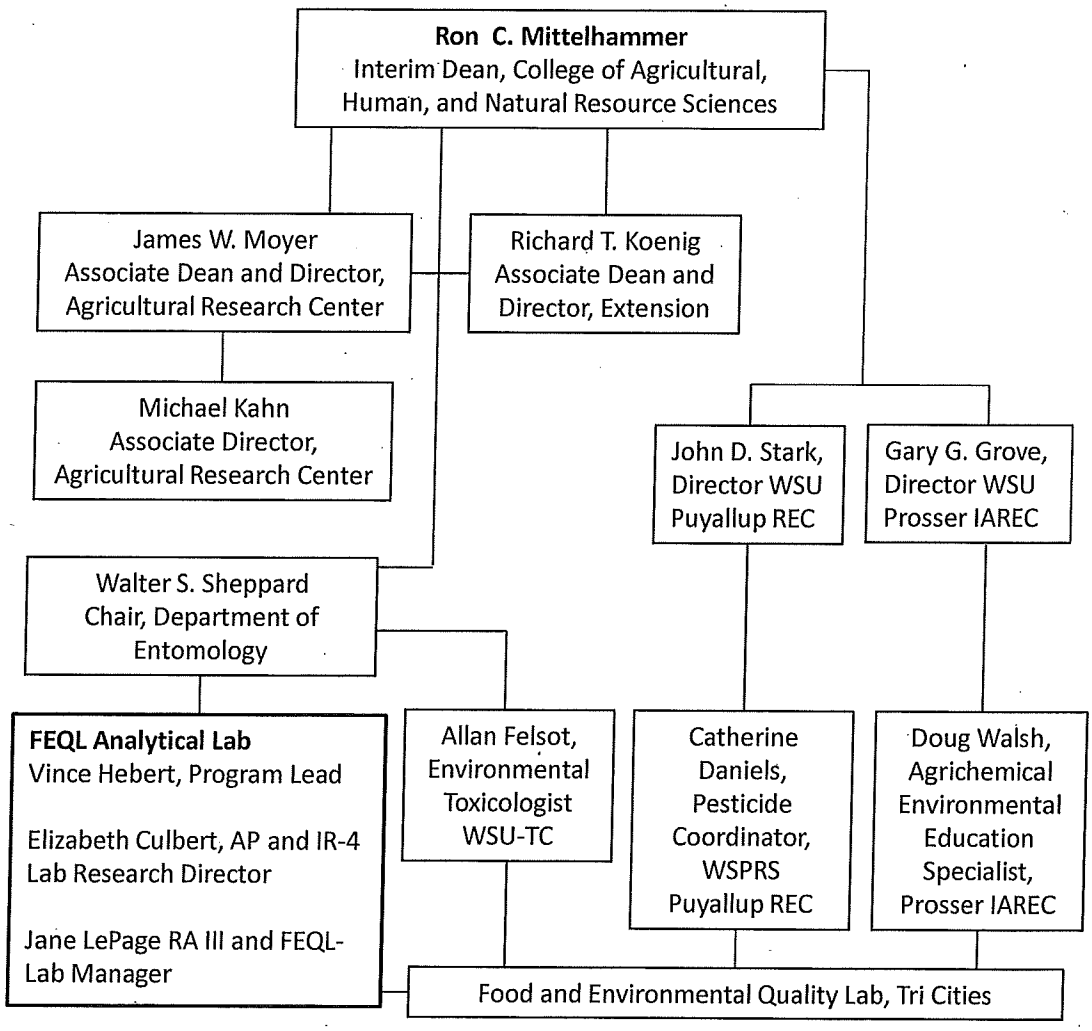
Since 2007, the FEQL-Lab has been recognized and received the Pesticide Stewardship Award for *Program Excellence* given by the Pesticide Stewardship Alliance (2009) and more recently received the 2013 the Western Association of Agricultural Experiment Station Directors *Award of Excellence* for its multistate extension-based research contribution along with other representatives of W-2045; Agrochemical Impacts of Human and Environmental Health: Mechanisms and Mitigation.

Five Year Strategic Vision: The FEQL analytical laboratory will continue to fulfill its mandate in providing regulatory science for crop protection, environmental fate-toxicology, and public health.
We will also remain poised to respond to and assess environmental releases of organic contaminants in air, soil, and water. PNW honey bee pollination concerns will be a major area of investigative research and program development focused on insecticides (and their metabolites) implicated in honey bee colony collapse disorder. Today, Spotted Wing Drosophila (SWD)preventive measures to reduce injury to PNW small fruit crops has resulted in prophylactic weekly pesticide treatments by growers. As a result of this response, pesticide residues may exceed maximum residues levels (MRLs) in internationally exported PNW cane and berry specialty crops and cause resistance concerns. The FEQL-Lab will continue to effectively work with PNW growers in developing efficacious application tactics that reduce pesticide use and the potential for chemical resistance. The next five years will also see a concerted effort to enhance research with Pacific Northwest National Laboratory (PNNL). Here the FEQL will explore joint appointment opportunities with PNNL scientists that specialize in hazard/exposure chemical assessment. This association has potential in attracting highly qualified graduate researchers with federal funding support. The FEQL-Lab will also strengthen multidisciplinary collaborations with the *School of Nursing* and with other WSU units in addressing rural community health issues. For any research to move forward (academic and regulatory) , the FEQL-Lab must continue to rebuild aging infrastructure and secure funding to replace obsolete equipment with state of the art instrumentation needed for today's newer pesticide chemistries. Resources in the amount of ca. $ 700K will be sought over the next 5-yr period for GC and LC tandem mass spectrometry instrumentation and replacement of aging refrigeration/heating systems.

Organizational Structure

The CAHNRS FEQL-Lab is a service facility that conducts regulatory science research according under CFR 40 Part 160 Good Laboratory Practice standards.

Organizational Flow Chart



Organizational Resources

The FEQL-Lab is a self-directing unit that is fiscally managed by faculty (V. Hebert 1.0 FTE) and staff and through the department of Entomology (Adam Williams) and the CAHNRS Food Science and Clark Hall Business Center. The FEQL-Lab receives $ 10K/yr operational support. CAHNRS currently provides ca. 63% salary support for Elizabeth Culbert (AP 1.0 FTE) and Jane LePage (RA III, 0.7 FTE).

External support (2007-present)

National Institute of Food and Agriculture (NIFA) flow-through funding in support of dietary risk assessment (IR-4 Project)	$ 479,900
Federal Competitive Programs	$ 130,750
State Programs	$ 201,030
State Commodity Commissions	$ 279,410
WSCPR	$ 41,500
NOAA Fisheries	$ 53,200
Funds received from outside grants/contracts (Service Center)	$ 166,500
Gifts	$ 15,000
	$ 1,472,290

Current and Needed

Current: The FEQL-Lab requires a sizable financial input for daily operation, maintenance, infrastructure improvement, and upgrading/ replacing obsolete instrumentation. The FEQL-Lab made infrastructure and new instrumentation improvements totaling ca. $ 480,000 from 2007 to present. The FEQL-Lab annual operational budget (excluding staff salaries and student wages) can range from $ 170 to $ 250K per year. A substantial portion of funding to cover laboratory operations comes from external grants, contracts, and NIFA flow-through funding.

Needed: Resources will be sought by Dr. Hebert through grants and contracts over the next 5-yr period for lab infrastructure improvements and instrumentation. Dr. Hebert also will seek internal funding avenues for supporting a graduate research assistantship for PNW beehive health and pollen foraging behavior investigative studies.

CAHNRS FEQL Laboratory Services Provided to Tri Cities Campus

WSU-Tri Cities

Arts and Sciences

- Graduate research and undergraduate intern FEQL-Lab opportunities for students in EoS and Chemistry
- Lab intensive undergraduate-graduate course offerings by FEQL-Lab faculty/staff providing students with "hands on" chromatographic and regulatory science training
- Use of FEQL-Lab resources (refrigeration, vacuum, DI water, ovens, bench space, reagents, chromatographic instrumentation). Currently, the shared use of the above is not a service-based charge. However, a CAHNRS Service Center arrangement is under consideration.

Viticulture and Enology

- Instructional laboratory courses/seminars, staff time, and use of FEQL-Lab resources and space

Biofuels Science and Engineering Laboratory

- Use of FEQL-Lab GC/MS, LC resources and staff time to directly aid tenure-track faculty research

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Freight Policy Transportation Institute

A Research Institute

Ken Casavant, Director
Washington State University
School of Economic Sciences
PO Box 646210
Pullman, WA. 99164-6210
509-335-1608
http://www.fpti.wsu.edu/

Established 2010

Organizational Summary

A. The **mission** of the FPTI is to advance knowledge and analytics in the area of transportation economics and policy. Underlying themes drive FPTI to:

1) Identify relevant and pressing issues for analysis;
2) Apply rigorous theoretical and analytical techniques; and
3) Evaluate results and reports.

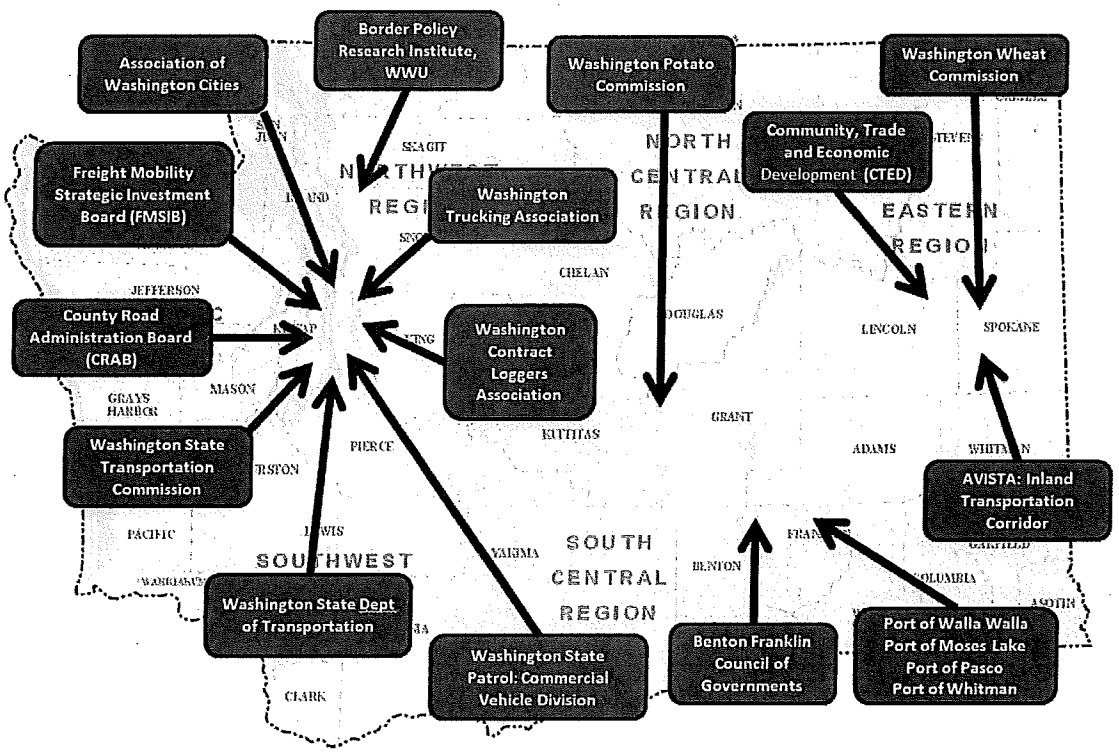
This organized technology transfer effort reaches out to policymakers and other researchers in a coordinated program with the findings of the studies, thus avoiding duplication of research efforts. The FPTI provides a broader perspective on transportation research, enhancing synergies among and between other technical research efforts in the State, region and nation, while reducing redundancies and overlap by using economic analysis as the performance norm. The FPTI offers policy analyses, especially economic policy analyses, which can move the overall research effort forward in a coordinated and synergistic manner, rather than a series of disjointed and even duplicative projects. The Director coordinates, streamlines and guides research efforts towards policy relevant areas of inquiry in a systematic fashion, utilizing the Assistant Director and the various Principal Investigators.

The FPTI was and is currently funded by the United States Department of Transportation (USDOT), supplemented by many grants and research contracts. Dr. Ken Casavant is Director of the Institute. A Technical Advisory Committee (TAC) comprised of Federal, State and local representatives has been assembled in order to identify relevant and pressing issues for analysis, apply rigorous theoretical and analytical techniques and evaluate results and reports. The following are key goals and objectives for the Freight Policy Transportation Institute:

- Improve understanding of the importance of efficient and effective freight transportation to both the regional and national economy.
- Address the need for improved intermodal freight transportation, as well as policies and actions that can be implemented to lower operating costs, increase safety and lower environmental impacts of freight transportation nationwide.
- Improve freight transportation performance to specific industries and sectors of the economy.

B. The **effectiveness** of the FPTI can be evaluated in several ways. The volume, quality and acceptance of its research output has been established in journal output, invited papers, seminars, and many other academic outlets. In addition, the goal of developing funding

partners on relevant and timely research topics, particularly in the policy arena, has been singularly successful. The attached graphic indicates the funding sources/partnerships within the state and in the nation. The FPTI research and its personnel are nationally known and sought after. The requests for its expertise continually come in and, quite importantly, come in from previous grant/contract sponsors. This indicates the respect and appreciation the quality of research has garnered. Finally, as an example, the research findings for the Oregon Department of Transportation was the rationale for a recent national positive vote changing the structure of the International Truck Registration program.... research that is policy relevant, a goal of the FPTI.



FPTI Recent Funding Sources and Partnerships

C. No major **changes** in the goals or functions have occurred. Changes reflect the policy issues that have arisen that direct some of the projects within the overall program, but since this was one of the original goals of the FPTI, no major change is noted.

D. The FPTI is a research entity and its **nature and scope** of its efforts reflect that charge. As will be indicated in this review the program is both broad and deep. It does develop models and analytical frameworks that have been sought out by other researchers and policy makers, but even these are in an applied approach focused on the problem to be solved and the policy issues to be examined. In its academic position within the School of Economic Sciences it is fully committed to that home. It sponsors seminars, both invited from leaders in the transportation economics/planning community and from real world policy decision makers as well. Personnel affiliated with the Institute are consistently invited to give presentations at academic Universities, for legislative and congressional staffers, at national and international conferences on transportation planning and development, and local commodity/development groups within Washington and the Pacific Northwest. The underlying scope of the Institute's activities is to be successful in competing for and receiving funding for its extensive research program. As indicated, in the funding review below, the Transportation Research Group (TRG) within the SES that surrounds the FPTI, has been satisfactorily successful, though efforts always continue to increase the level of funding and the academic and policy impact of that funded research.

E. The Institute's activities and functions have generated ample opportunities to **interact and affect** other units and academic disciplines on campus. A series of funded projects have been accomplished with the bio- energy field, with the personnel of FPTI providing the economic and GIS expertise in fulfilling the grants with the Departments of Energy and Ecology, in an interdisciplinary team. In addition, when economic or transportation/planning/locational theory expertise is needed in a team, numerous proposals have been generated with the Institute's participation. Generally, whenever transportation, in its many manifestations, is a desire of a funder/sponsor or the problem being investigated, our personnel are called on to participate. This strengthens the project proposal both from expertise and reputation.

F. The School of Economic Sciences has had a series of transportation economics courses on its books but had not offered the course to undergraduates and graduate students for significant years. The main course in that series is now being taught in the SES, available to undergraduate and graduate students as one of its **contributions to the instructional mission**

of the University. While being predominantly research oriented and funded, FPTI personnel teach the course(s), with no remuneration from the SES. Additionally, courses in marketing, management, location theory, GIS, and industrial organization receive treatments of transportation planning and policy analysis in the course structure. Further, the personnel of the Institute have been guest lecturers in planning, business and engineering classes on the Pullman WSU campus. Finally, FPTI personnel were invited to present a short course to the Agricultural Marketing Service personnel of the United States Department of Agriculture in Washington D.C in the theory and application of GIS techniques.

G. The transportation economics program, initially in the Agricultural Economics Department prior to its merger with the Economics Department, had a rich history and reputation. Since the merger, the **impact on the University and clients** has even increased. It has been chosen as an Area of Excellence within the SES, one of only four to receive that focus and honor. It has enhanced the regional and national reputation of the University for research scholarship and policy relevant output, recently witnessed by its receiving the USDA's Superior Service Award for its work on the Agricultural and Rural Transportation Issues study. It has contributed to policy changes in regulatory standards in truck transportation in the state, has affected the economic registration of trucks nation-wide and was the leader in increasing the profile of freight transportation in state and national policy and program debates. Its grown breaking work on the future of short-line railroads and critical conditions of waterway transportation are constantly referenced and personnel are continually being sought out by state action agencies and other researchers for advice and counsel.

H. The **continuing vision** for FPTI is to enhance the solid base that has been built, while broadening the boundaries of its activities in research, continually using that research in an instructional and outreach manner. One segment of the plan is to be awarded a University Transportation Center from USDOT in the future, focused on the main theme of FPTI, freight transportation policy. The competition for these Centers will be reissued in two years, at $2.5 million per year for five years, to be extended for another series based on performance. FPTI was not successful in the last competition but has been informally and formally encouraged to reapply in the next competition. Currently the FPTI is in consultation with all four of the states in the Pacific Northwest for projects that are policy relevant and intellectually contributory. Contracts have been signed with Idaho and Washington State Departments of Transportation and projects are under negotiation with Oregon and Montana Departments of Transportation. Further a proposal is being developed for a NSF section, one that fits nicely in the theme of

FPTI. Similarly, proposals are being developed for the Department of Ecology and the Department of Energy in Washington State and for the Federal Maritime Administration and USDA in Washington DC.

A movement of the boundaries of FPTI will also occur in the area of research outreach. Nationally and internationally recognized transportation economists/engineers/planners will be invited to conduct collaborate research as visiting professors. Invited seminars will also be designed to spotlight cutting-edge research methods and policy analysis. Potential partners in research funding will also be asked to identify their needs in a seminar setting. Operational funds supporting these efforts will initially be provided from grants and private/public partnerships.

Both the new research successes and the outreach activities will enhance the profile of an internationally recognized and sought after Institute. Clients will be served, students educated and instilled in commercial and academic positions, and policies will be improved. That is the vision for this Institute.

Organizational Structure

A. The current Director, Dr. Ken Casavant, was appointed by the Dean based on his 47 year career at Washington State University. It is a Dean driven decision, in consultation with the Director/Chair of the relevant home department. Qualifications that underlie the current selection and will be used to guide future selections include the following: experience in managing a large and multi-project research program, intimate knowledge of transportation economics or other related discipline and the issues surrounding the Institute, a proven research record in scholarly journal, both top quality and applied in nature that includes interdisciplinary teams and approaches, and the existence or the ability to develop contacts with relevant agencies and Universities. The Director serves at the discretion of the Dean, with consultation with the relevant Director/Chair. The current Director's vita follow, very abbreviated since the entire resume is over 85 pages. The full vitae can be made available at the Committee's request.

Kenneth L. Casavant

Overview: K.L. Casavant has published three textbooks on applied economics and has fourteen chapters in other books and monographs. A nationally known transportation economist, he has published over 100 articles and given over 300 presentations, including

testifying before state legislatures, regulatory bodies and U.S. Congress, leading to public debate and understanding by all sectors of the economy of the crisis of freight mobility. He was chosen to speak at the last three national agricultural transportation summits, hosted by USDA and the USDOT. This prominence has brought in over $7million of grants and contracts to his personal research program and over a million dollars to multi-discipline research teams of which he served as member.

EDUCATION AND TRAINING

1965	B.Sc.	(Agricultural economics) Dept. of Agricultural Economics, North Dakota State University, Fargo, North Dakota
1967	M.S.	(Agricultural economics, transportation and logistics) Dept. of Agricultural Economics, North Dakota State University, Fargo, North Dakota
1971	Ph.D.	(Agricultural economics, with field interest in transportation policy and marketing) Dept. of Agricultural Economics, Washington State University, Pullman, Washington

PROFESSIONAL EXPERIENCE

2012 – present	Director, WSU Pacific Northwest Transportation Consortium
2009 – present	Director, Freight Policy Transportation Institute, Washington State University
2002 – present	Adjunct Professor, UGPTI, North Dakota State University
1998	Interim Vice Provost for Academic Affairs, Washington State University
1998	Interim Vice Provost for Research, Washington State University
1998 – 1999	Visiting Professor, North Dakota State University
1990 – 1991	Key Center Visiting Professor, University of New England, Armidale, NSW, Australia
1984 – 1987	Associate Director, Washington State Transportation Center, Washington State Dept. of Transportation, Olympia, Washington
1980 – present	Professor and Economist, School of Economic Sciences, WSU.
1980 – 1981	Visiting Professor, Upper Great Plains Transportation Institute, North Dakota State Univ.
1975 – 1980	Associate Professor and Associate Agricultural Economist, Department of Agricultural and Resource Economics, Washington State Univ.
1975 – 1976	Visiting Professor, University of Alaska, Fairbanks, Alaska
1971 – 1975	Assistant Professor and Assistant Agricultural Economist, Department of Agricultural and Resource Economics, Washington State Univ.
1969 – 1970	Instructor, Department of Agricultural Economics, Washington State Univ.
1967 – 1969	Graduate Research Assistant, Department of Agricultural Economics, Washington State Univ.

1965 – 1967 Graduate Research Assistant, Department of Agricultural Economics, North Dakota State Univ.

HONORS AND AWARDS

- Lifetime Achievement Award, Upper Great Plains Transportation Institute, North Dakota State University
- Distinguished Faculty Address, Washington State University
- Selected for "University Experts in Transport," Grain Journal, 1984-2013
- Sahlin Unversity Award for Leadership, Washington State University, 2009
- Best Paper Award, 2006 European Applied Business Conference, Florence, Italy
- Recognized as "Featured Teacher" of college at WSU, 1975, 1985, 2002, and 2005
- Member of Board of Directors, Pacific NW Regional Economic Conference, 1975-2005
- Best Paper Award, 2004 International Applied Business Research Conference, San Juan, Puerto Rico
- Sahlin University Award for Public Service, Washington State University, 2004
- Distinguished Scholar, Western Agricultural Economics Association, 2003
- Member of Governor's Joint Natural Resources Cabinet, 1998-1999
- Member, Northwest Power Planning Council, 1994-1998
- Chair, Faculty Senate, Washington State University, 1992-1993
- Featured Teacher, College of Agriculture, WSU, 1974, 1975, 1979, 1989
- President, Western Agricultural Economics Association, 1988-89
- Selected as Washington State University's Faculty Member of the Year (for exceptional teaching performance), 1987
- Fellow of the National Association of Colleges and Teachers of Agriculture (NACTA), 1983
- NACTA Western Regional Outstanding Teacher Award, 1983
- Teaching Fellow, National Association of Colleges and Teachers of Agriculture, 1983
- Recipient of Western Regional Outstanding Teacher Award, National Association of Colleges and Teachers of Agriculture, 1983
- President, Agricultural Chapter of Transportation Research Forum, 1982-83
- Recipient of National Outstanding Teacher Award, American Agricultural Economics Association, 1981
- Outstanding Teacher Award from the American Association of Agricultural Economics, 1981
- The R.M. Wade Award, the highest honor in College of Agriculture, Washington State University, 1979
- Scholarly work in teaching pedagogy (six articles) included Colleague Aided Evaluation (CAE), a technique now used in various forms in other departments at other Land Grant Universities
- Member of Alpha Zeta, National Honorary Agricultural Society
- Steering Committee, Washington State Transportation Plan

PROFESSIONAL ACTIVITIES

1. Selected Membership/Major Offices in Professional Organizations:

- *President, Western Agricultural Economics Association, 1988-1989*
- *President, Agricultural Chapter of Transportation Research Forum, 1982-1983*
- *Member, American Agricultural Economics Association, 1972-present*
- *Member, Western Agricultural Economics Association, 1974-present*
- *Member, Transportation Research Forum, 1975-present*
- *Member, Transportation Research Board, 1980-present*
- *Member, Western Regional Science Association, 1982-present*

2. Selected Presentations:

Wang, Z, Sage, J., Goodchild, A., Jessup, E., Casavant, K. and Knutson, R. "A Framework for Determining Highway Truck-Freight Benefits and Economic Impacts." Presented at the Transportation Research Board 92nd Annual Meeting in Washington, D.C., January 13-17, 2013.

Holmgren, M., Casavant, K., Jessup, E., Sage, J. "After 35 Years, Does It Need to Change? Evaluating the Fuel Usage Factor for Structures." Poster presented at the Transportation Research Board 92nd Annual Meeting in Washington, D.C., January 13-17, 2013.

Simmons, S, Casavant, K., and Sage, J. "A Real Time Assessment of the Columbia-Snake River Extended Lock Outage: Process and Impacts." Presented at the Transportation Research Board 92nd Annual Meeting in Washington, D.C., January 13-17, 2013.

Taylor, J., Casavant, K., Moore, D., Sage, J., and Ivanov, B. "The Economic Impact of Increased Congestion for Freight Dependent Businesses in Washington State." Presented at the Transportation Research Board 92nd Annual Meeting in Washington, D.C., January 13-17, 2013.

Taylor, J., Casavant, K. Moore, D., Sage J., and Ivanov, B. "Freight Dependent Business Responses to Increased Costs of Congestion." Presented at the Transportation Research Forum 54th Annual Meeting in Annapolis, MD. March 21-23, 2013.

Wang, Z, Sage, J., Goodchild, A., Jessup, E., Casavant, K., and Knutson, R. "A Framework for Determining Highway Truck-Freight Benefits and Economic Impacts." Presented at Transportation Research Forum 54th Annual Meeting, in Annapolis, MD, March 21-23, 2013.

McMullen, B. Starr, D. Holder, Z. Wang, E. McCormack, A. Goodchild, K. Casavant and J. Sage. "Reliability Measurement, Value of Travel Time, and the Value of Travel Time Reliability for Freight." Presented at Transportation Research Forum 54th Annual Meeting in Annapolis, MD, March 21-23, 2013.

Taylor, J., Casavant, K., Sage, J. and Ivanov, B. "The Cost of Congestion: Breaking Down Societal Benefits and Consumer Costs." Presented at the Pacific Northwest Regional Economic Conference 2013 in Spokane, WA, May 16-17, 2013.

Sage, J., Casavant, K., and Lawson, C. "Time for change? Evaluating the Jurisdictional and Industry Benefits of a Full Reciprocity System in Commercial Vehicle Registration." Presented at the Pacific Northwest Regional Economic Conference 2013 in Spokane, WA, May 16-17, 2013.

Sage, J., Casavant, K., Eustice, J. B. and Zhou, Y. "Washington State Commodity Flows: Improving the Understanding of the Impacts of Infrastructure Investment." Presented at the Pacific Northwest Regional Economic Conference 2013 in Spokane, WA, May 16-17, 2013.

Taylor, J., Casavant, K. Sage, J. & Ivanov, B. The Economic Impact of Increased Congestion for Freight Dependent Businesses. Western Economic Association International Conference in Seattle, June 2013.

Sage, J.L. and Casavant, K. Choosing the Right Model: Effects of Economic Model Selection Truck-Freight Network Investment Prioritization. Western Economic Association International Conference in Seattle, June 2013.

Casavant, K., McCracken, V., Nguyen, D., Sancewich, Bl, Jessup, E., McCluskey, J. & Sage, J. Examining Agribusiness Shippers' Responses to Regulatory Change. World Conference on Transportation Research, Rio de Janeiro, Brazil, July 2013.

Sage, J.L., Casavant, K. Eustice, J. & Zhou, Y. Washington State Commodity Flows: Perishable Goods' Mitigation of Extended Weather Induced Road Closure. Food Distribution Research Society Conference in Chicago, October 2013.

Sage, J.L., Casavant, K., Goodchild, A. McCormich, E., McMullen, B., & Wang, Z. Developing a Performance Measurement Approach to Benefit/Cost Freight Projuect Prioritization. PacTrans Regional Transportation Conference, Seattle, October 2013.

Taylor, J., Casavant, K. Sage, J. & Ivanov, B. The Cost of Congestion: The True Costs of Slowing the Distribution Networks. Food Distribution Research Society Conference in Chicago, October 2013.

Sage, J. Jessup, E and Casavant, K. "Geographic Scale Effects on Economic Model Performance in Response to Truck-Freight Network Improvements." Presented at the Pacific Northwest Regional Economic Conference, Seattle, WA, May 17-18, 2012.

Simmons, S., Jessup, E., Casavant K. "A Real Time Assessment of a Major Transportation Disruption." Presented at 52nd Annual Transportation Research Forum, Long Beach, CA. March 2011.

Khachatryan, H., Casavant, K., and Jessup E. "Spatial Patterns in Household Demand for Ethanol." 51st Annual Transportation Research Forum, Arlington VA. March 2011.

Simmons, S., Jessup, E. and Casavant, K. "A Real Time Assessment of a Major Transportation Disruption." Presented at the Pacific Northwest Regional Economic Conference, Victoria BC. May 2011.

Khachatryan, H., Casavant, K. Jessup E., and Frear, C. "Economic Feasibility Assessment for Renewable Fertilizers from Anaerobic Digestion with Integrated Manure Nutrient Recovery System. Presented at the 21st Annual International Food and Agribusiness Management Association World Forum and Symposium in Frankfurt, Germany. June 2011.

Jessup, E., and Casavant, K. :U.S. Corn Ethanol Policies: Review and Assessment". International Farm and Agribusiness Management Association Symposium, Frankfurt, Germany. June 2011.

Goodchild, A., Ivanov, B., Casavant, K., and Jessup, E. "Quantifying Freight Benefits for Project Planning and Prioritization." National Urban Freight Conference. October 2011.

Khachatryan, H., Casavant, K., Jessup, E., Chen J., Chen, S., Frear, C. "Waste to Fuels Technology: Regional Evaluation of Three Technology Options and the Economics for Converting Biomass to Fuels." North American Meeting of Regional Science Association International. November, 2011.

Khachatryan, H., Casavant, K., Jessup, E., Sage, J. and Frear, C. "Geographic Market Assessment and Sensitivity Analysis for Renewable Fertilizers from Dairy Anaerobic Digestion with Integrated Nutrient Recovery Systems." 58th Annual North American Meeting of Regional Science Associated International. 2011.

Casavant, K., Jessup, E. and Lawson, C. "Developing Successful Methods for Collecting Truck Trip Data." Presented at the International Conference on Truck Survey Methods in Chile. November 2011.

Casavant, K., Jessup, E. Nguyen, D., and McCracken, V. "Structural Characteristics and Performance of Washington Log Trucking Companies: An Empirical Analysis." Paper presented at the Transportation Research Forum, Washington DC, March 2010.

Prater, Marvin, Casavant, Ken, Jessup, Eric, Bahizi, Pierre, Nybarger, Daniel, & Blanton, Bruce. "An Investigation of Rail Freight Transportation Competition." Paper presented at the Transportation Research Forum, Washington DC, March 2010.

Khachatryan, H., Jessup, E.L., & Casavant, K. (2010). "A GIS-Based Estimation of Regional Biomass Supply and Transportation Costs for Biofuel Plant Least-Cost Location

Decisions." Paper presented at the Transportation Research Forum, Washington DC, March 2010.

Denicoff, Marina, Jessup, Eric, Taylor, April, Nybarger, Daniel, Casavant, Ken, & Blanton, Bruce. "Assessing the Importance of Freight Transportation to U.S. Agriculture." Paper presented at the Transportation Research Forum, Washington DC, March, 2010.

Simmons, S., & Casavant, K. Factors Affecting Transportation Mode Choices: A Washington State Case Study. Paper presented at the Transportation Research Forum, Washington DC, March, 2010.

Holmgren, M., Jessup, E., Casavant, K., and Lazarus, J. "Improving Fuel Price Adjustments for State Departments of Transportation: A National Survey of Practice." Invited presentation at the Transportation Research forum, Washington DC, March 2010.

Khachatryan, H., Jessup, E.L, & Casavant, K. "Spatial Patterns in Household Demand for Ethanol." Paper presented at the Transportation Research Forum, Washington DC, March, 2010.

Casavant, K., Jessup, E. Prater, M. Blanton, B., Bahizi, P., Nybarger, D., Hill, J., and Weingram, I. "Rail Rate Changes Since the Staggers Act." Paper presented at the Transportation Research Forum, Washington DC, March 2010.

Casavant, K., & Simmons, S. "Investigating the overall impacts of the extended lock closure." Presentation to the Marketing team of Tidewater Barge Lines, Portland, Oregon, 2010.

Khachatryan, H., E. Jessup and K. Casavant. "Waste to Fuel: Investigation of Regional Biomass Supply." Paper presented at the Pacific Northwest Regional Economic Conference, Missoula, Montana, May 20-21, 2010.

Sage, J., Jessup, E.L., & Casavant, K. "Spatial Non-Stationarity of Educational Travel Time Impacts: An Application of Geographically Weighted Regression." Paper presented at the Pacific Northwest Regional Economic Conference, Missoula, Montana, May 20-21, 2010.

Holmgren, M., K. Casavant, E. Jessup and J. Lazarus. "Evaluating the Current Practice of Use of Fuel Price Adjustments in Highway Construction: A Case Study of the State of Oregon." Paper presented at the Pacific Northwest Regional Economic Conference, Missoula, Montana, May 20-21, 2010.

Simmons, S., E. Jessup and K. Casavant. "Factors in a Fuel Consumer's Choice to Drive: A Washington State Case Study." Paper presented at the Pacific Northwest Regional Economic Conference, Missoula, Montana, May 20-21, 2010.

Casavant, K., E. Jessup and M. Prater. "Status of Railroad Performance Relative to Agricultural Shipments." Paper presented at the Pacific Northwest Regional Economic Conference, Missoula, Montana, May 20-21, 2010.

Casavant, K., E. Jessup and D. Nibarger. "Rail Rate Changes Since the Staggers Act." Paper presented at the Pacific Northwest Regional Economic Conference, Missoula, Montana, May 20-21, 2010.

Casavant, K., & Jessup, E.L. "Final Recommendations for the Oregon Fuel Factor Process." Invited presentation to the Technical Advisory Committee for Oregon State Department of Transportation, Corvallis, OR, 2010.

Casavant, K., & Jessup, E.L. "Emerging Issues in Transportation in Washington and Research Opportunities." Invited presentation to WSDOT Freight Mobility Research Working Group, Olympia, WA, 2010.

Casavant, K., & Jessup, E.L. "A Research Agenda for the Future. Presentation at the Technical Advisory Committee of the Freight Policy Transportation Institute, Washington DC, 2010.

Casavant, K., & Jessup, E.L. "Developing New Fuel Factors for Construction Project Costs." Paper presented at the Conference on Agricultural Research, Athens, Greece, 2010.

Casavant, K., & Jessup, E.L. "Transportation Costs Impact on the Economic Viability of Ethanol Industries." Paper presented at the World Conference on Transportation Research, Lisbon, Portugal, 2010.

Casavant, K., & Simmons, S. "Impact of River Closure on Local Ports." Paper presented at the Port of Whitman County Board of Directors, Colfax, WA, 2010.

Khachatryan, H., Jessup, E.L., & Casavant, K. "Locally Linear Spatial Estimation of Ethanol Demand in Minnesota." Paper presented at the World Conference of the Spatial Econometrics Association, Chicago, IL, 2010.

Sage, J., Jessup, E.L., & Casavant, K. "When All Miles are Not the Same: Spatial Non-Stationarity Impacts of Educational Travel Time Requirements." Paper presented at the World Conference on Spatial Econometrics Association, Chicago, IL, 2010.

Casavant, K., & Corsi, T. "A Methodology to Determine Benefits of Private Rail Car Ownership." Invited presentation at the Annual Meeting of the North America Freight Car Association, Chicago, IL, 2010.

Casavant, K. "The Role of the Faculty Athletics Representative in the Intercollegiate System." Invited presentation at the National Meeting of the Coalition of Intercollegiate Athletics, Los Angeles, CA, 2010.

Khachatryan, H., Jessup, E.L., & Casavant, K. A GIS-Based Estimation of Regional Biomass Supply and Transportation Costs for Biofuel Plant Least-Cost Location Decisions. Paper presented at the Transportation Research Forum, Portland, OR, March 16-18, 2009.

Casavant, K. & E. Jessup. "Essential Issues in Agricultural Trucking: Politics, Policy and Practice." Invited presentation to the National Agricultural Trucking and Trade Conference, Washington DC, July 2009.

Holmgren, M., Casavant, K., and Jessup, E. "Evaluation of Fuel Usage Factors in Construction for Oregon." Invited presentation to the Oregon Department of Transportation, Technical Advisory Committee, Salem, OR, November 2009.

Delivered transportation costs of forest residue for cellulosic ethanol processing. International Food and Agribusiness Management Association, Monterey, CA, 2008

Biomass inventory technology and economics assessments: Collection and distribution cost curves. Pacific Rim Summit on Industrial Biotechnology and Bioenergy, Vancouver, BC, 2008

Spatial investigation of biomass for cellulosic ethanol processing in the State of Washington. Pacific Northwest Regional Economic Conference, Tacoma, WA, 2008

Modeling infrastructure for biofuels industry: Derivation of crop residue feedstock supply curves using GIS. Transportation Research Forum, Fort Worth, TX, 2008

Projections of Washington-British Columbia trade and traffic, by commodity, route and border crossing. Transportation Research Forum, Boston, MA, 2007 (http://www.trforum.org/forum/2007/schedule.php)

Demand forecasting for rural transit: Models applied to Washington State. Transportation Research Board Annual Meeting, Washington, DC, 2007

Energy use and alternatives in the transport of people and goods. Invited Presentation, 2007 All Extension Conference, Spokane, WA, 2007, (http://ext.wsu.edu/aec/secondary/DAY2.html)

Transportation infrastructure bottlenecks in the Pacific Northwest. Invited Presentation, INFORMA: Transportation and logistics roundtable: The Northwest Passage, Land, Water and Sea, Port of Seattle, Seattle, WA, 2007

Transportation challenges and outlook: Bio energy and agriculture. Invited Presentation, School of Economic Sciences 2007 Annual Conference: Economic Issues and Outlook, Pasco, WA, 2007

History, function and future of the Columbia-Snake waterway. Invited Presentation, Washington State Transportation Commission, Skamania Lodge, Stevenson, WA, 2007

Moving it all: Supplying transportation capacity to meet regional and state needs. Invited

Presentation, School of Economic Sciences, Friends Event, Vancouver, WA, 2007

3. *Collaborators & Other Affiliations*

- *Dr. Eric Jessup, School of Economic Sciences, Washington State University*
- *Dr. Wes Wilson, Department of Economics, University of Oregon*
- *Dr. Denver Tolliver, Upper Great Plains Transportation Institute, North Dakota State University*
- *Dr. Ken Duft, School of Economic Sciences, Washington State University*
- *Dr. Debbie Bridges, Department of Economics, University of Nebraska*
- *Dr. Richard Bielock, Department of Agricultural Economics, University of Florida*
- *Dr. Michael Babcock, Department of Economics, Kansas State University*

PUBLICATIONS (total of 140 publications, plus 340 presentations)

Some Refereed Articles on Original Research

Wang, Z., Sage, J., Goodchild, A., Jessup, E., Casavant, K., and Knutson, R. (2013). A Framework for Determining Highway Truck-Highway Benefits and Economic Impacts. Journal of the Transportation Research Forum 52 (2), pp. 27-43.

Simmons, S., Sage, J., Casavant, K. and Sage, J. (2013). Real-Time Assessment of the Columbia-Snake River Extended Lock Outage: Process and Impacts. Transportation Research Record: Journal of the Transportation Research Board, No 2330, pp. 95-102.

Khachatryan, H., Joireman, J. and Casavant, K. (June 2013). Relating Values and Consideration of Future and Immediate Consequences to Consumer Preference for Biofuels: A Three-Dimensional Social Dilemma Analysis. *Journal of Environmental Psychology* 34 (2013) 97-108.

Corsi, T.M., Casavant, K., and Graciano T.A. (Spring 2012). A Preliminary Investigation of Private Railcars in North America. *Journal of the Transportation Research Forum* 51(1), p53-70.

Casavant, K., Jessup E., Prater, M.E., Blanton, B., Bahizi, P., Nibarger, D., Hill, J., Weingram, I. (Spring 2011). Rail Rate and Revenue Changes Since the Staggers Act. *Journal of the Transportation Research Forum* 50(1), p55-75.

Khachatryan, H., Yan, J. & Casavant K. (Spring 2011). Spatial Differences in Price Elasticity of Demand for Ethanol. *Journal of the Transportation Research Forum* 50(3), p. 43-61.

Nguyen, D., McCracken V., Casavant, K., Jessup, E. (June 2011). Geographic Location, Ownership and Profitability of Washington Log Trucking Companies. *Regional Science Policy & Practice* 3(2), p. 115-126.

Prater, M., Casavant, K., Jessup, E., Blanton, B., Bahizi, P., Nibarger, D., & Weingram I. (Fall 2010). Rail Competition Changes Since the Staggers Act. *Journal of the Transportation Research Forum* 49(3), p.111-132.

Khachatryan, H., Jessup, E. and Casavant, K. 2009. Derivation of crop residue feedstock supply curves using geographic information systems. Journal of the Transportation Research Forum **48**(1):5-21.

Khachatryan, H., Jessup, E.L. and Casavant, K. 2008. Spatial investigation of mineral transportation characteristics in the State of Washington. Journal of the Transportation Research Forum **47**(1):34-51

Khachatryan, H., Jessup, E.L. and Casavant, K. 2008. A GIS-based estimation of regional biomass supply and transportation costs for biofuel plant least-cost location decisions. Transp. Res. Rec.

Peterson, S., Jessup, E. and Casavant, K. 2007. Empirical estimation of modal cross price and service elasticity using geographical attribute information in transportation optimization analysis. Transp. Res. Rec. pp. 59-64.

Painter, K.M., Jessup, E.L., Gossard, M. and Casavant, K. 2007. Demand forecasting for rural transit: Models applied to the State of Washington. Transp. Res. Rec. 1997 pp. 35-40.

Newkirk, J.R., Jessup, E.L., Casavant, K. and Gossard, M. 2007. Qualitative research for a quality of life: benefits of rural airports. Western Planner January 2007.

Farrell, T., Casavant, K. and Jessup, E.L. 2007. An approach to determining the market for academic positions: application to the discipline of agricultural economics. Journal of College Teaching and Learning 191.

Jessup, E.L., Casavant, K. and Pike, Q. 2007. Transportation usage and characteristics of Washington State warehouse/distribution center businesses: A first look. Journal of Business Case Studies (JBCS# S06-168).

Painter, K., Jessup, E. and Casavant, K. 2006 If you build it, will they come--and how many? Western Planner, January 2006, pp. 6-8.

Casavant, K., Peterson, S. and Jessup, E. 2006. Comparison and evaluation of different empirical estimation procedures identifying factors influencing inter-modal facility location decisions. Transp. Res. Rec., pp. 37-46.

Jessup, E.L., Casavant, K., Lawson, C. and Kirk, A. 2006. Intercept surveys: Productivity in collecting truck trip data, a case study of Portland, Oregon. Journal of the Transportation Research Forum 45(2).

B) The core of the faculty participation in the Institute is in the School of Economic Sciences, supplemented, to varying degrees depending on the project needs, by a fluid number of other faculty on specific grant proposals and teams, seminars, workshops, meetings, etc. Many other disciplines and units have been represented on research teams and student committees. Members have come from:

- College of Agricultural, Human and Natural Resource Sciences: School of Economic Sciences, Department of Biological Systems, Crops and Soil Sciences, Department of Natural Resource Sciences, and Center for Sustaining Agricultural and Natural Resources
- College of Business: Marketing
- College of Engineering and Architecture: Composite Materials and Engineering Center, Department of Civil and Environmental Engineering, School of Engineering and Computer Science, School of Earth and Environmental Sciences
- College of Liberal Arts: Social and Economic Sciences Research Center, Department of Sociology
- United States Department of Agriculture on Pullman campus.

C) Membership in the FPTI is not formally constituted but instead is demand driven. As research opportunities or needs arise, FPTI contacts colleagues as potential team members

with expertise to meet the grant requirements. Such individuals become participating faculty associates from then on. This is a dynamic and growing group.

D) Graduate students are a critical component of the Institute's activities. Every project noted in the list of grants and contracts would have had one or two graduate students associate with them. A review of the projects suggests over 40 graduate students have been on appointment with the Institute over the years. In addition, summer support on selected projects, using grant monies or accruals from other projects has been made available. Several postdoctoral individuals have been part of the Institute and, frankly, these have been the most productive and scholarly of all of the appointments. Additionally, visiting scholars have been and will be brought in for seminars and consultations. This is expected to lead to inter-institutional projects in the future.

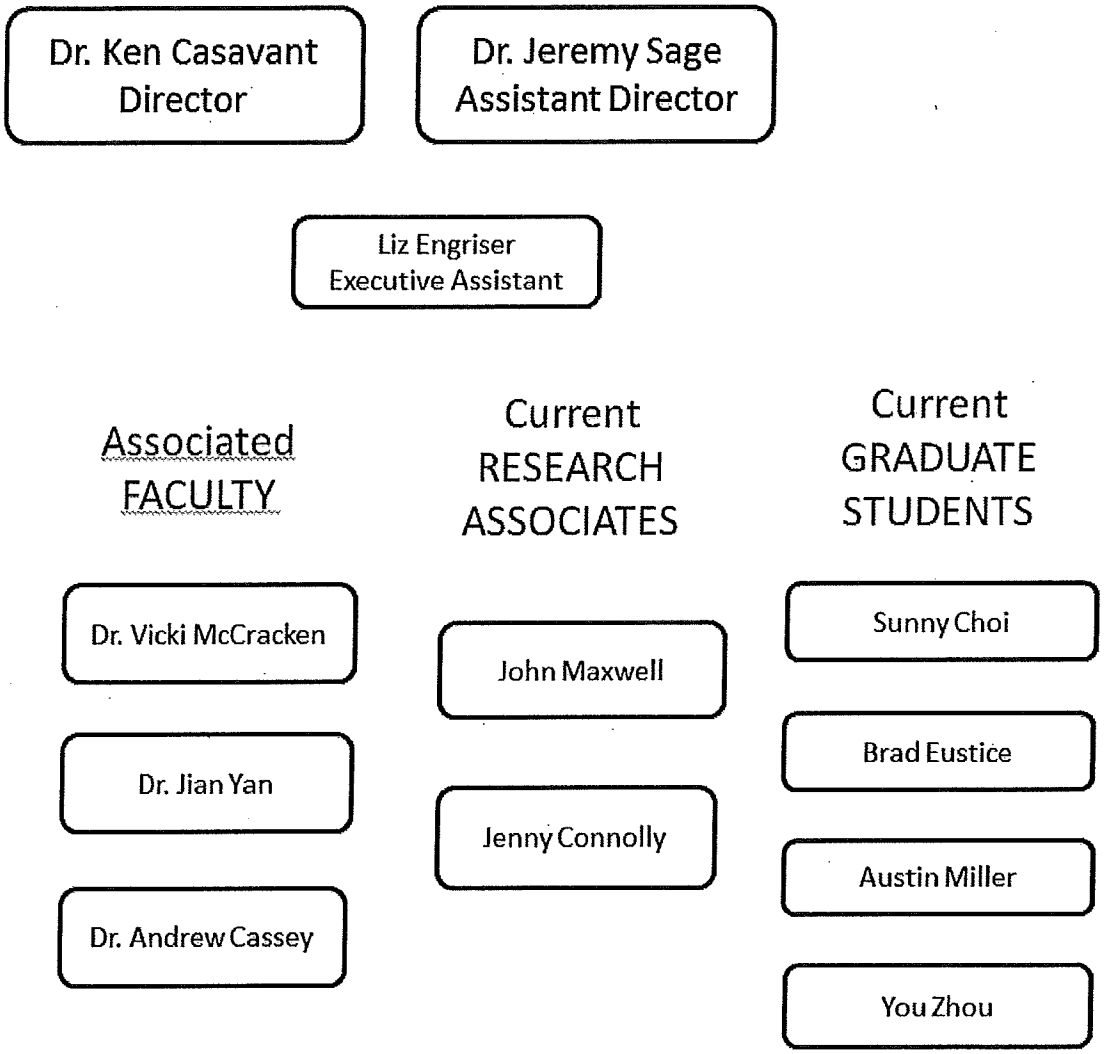
E) The only College or Department within a college that are responsible for support of the FPTI is CAHNRS and SES. This is only in the form of space and salary of the Director. No additional increment is provided by the College, only the state funded position of a typical tenure position in WSU. The Director's responsibilities are considered part of the teaching/research position.

F) The Institute's personnel, supportive and administrative, are those of a typical department. The Institute is in the SES and as such its finance, advisory functions and other needs are provided from the normal schools structure within SES. As indicated below the Institute has an executive assistant but this position is funded 11% from grant funds, but reports administratively to the SES classified staff hierarchy.

Organizational Flow Chart

The Freight Policy Transportation Institute operates on a simple line organizational structure, as depicted below. Dr. Casavant is the Director, aided by Dr. Jeremy Sage as Assistant Director and Principle Investigator. As indicated earlier, no salary increment is received by the Director and the entire salary of the Assistant Director is drawn from the grants and contracts of the Institute. The executive assistant is also supported totally from grants, as well as the current Research Associates and graduate students. As the additional faculty work on the grants and efforts of the Institute they received salary and travel support for summers or accruals as appropriate.

There are no other leadership positions or technical services positions supported by the unit. It is expected that an additional research associate or Post-doc position will be developed in the future, all funded from grants and contracts.



Organizational Resources

A) The expected levels of support from various sources remain the same as current, subject to major successes expected in grants and contracts. No funding, current or future is expected from the University. The only monies expected in the future from the State are in the form of contracted research with the state agencies, not from the State budget. Gift sources may be identified, to build on the modest James C Nelson Scholarship fund currently used to support graduate students. The principal source any new monies will therefore be in the form of external awards allowing the research base of the Institute to grow and prosper.

B) Little or marginal increases in space will be requested as required. The current offices, within the School of Economic Sciences are adequate and the offices for research associates are adequate and nicely in the corner suite on the third floor of Hulbert Hall. Any equipment required to improve the capability of the FPTI personnel will be drawn from SES allocations to normal faculty appointments or from grants.

In sum, the FPTI has been totally self-sustaining and the plan is to remain as such. Extra ordinary growth, which can't be planned for though it is a goal, would be the only occasion for increases in space.....but even here the Institute would plan to participate in the activity, just as it has already partially funded the TRG/SES conference room with its table and chairs.

Current and Recent Grants Received

Grant Title	Agency	Date	Award Amount
FUNDED			
Performance-Measure Based Asset Management Tool for Rural Freight Mobility	I DOT	2014	$75,000
U.S. 95 Freight Multi-Modal Corridor Supply Chain: A Pilot Study	I DOT	2014	$90,000
Agricultural transportation Study	USDA	2013	$65,000
Performance-Measure Based Asset Management Tool for Rural Freight Mobility in the Pacific Northwest	UNIV WA/DOT	2013	$133,133
Pacific Northwest Transportation Consortium (PacTrans)	UNIV WA/DOT	2013	$407,516
Pacific Northwest Transportation Consortium (PacTrans)	UNIV WA/DOT	2013	$63,867
Freight Commodity Flows: Selected Washington State Highways	WA DOT	2013	$83,322
Freight Commodity Flows: Selected Washington State Highways	WA DOT	2013	$70,000
ODOT Full Reciprocity Plan, WSU Proposal	OR DOT	2012	$85,703
Safe and Sustainable Solutions for the Transportation Needs of the Pacific Northwest: Research, Education and Outreach Projects at WSU	UNIV WA/DOT	2012	$434,500
Freight Commodity Flows: Selected Washington State Highways	WA DOT	2012	$150,000
Development of a Freight Benefit/Cost	WA DOT	2011	$98,030

Methodology for Project Planning			
Development of a Freight Benefit/Cost Methodology for Project Planning	WA DOT	2011	$104,413
Bridging the Gap: Do Farmers' Markets Help Alleviate Impacts of Food Deserts?	UNIV WI/USDA	2010	$38,363
Development and Perspective of Apple processing Industry in the U.S.	KOREA RURAL EC INST	2010	$20,000
Transportation and Environmental Assessment of the Impact of Extended Lock Outages: the Columbia-Snake River System	UNIV WA/DOT	2010	$75,047
Freight Policy Transportation Institute (FPTI) Phase III	DOT	2010	$730,500
The Economic Impact of Truck Congestion on Washington State Highways	WA DOT/DOT	2010	$42,500
Evaluation of Fuel Usage Factors in Highway Construction in Oregon	OR DOT/DOT	2009	$42,809
Agricultural Transportation Study	USDA	2009	$100,000
Freight Policy Transportation Institute at Washington State University	DOT	2009	$441,000
Freight Policy Transportation Institute (FPTI): Phase II	DOT	2009	$475,000
Washington State Community & Technical Colleges Transportation Access Study	WA ST BCTC	2009	$89,700
Advance Institute	UNIV WA/DOT	2009	$20,000
Advanced Institute	UNIV WA/DOT	2008	$20,000
Waste to Fuels Technology	WA ECOLOGY	2008	$450,000
Evaluation of Fuel Usage Factors in Highway Construction in Oregon	OR DOT/DOT	2008	$107,000
US Highway Privatization	US DOT	2008	$15,000
Advanced Institute	UNIV WA/DOT	2007	$20,000
Development of a Washington State Freight Data System	WA DOT	2006	$75,000
A Feasibility Study of Evaluating Transportation Security and Associated Muti-Modal Efficiency Impacts and the Advanced Institute	UNIV WA/DOT	2006	$34,321
A Feasibility Study of Evaluating Transportation Security and Associated Muti-Modal Efficiency Impacts	UNIV WA/DOT	2006	$14,000
A Feasibility Study of Evaluating Transportation Security and Associated Muti-Modal Efficiency Impacts and the Advanced Institute	UNIV WA/DOT	2006	$3,681
Identification and Evaluation of Traffic Data Gaps/Redundancies at Washington PTR/WIM Sites	WA DOT/DOT	2006	$50,000
Waste to Fuels Technology	WA ECOLOGY	2006	$220,000
Transportation & Logistic Characteristics, Uses and Needs of the WA State Potato Industry	WA POTATO COMM	2006	$10,000
Projections of Washington-British Columbia Trade and Traffic, by Commodity, Route and	WESTERN WA UNIV/DOT	2006	$64,144

Border Crossings			
Northern Plains-Pacific Center for Freight Mobility	N DAKOTA ST UNIV/DOT	2006	$16,304
Program Scoping State of Practice	WA DOT	2006	$50,000
Prioritization of Transportation Security Projects	WA DOT	2006	$60,000
Northern Plains-Pacific Center for Freight Mobility	N DAKOTA ST UNIV/DOT	2005	$99,200
Truck Trip Data Collection Methods	OR DOT/DOT	2003	$52,000
An Analytical Model Supporting Intermodal/Port Facilities	UNIV WA	2003	$42,000
Strategic Freight Transportation Analysis	WA DOT/DOT	2003	$1,338,742
Determining the Socioeconomic Role, functions, and Benefits of Rural Airports in Washington	WA DOT	5/22/2002	$149,091
Benefits and Impacts of Using 286,000 and 35,000 Pound Rail Cars on Light-Density Lines in the State of Washington	WA DOT	1/6/2000	$35,000
Scoping for Eastern Washington Intermodal Transportation Study (EWITS-II)	WA DOT	1/6/2000	$25,000
SUBMITTED/PENDING			
Pacific Northwest Transportation Consortium (PacTrans) **informally accepted**	UNIV WA/DOT	1/17/2014	$384,875
CyberSEES:Type 1: Efficacy of an Open Source Green Rating System Integration Platform for Interdisciplinary Sustainability Decision Making	NSF	2013	$300,000
Impacts of Policy-Induced Freight Modal Shifts	THE NATL ACADEMIES	5/13/2013	$350,000
UNFUNDED, but considered for resubmssion			
FPTI Tier 1 Prospectus for Economic Competitiveness	DOT	3/19/2013	$1,500,000
Improving Carbon and Hydrogen Efficiencies during Pyrolysis oil Production and Stabilization	DOE	2/20/2013	$2,836,719
The Effects of Winter Maintenance Operations on Highway Efficiency	MT ST UNIV	2013	$200,000
The Factors Affecting the Car Crashes in the U.S. and Developing Countries: The Implications of Cell Phone Laws on Developing Countries	RD TRAFFIC INJ RES NTWK	2013	$23,690
Developing a Performance Measurement Approach to Benefit/Cost Freight Project Prioritization	UNIV WA/DOT	4/16/2012	$100,000
Keeping Freight Moving: Enabling Disaster Resilient Transportation Networks	NSF	9/12/2012	$339,076
Agricultural and Rural Transportation Center (ART-C)	DOT	10/25/2011	$3,500,000

Smart Carbon And Nutrient (SCN) Products For Reducing The Carbon Footprint Of Cereal Production Systems In The Pacific Northwest	USDA	7/2/2010	$4,999,999
Overcoming Cost Barriers with Integrated Technologies for Fuel and Chemical Production from Algae	DOE	7/13/2010	$6,500,000
Does Environmental Footprint Related Information Affect Consumers' Willingness to Pay for Locally Produced Food Products	UT ST UNIV/USDA	5/27/2010	$25,000
Assessment of Renewable Fertilizers from Ad Manure Nutrient Recovery	WSU - CSANR	5/19/2008	$145,917
Transportation Economic Center	DOT	8/12/2008	$500,000
Integrate production, distribution of implication analysis of alternative Energy Systems	OFF OF RESEARCH--WSU	2/12/2007	$1,886,000
A Supply Chain Systems Approach to Developing an Alternative Fuels Industry to Aid in Rural Development	USDA	7/12/2007	$496,694
Improving Efficiencies of Transportation and Collection of Forest Thinning Materials for Use in a Thermal Ethanol Plant in the PNW	USDA	7/11/2007	$477,679
Advancement of a Biodiesel Industry in the Pacific Northwest via Development of Co-Products and an Integrated Economic Business and Incubation Model	USDA	4/29/2005	$1,839,008
Regional Center for Freight Mobility	N DAKOTA ST UNIV	7/5/2005	$99,120
Developing analytical tools to optimize oilseed cropping system and co-product utilization for establishing a viable biodiesel industry in the Pacific Northwest.	DOE	12/20/2005	$479,949
Freight Choke Points: Defined and Identified	UNIV WA	4/29/2004	$54,762

Selected Research Output of FPTI

2014

Fu, X., Oum, T. and Yan, J. (forthcoming 2014). An Analysis of Travel Demand in Japan's Inter-city Market: Empirical Estimation and Policy Simulation. Journal of Transport Economics and Policy

2013

Casavant, K., Goodchild, A., Jessup, E., & Lawson, C. (2013). NCFRP Report 26. Guidebook for Developing Subnational Commodity Flow Data. Transportation Research Board

Casavant, K., McCracken, V.A., Nguyen, D., Sancewich, B., Jessup, E., McCluskey, J.J., & Sage, J.L. (2013). Agribusiness Shipper's Responses to Regulatory Change: A Re-Examination. Presentation at World Conference on Transportation Research, Rio de Janeiro, Brazil.

Casavant, K., McCracken, V.A., Nguyen, D., Sancewich, B., Jessup, E.L., McCluskey, J.J., & Sage, J.L. (2013). Examining Agribusiness Shippers' Responses to Regulatory Change. World Conference on Transportation Research 13th World Conference on Transportation Research Proceedings, Rio de Janeiro, Brazil.

Holmgren, M., & McCracken, V.A. (2013). What Affects Demand for the "Greatest Snow on Earth"?. Journal of Hospitality Marketing and Management. http://http://www.tandfonline.com/doi/abs/10.1080/19368623.2012.746212?

Holmgren, M., Casavant, K., Jessup, E., & Sage, J.L. (2013). After 35 Years, Doe It Need to Change? Evaluating the Fuel Usage Factor for Structures. Transportation Research Board 92nd Annual Meeting, Washington Dc.

Khachatryan, H., Joireman, J., & Casavant, K. (2013). Relating Values and Consideration of Future and Immediate Consequences to Consumer Preference for Biofuels: A Three-Dimensional Social Dilemma Analysis. Journal of Environmental Psychology.

McMullen, B., Holder, D., Wang, Z., McCormick, E., Goodchild, A., Casavant, K., & Sage, J.L. (2013). Reliability Measurement, Value of Travel Time, and the Value of Travel Time Reliability for Freight. Transportation Research Forum 54th Annual Meeting, Annapolis.

Sage J., V. McCracken, R. Sage. (2013). Bridging the Gap: Do Farmers' Markets Help Alleviate Food Deserts? in press. American Journal of Agricultural Economics. AAEA/ASSA Proceedings; 1/4/13-1/6/13; San Diego, CA.

Sage, J. (2013) "Keeping Freight Moving: Enabling Disaster Resilient Transportation Networks." Presented at Transportation Research Board's midyear meeting, Meeting State & MPO Information Needs in a Constrained Fiscal Environment, in Washington D.C.

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Khachatryan, H., Jessup, E.L., & Casavant, K. (2008). A Geographic Information Systems Approach to Estimating Delivered Cost of Energy Feedstocks. Proceedings, Canadian Transportation Research Forum, New Brunswick, Canada.

Khachatryan, H., Jessup, E.L., & Casavant, K. (2008). Biomass Inventory Technology and Economics Assessments: Collection and Distribution Cost Curves. Pacific Rim Summit on Industrial Biotechnology and Bioenergy Pacific Rim Summit on Industrial Biotechnology and Bioenergy, Vancouver, BC. Presentation.

Khachatryan, H., Jessup, E.L., & Casavant, K. (2008). Delivered Transportation Costs of Forest Residue for Cellulosic Ethanol Processing. International Food and Agribusiness Management Association, Monterey, CA. Presentation.

Khachatryan, H., Jessup, E.L., & Casavant, K. (2008). Estimating Distribution Costs for Cellulosic Ethanol: Origin-Destination Route Optimization Using GIS. Proceedings, Regional Science Association International, Brooklyn, NY.

Khachatryan, H., Jessup, E.L., & Casavant, K. (2008). Modeling Infrastructure for Biofuels Industry: Derivation of Crop Residue Feedstock Supply Curves Using GIS. Transportation

Research Forum Transportation Research Forum, Fort Worth, TX. Presentation.
Khachatryan, H., Jessup, E.L., & Casavant, K. (2008). Spatial Investigation of Mineral Transportation Characteristics in the State of Washington. Journal of the Transportation Research Forum 47(1).
Khachatryan, H., Jessup, E.L., & Casavant, K. (2008). Spatial Investigation of Biomass for Cellulosic Ethanol Processing in the State of Washington. Pacific Northwest Regional Economic Conference Pacific Northwest Regional Economic Conference, Tacoma, WA. Presentation.
Mason, L.C., Casavant, K., Lippke, B.R., Nguyen, D., & Jessup, E.L. (2008). The Washington State Log Trucking Industry: Costs and Safety Analysis. The Washington State Log Trucking Industry: Costs and Safety Analysis , pp 109.
Oum, T., Yan, J. and Yu, C. (2008). Ownership Forms Matter for Airport Efficiency: A Stochastic Frontier Investigation of Worldwide Airports. Journal of Urban Economics, (64), pp. 422-435.
Yan, J., Liu, J. and Li, K. (2008). Threshold Control of Mutual Insurance with Limited Commitment. Mathematics and Economics, August (43), pp. 108-115.
Yan, J., Fu, X., and Oum, T. Market Power, Product Differentiation, and Hub Premium. (2008) Allied Social Sciences Association (ASSA) conference, New Orleans, January 4-6, 2008

2007

Casavant, K., & Jessup, E.L. (2007). Development of a Washington State Freight Data System. Washington State Department of Transportation.
Casavant, K., & Jessup, E.L. (2007). Energy Use and Alternatives in the Transport of People and Goods. 2007 All Extension Conference, Spokane, WA, invited presentation. http://ext.wsu.edu/aec/secondary/DAY2.html.
Casavant, K., & Jessup, E.L. (2007). Moving it All: Supplying Transportation Capacity to Meet Regional and State Needs. School of Economic Sciences, Friends Event, Vancouver, WA, invited presentation.
Casavant, K., & Jessup, E.L. (2007). Transportation Infrastructure Bottlenecks in the Pacific Northwest. INFORMA: Transportation and Logistics Roundtable: The Northwest Passage, Land, Water and Sea, Port of Seattle, Seattle, WA, invited presentation.
Casavant, K., Gossard, M., & Jessup, E.L. (2007). CO2 vs. Salmon: Complementary Policies in Wheat Transportation in the Pacific Northwest?. Transportation Research Forum, Boston, MA. http://www.trforum.org/forum/2007/schedule.php.
Casavant, K., Gossard, M., Jessup, E.L., & Painter, K.M. (2007). Rural Transit Demand Estimation: An Alternative Approach in the State of Washington. http://www.trforum.org/forum/2007/schedule.php.
Casavant, K., Jessup, E.L., & Holmgren, M. (2007). Prioritization and Funding of Transportation Security Projects for Washington State. Washington State Department of Transportation.
Casavant, K., Jessup, E.L., & Holmgren, M. (2007). Program Scoping / State of Practice for Washington State. Washington State Department of Transportation.
Galloway, H., Casavant, K., & Jessup, E.L. (2007). Projecting Trade and Traffic by Commodity, Route, and Border Crossings: A Case Study of Washington State and Canada. I Mediterranean Conference of Agro-Food Social Scientists, Barcelona, Spain.
Galloway, H., Casavant, K., & Jessup, E.L. (2007). Projections of Washington-British Columbia Trade and Traffic by Commodity, Route and Border Crossing, SFTA Research Report #22. SFTA Research Report #22 http://www.sfta.wsu.edu/research/reports/pdf/Report22_ProjectionsTrade-Traffic.pdf.
Galloway, H., Casavant, K., & Jessup, E.L. (2007). Projections of Washington-British Columbia Trade and Traffic, by Commodity, Route and Border Crossing. Transportation Research Forum, Boston, MA. http://www.trforum.org/forum/2007/schedule.php.
Galloway, H., Casavant, K., & Jessup, E.L. (2007). Projections of British Columbia-Washington Truck Freight Border Crossings Based on Commodity Trade. Canadian Transportation Research Forum Canadian Transportation Research Forum, Winnipeg, Canada. http://www.ctrf.ca/past_conferences.htm.

Galloway, H., Casavant, K., & Jessup, E.L. (2007). Projections of Washington-British Columbia Trade and Traffic, by Commodity, Route and Border Crossing. Transportation Research Forum, Boston, MA. http://www.trforum.org/forum/2007/schedule.php.

Galloway, H., Casavant, K., & Jessup, E.L. (2007). Projections of British Columbia-Washington Truck Freight Border Crossings Based on Commodity Trade. Canadian Transportation Research Forum, Winnipeg, Canada. http://www.ctrf.ca/past_conferences.htm.

Gossard, M., Jessup, E.L., & Casavant, K. (2007). CO2 vs. Salmon: Complementary Policies in Wheat Transportation in the Pacific Northwest? Transportation Research Forum Transportation Research Forum, Boston, MA. http://www.trforum.org/forum/2007/schedule.php.

Jessup, E.L., & Casavant, K. (2007). History, Function and Future of the Columbia-Snake Waterway. Washington State Transportation Commission, Skamania Lodge, Stevenson, WA, invited presentation.

Jessup, E.L., & Casavant, K. (2007). Transportation Challenges and Outlook: Bio Energy and Agriculture. School of Economic Sciences 2007 Annual Conference: Economic Issues and Outlook, Pasco, WA, invited presentation.

Jessup, E.L., & Casavant, K. (2007). Transportation Opportunities/Challenges: Productive Partnerships. Invited presentation at the School of Economic Sciences Annual Outlook Conference, Pasco, WA, 2007.

Jessup, E.L., Casavant, K., & Pike, Q. (2007). Transportation Usage and Characteristics of Washington State Warehouse/Distribution Center Businesses: A First Look. Journal of Business Case Studies , (JBCS# S06-168).

Jessup, E.L., Cullen, K., Lenzi, J., & Casavant, K. (2007). All Weather Road Projects for the State of Washington: A GIS Application/Analysis, SFTA Research Report #23. SFTA Research Report # 23. http://www.sfta.wsu.edu/research/reports/pdf/Report23_AllWeatherRoad.pdf.

Jessup, E.L., Meenach, S., & Casavant, K. (2007). Modeling Containerized Hay Shipments in the Pacific Northwest: Investigating Cost and Volume Impacts as Port of Portland Container Services is Reduced. Transportation Research Forum, Boston, MA. http://www.trforum.org/forum/2007/schedule.php.

Khachatryan, H., Jessup, E.L., & Casavant, K. (2007). 2005 Transportation of Mining/Mineral Survey Summary Report, SFTA Research #21. SFTA Research Report #21.http://www.sfta.wsu.edu/research/reports/pdf/Rpt21_TransMineralSurveyReport.pdf

Meenach, S., Jessup, E.L., & Casavant, K. (2007). Modeling Containerized Hay Shipments in the Pacific Northwest: Investigating Cost and Volume Impacts as Port of Portland Container Services are Reduced. Transportation Research Forum, Boston, MA. http://www.trforum.org/forum/2007/schedule.php.

Monson, G., Jessup, E.L., & Casavant, K. (2007). Management of Supply Chains for Economic Efficiency in a Security Environment: A Case Study of a Big Box Chain Store. I Mediterranean Conference of Agro-Food Social Scientists, Barcelona, Spain.

Monson, G., Jessup, E.L., & Casavant, K. (2007). Supply Chain Analysis: Port Security Measures and Catastrophic Events. Transportation Research Forum, Boston, MA. http://www.trforum.org/forum/2007/schedule.php.

Monson, G., Jessup, E.L., & Casavant, K. (2007). Supply Chain Analysis: Port Security Measures and Catastrophic Events. Transportation Research Forum, Boston, MA. http://www.trforum.org/forum/2007/schedule.php.

Newkirk, J.R., Jessup, E.L., Casavant, K., & Gossard, M. (2007). Qualitative Research for a Quality of Life: Benefits of Rural Airports. Western Planner , January..

Painter, K.M., Jessup, E.L., Gossard, M., & Casavant, K. (2007). Demand Forecasting for Rural Transit: Models Applied to the State of Washington. Transportation Research Record. 1997, 35-40.

Painter, K.M., Jessup, E.L., Gossard, M., & Casavant, K. (2007). Demand Forecasting for Rural Transit: Models Applied to Washington State. Transportation Research Board Annual Meeting, Washington, DC.

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Laboratory of Astrobiological Investigations and Space Mission Planning

Research Laboratory

Lab Director: Dirk Schulze-Makuch

Webster 1148

dirksm@wsu.edu

Tel: 001-509-335-1180

http://environment.wsu.edu/people/faculty/dirkschulzemakuch.html

Year established: 2007

Organization Summary

a. The mission of the Laboratory of Astrobiological Investigations and Space Mission Planning is to foster collaborative research associated with the research focus of the laboratory and allow both students and senior researchers to be part of frontier, cutting-edge type of research, either on all or only specific research initiatives. The goal is also to attract funding from NASA initiatives such as the NASA Astrobiology Institute (NAI), especially to demonstrate that interested researchers and some infrastructure is already present at WSU to allow the establishment of a NAI on the WSU campus.

b. The lab's effectiveness is attested by 21 presentations, 17 papers, and proposal activities, including a major institutional proposal listed below, during the last 5 years:. The accomplishments are in detail:

Presentations:

1. Schulze-Makuch, D., Haque, S., Hosein, R., Guinan, E., Hallam, S.J., Khan, A., and Meckenstock, R. (2013) Observations of Microbial Life in a Naturally Occurring Liquid Asphalt Desert. Molecules and Life in Extremes, Edinburgh, Scotland, 17-19 April 2013.
2. Schulze-Makuch, D., Fairen, A.G., and Irwin, L.N. (2012) Planetary Habitability and Rapid Environmental Change: The Biological Perspective. American Geophysical Union (AGU) Fall Meeting, 3-7 Dec 2012.
3. Turse, C., Khan, A., Leitner, J.J., Firneis, M., and Schulze-Makuch, D. (2012) Miller-Urey Experiments to Assess the Production of Amino Acids under Impact Conditions on Early Titan. Extraterrestrial Life – Beyond our Expectations? – Workshop, hosted at the Institute of Astronomy, University of Vienna, Vienna, Austria, 21-22 May 2012.
4. Turse, C., Khan, A., Leitner, J.J., Firneis, M., and Schulze-Makuch, D. (2012) Miller-Urey Experiments to Assess the Production of Amino Acids under Impact Conditions on Early Titan. Astrobiology Science Conference, Atlanta, Georgia (USA), April 15-20, 2012.
5. Schulze-Makuch, D., Mendez, A., Fairen, A.G., von Paris, P., Turse, C., Boyer, G., Davila, A., Antonio, M.R.S., Catling, D., and Irwin, L.N. (2012) Metrics to Assess Planetary Habitability: The Earth Similarity Index and the Planetary Habitability Index (PHI). Astrobiology Science Conference, Atlanta, Georgia (USA), April 15-20, 2012.
6. Irwin, L.N., Mendez, A., Fairen, A.G., Catling, D., and Schulze-Makuch, D. (2012) Metrics for Predicting Biological Complexity on other Worlds. Astrobiology Science Conference, Atlanta, Georgia (USA), April 15-20, 2012.
7. Antonio, M.R.S. and Schulze-Makuch, D. (2012) Social structure as the propeller of intelligent features. Astrobiology Science Conference, Atlanta, Georgia (USA), April 15-20, 2012.
8. António, MR.S. and Schulze-Makuch, D. (2012) In-Situ Sampling of Biomolecules in the Higher Atmospheric Layers and the Space Interface. Next-Generation Suborbital Researchers Conference 2012, Palo Alto, California, February 27-29, 2012.
9. Schulze-Makuch, D. and Guinan, E.F. (2010) Gliese 581d: A Possibly Habitable Planet around a Red Dwarf Star. European Planetary Science Conference (EPSC) Rome, Italy, Sept. 19-25, 2010.
10. Schulze-Makuch, D., António, MR.S., and Turse, C. (2010) Is cancer unique to complex life on Earth or a universal phenomenon for all multicellular life in the universe? Astrobiology Science Conference, April 26-29, 2010, League City, Texas.
11. Turse, C., Schulze-Makuch, D., Lim, D.D.S., Laval, B., and Irwin, L.N. (2010) The rise of complexity" cell signaling compounds in Pavilion Lake microbialites and temperate zone microbial community ecosystems. Astrobiology Science Conference, April 26-29, 2010, League City, Texas.
12. Schulze-Makuch, D. and Guinan, E.F. (2010) Life around a red dwarf (dM) star with special emphasis on Gliese 581. Astrobiology Science Conference, April 26-29, 2010, League City, Texas.
13. António, MR.S. and Schulze-Makuch, D. (2010) Social structure: the key to an intelligent lineage. Astrobiology Science Conference, April 26-29, 2010, League City, Texas.

14. Harrop, B.L. and Schulze-Makuch, D. (2010) The detection of a Dyson-Harrop Satellite: a technologically feasible astro-engineering project and alternative to the traditional Dyson Sphere. Astrobiology Science Conference, April 26-29, 2010, League City, Texas.
15. António, MR.S. and Schulze-Makuch, D. (2010) Cancer, an evolutionary developmental process in multicellular life. Astrobiology Science Conference, April 26-29, 2010, League City, Texas.
16. Reiswig, B. and Schulze-Makuch, D. (2010) Flight: a recurrent theme for advanced civilizations? Astrobiology Science Conference, April 26-29, 2010, League City, Texas.
17. Fan, C., Xie, H., Schulze-Makuch, D., and Ackley, S. (2009) A likely formation mechanism for the hematite-rich spherules in the equatorial region of western Mars. LPSC, March 23-27, 2009, The Woodlands, Texas.
18. Fan, C., Schulze-Makuch, D., Wolff, J., and Fairen, A.G. (2008) A new hypothesis for the origin and redistribution of sulfates in the equatorial region of western Mars. AGU Fall Meeting, December 15-19, San Francisco, CA.
19. Schulze-Makuch, D., Turse, C., Houtkooper, J., and McKay, C.P. (2008) A biomarker for the hydrogen peroxide-water hypothesis for life on Mars and its possible detection by the TEGA instrument on the Phoenix lander. Astrobiology Science Conference (AbSciCon), Santa Clara, CA, *Astrobiology*, p. 435.
20. Turse, C., Schulze-Makuch, D. Lim, D., Laval, B., and Irwin, L. (2008) The rise of complexity: evidence from cell signaling compounds for Pavilion Lake microbialites and temperate zone microbial community ecosystems. Astrobiology Science Conference (AbSciCon), Santa Clara, CA, *Astrobiology*, p. 383.
21. Hosein, R., Schulze-Makuch, D. and 12 co-authors (2008) Mud volcanoes and a hydrocarbon lake in Trinidad as analog study sites for Titan. Astrobiology Science Conference (AbSciCon), Santa Clara, CA, *Astrobiology*, p. 352.

Papers:

1. Fisher, T.M. and Schulze-Makuch, D. (2013) Nutrient and population dynamics in a subglacial reservoir: a simulation case study of the Blood Falls ecosystem with implications for astrobiology. In press at *Int. J. Astrobiology*.
2. Schulze-Makuch, D., Fairén, A.G, and Davila, A. (2013) Locally targeted ecosynthesis: a proactive in situ search for extant life on other worlds. In press at *Astrobiology*.
3. Schulze-Makuch, D., Lim, D.S.S., Laval, B., Turse, C., Antonio, M.R.S., Chan, O., Pointing, S.B., Reid, D., and Irwin, L.N. (2013) Pavilion Lake microbialites: morphological, molecular, and biochemical evidence for a cold-water transition to colonial aggregates. *Life*, 3(1), 21-37; doi:10.3390/life3010021.
4. António, M.R.S. and Schulze-Makuch, D. (2012) Toward a new understanding of multicellularity. *Hypotheses in the Life Sciences,* vol. 2, no. 1, p. 4-14.
5. Schulze-Makuch, D., Méndez, A., Fairén, A.G., von Paris, P., Turse, C., Boyer, G., Davila, A.F., António, M.R.S., Catling, D., and Irwin, L.N. (2011) A two-tiered approach to assessing the habitability of exoplanets. *Astrobiology,* vol. 11, no. 10, p. 1041-1052.
6. Schulze-Makuch, D., Haque, S., Antonio, M.R.S., Ali, D., Hosein, R., Song, Y.C., Yang, J., Zaikova, E., Beckles, D.M., Guinan, E., Lehto, H.J., and Hallam, S.J. (2011) Microbial life in a liquid asphalt desert. *Astrobiology*, vol. 11, no. 3, p. 241-258.
7. Lim, D.S.S., Brady, A.L., and PRLP-Team (Abercromby, A., Andersen, D., Andersen, M., Arnold, R., Bird, J., Bohm, H., Cardman, Z., Chan, A., Chan, O., Cowie, B., Davila, A., Deans, M., Druschel, G., Fong, T., Forrest, A., Gernhardt, M.L., Hawes, I., Hansen, J., Laval, B.L., Lees, D., Leoni, L., Looper, C., Marinova, M., McCombs, D., McKay, C.P., Nuytten, P., Pendery. R., Pieters, R., Pointing, S., Pollack, J., Reay, M., Saffari, M., Reid, D., Schulze-Makuch, D., Shepard, R., Slater, G.F., Sumner, D.Y., Suttle, C., Turse, C., Wilhelm, M., Wilkinson, N., Williams, D., Winget, D). (2011) A historical overview of the Pavilion Lake Research Project – Analog science and exploration in an underwater environment. In *GSA Special Paper 483* - Analogs for Planetary Exploration (edited by W. Brent Garry and Jacob E. Bleacher), Paper # 7.
8. Reiswig, B. and Schulze-Makuch, D. (2011) The desire for the development of flight: a recurrent theme for advanced civilizations? *Journal of Scientific Exploration,* vol. 25, no. 2, p. 321-327.
9. António, M.R.S. and Schulze-Makuch, D. (2010) The power of social structure: how we became an intelligent lineage. *Int. J. Astrobiology*, vol. 10, no. 1, p. 15-23.

10. Lim, D.S.S., Warman, G.L., Gernhardt, M.L., McKay, C.P., Fong, T., Marinova, M.M., Davila, A.F., Andersen, D., Brady, A.L., Cardman, Z., Cowie, B., Delaney, M.D., Fairen, A.G., Forrest, A.L., Heaton, J., Laval, B.E., Arnold, R., Nuytten, P., Osinski, G., Reay, M., Reid, D., Schulze-Makuch, D., Shepard, R., Slater, G.F., and Williams, D. (2010) Scientific field training for human planetary exploration. Planetary and Space Science 58, p. 920-930.
11. Brooks, H. and Schulze-Makuch, D. (2010) The Solar Wind Power Satellite as an alternative to a traditional Dyson Sphere and its implications for remote detection. *Int. J. Astrobiology*, vol. 9, no. 2, p. 89-99.
12. Fan, C., Xie, H., Schulze-Makuch, D., and Ackley, S. (2010) A formation mechanism for hematite-rich spherules on Mars. *Planetary and Space Science* 58: 401-410.
13. António, M.R.S. and Schulze-Makuch, D. (2009) The immune system as key to cancer treatment: triggering its activity with microbial agents. *Bioscience Hypotheses,* vol. 2, no. 6, p. 388-392.
14. Fan, C., Schulze-Makuch, D., Xie, H., and Lu, N. (2009) Investigation of water signatures at gully-exposed sites on Mars by hyperspectral image analysis. *Planetary and Space Science*, vol. 57, no. 1, p. 93-104.
15. Lim, D.S.S., B.E. Laval, G. Salter, D. Antoniades, A.L. Forrest, W. Pike, R. Pieters, M. Saffari, D. Reid, D. Schulze-Makuch, D. Andersen, and C.P. McKay. (2009) Limnology of Pavilion Lake, B.C., Canada – Characterization of a microbialite forming environment. *Fundamental and Applied Limnology*, vol. 173, no. 4, p. 329-351.
16. Fink, W., Datta, A., Dohm, J.M., Tarbell, M.A. Jobling, F.M., Furfaro, R., Kargel, J., Schulze-Makuch, D., and Baker, V.R., (2008) Automated Global Feature Analyzer (AGFA) – A Driver for Tier-Scalable Reconnaissance. IEEE Aerospace Conference Proceedings, paper #1273, Big Sky, Montana DOI: 10.1109/AERO.2008.4526422
17. Fan, C., Schulze-Makuch, D., Wolff, J.A., and Fairén, A.G (2008) A new hypothesis for the origin and redistribution of sulfates in the equatorial region of Western Mars. *Geophysical Research Letters* 35, L06201, doi:10.1029/2007GL033079

Proposals:

Student Grants Succcessful

Student	Granting Agency	Type of Award	Award Amount	Year
Carol Turse	WSU	Robert Lane Fellowship	$ 2,000	2008/09
Grayson Boyer	NASA	NASA Space Grant	$ 2,500	2010
Carol Turse	NASA	NASA Space Grant	$ 2,500	2010
Carol Turse	NASA	NASA Space Grant	$ 2,500	2011
Carol Turse	NASA	NASA Space Grant	$ 2,500	2012

Grant Proposals declined

Role/Principal Investigators	Granting Agency	Project Title	Award Amount	Duration
PI PI: Dirk Schulze-Makuch Co-I Manfred Cuntz	NASA Exobiology	Viability of Microbial Organisms in Response to Simulated Stellar Flare Activity	$ 491,243	declined
PI PI: Dirk Schulze-Makuch, Co-I: Edward Guinan	NASA Exobiology	Life in the Habitable Zone: Determining the Effects of UV/NUV Radiation of Solar-type cooler dK and	$ 290,999	declined

		dM Stars on Microbial Survival Rates of Hosted Terrestrial-Size Planets		
Co-I Eric Chassefière (PI) Sanjay Limaye (U.S.-lead), Co-I Dirk Schulze-Makuch et al.	ESA (NASA for U.S. participants)	European Venus Explorer (EVE; Cosmic Vision)	Total about $ 5 million	declined

Major (Institutional) Grant Proposal declined:

Role/Principal Investigators	Granting Agency	Project Title	Award Amount	Duration
PI PI: Dirk Schulze-Makuch and 21 Co-Is	NASA Astrobiology Institute	A WSU-DLR lead NASA Astrobiology Institute of Habitability of Martian Environments (HOME)	$ 9,174,946 (including $ 2 M from DLR)	Sept 1, 2012 - Aug 30, 2017

* unsuccessful even though excellent review comments were received

c. N/A, no major changes during preceding five years

d. Enhance research collaboration in regard to its research focus in form of presentations, papers, think tank activities, and proposals

e. No formal relationship to other laboratories or centers, part of the School of the Environment

f. Instruction for students is provided as unique research experience and as relevant to the unit's goals

g. Provide excitement for a research focus that is otherwise not present within the university. Major financial and prestige benefits if the laboratory would be expanded to a NASA Astrobiology Institute

h. The laboratory will further excel in output, particularly papers, presentations, and proposals, increase in visibility within and outside of the university, and will undertake another attempt to expand it to a WSU-led NASA Astrobiology Institute (the next proposal deadline being in early 2014).

Organizational Structure

a. Director's term is unlimited, brief Vita:

DIRK SCHULZE-MAKUCH

Professor, School of the Environment, Washington State University
Pullman, WA 99164-2812, Tel: (509)-335-1180; Fax: (509)335-3700, email: dirksm@wsu.edu

EDUCATION

Ph.D., 1996, University of Wisconsin-Milwaukee (Geosciences)
Diploma (M.S.), 1991, Justus-Liebig-University Giessen (Geology)
Vordiploma (B.S.), 1988, Justus-Liebig-University Giessen (Geology)

EXPERIENCE

2010-present:	Professor, School of the Environment, Washington State University
2013-present:	Adjunct Professor, Beyond Center, Arizona State University
2011:	Humboldt Foundation Fellow (Friedrich-Wilhelm-Bessel Award; Jan-Aug 2011), German Aerospace Centre (DLR), Berlin, Germany
2004-2010:	Associate Professor, School of Earth and Environmental Sciences, Washington State University
1999:	NASA Summer Faculty Fellow at the Goddard Space Flight Center
1998-2004:	Assistant Professor, University of Texas at El Paso. Department of Geological Sciences, and Environmental Science and Engineering Program
1998:	Assistant Professor, Center of Environmental Resource Management, University of Texas at El Paso
1996-1998:	Senior Project Hydrogeologist at Envirogen, Inc. (Princeton Research Center) – Division Fluid Management.
1997-1998:	Adjunct Professor, Department of Earth Sciences and Geography, University of Wisconsin-La Crosse.
1993-1994:	Doctoral Research Assistant, Department of Geosciences, University of Wisconsin-Milwaukee
1990-1992:	Research Associate and Consultant, Geobureaux for Geosciences and Environmental Sciences
1991:	Research Associate, Institute of Applied Geosciences, Justus-Liebig-University, Giessen, Germany.
1988-1991:	Research Assistant, Department of Geology, Justus-Liebig-University, Giessen, Germany.

RELATED EXPERIENCE

2007-present:	Director of the Laboratory for Astrobiological Investigations and Space Mission Planning http://www.sees.wsu.edu/ABcenter/index.html
2012:	Guest Professor at the University of Vienna, Austria (May); and Guest Scientist at the German AeroSpace Center (DLR) in Berlin, Germany (June-August)
2000-2009:	Chief Scientist of the Geobiological Groundwater Research Group (GBiG)

BRIEF HIGHLIGHTS

1. MAJOR SCIENTIFIC ACCOMPLISHMENTS

1. Resolved the scaling behavior of hydraulic conductivity and longitudinal dispersity in geological media, which is one of the major problems in hydrogeology pertaining to the transport of chemical compounds and microbial organisms in the ground-water environment. Three key publications: Scale dependency of hydraulic conductivity in heterogeneous media/*Ground Water* 1999 [93 citations]; Variation of hydraulic conductivity with scale of measurement/*Hydrogeology Journal* 1998 [56 citations]; and Longitudinal dispersivity data and implication for scale behavior/*Ground Water* 2005 [85 citations].
2. Moved on to extraterrestrial hydrogeology and the search for life on Mars and other planetary bodies. Published the primer in the field: "Life in the Universe: Expectations and Constraints" (Springer 2004, 2008 [2nd edition; 113 citations]) and other key publications such as Exploration of hydrothermal targets on Mars/*Icarus* 2007 [46 citations].
3. Became a world-leading expert in geobiology and planetary habitability; particularly on the co-evolution of life and its environment. Received the Friedrich-Wilhelm Bessel Award in Theoretical Biology by the Humboldt Foundation. Two example publications are: A sulfur-based UV adaptation strategy for putative phototrophic life in the Venusian atmosphere (*Astrobiology*, 2004 [53 citations]) and "Major environmental changes of the terrestrial planets during Solar System history" (commissioned by *Nature Geoscience*). Published the most papers of any author in the renowned subject journal *Astrobiology* (16 plus 2 in review), and six more books related to habitability and astrobiology.

2. INTERNATIONAL PRIZES/AWARDS/RECOGNITION

Member of the Board of Directors of StarVoyager.org (2012-Present)
Member of the Editorial and Advisory Board of Springer's Book Series on "Science and Fiction" (2012-Present)
Lifeboat Scientific Advisory Board Member (2011-Present)
Friedrich-Wilhelm-Bessel Award from the Humboldt Foundation (2010)
Appearances/Interviews in Scientific Television Documentaries:

a. NHK-TV Japanese Broadcast Channel, Cosmic Front (Japan, 2012)
b. National Geographic Documentary (USA, 2010)
c. ARD TV Special, Quarks & Co. Scientific Series (Germany, 2010)
d. Discovery Channel Documentary on research at my Trinidad Field Site (USA, 2009)

Reports about my research also in other news outlets such as *Science*, *Popular Science*, *Discovery Magazine*, *New Scientist*, *World Science*, *Natural History Magazine*, BBC, CNN, MSNBC, etc. Also, listed on Wikipedia: http://en.wikipedia.org/wiki/Dirk_Schulze-Makuch

3. BOOK PUBLICATIONS

7 total, from which 3 are academic (one being in the 2nd edition), 3 popular science (one of them a bestseller in the U.K.), and 1 science fiction; all of them in the last 10 years.

4. PAPER PUBLICATIONS (REFEREED)

133 total, from which 97 are published in journals and the rest in form of book chapters (most of them invited) and conference proceedings; 110 of these 133 papers were published in the last 10 years. An additional 10 papers are in review, at various stages in the review process

5. PRESENTATIONS AT CONFERENCES AND INVITED TALKS

Presentations at Conferences: 193 total; Invited Talks and Seminars: 80 total

6. GRANTED PATENTS

Removal of Biological Pathogens using Surfactant Modified Zeolite, awarded 25 Dec 2007, Patent No. US 7,311,839 B2.

7. RESEARCH GRANT HISTORY

24 total, plus 6 to my PostDocs and graduate students.

8. SELECTED SPECIAL RESPONSIBILITIES

1. Co-Organizer of NASA Meeting on "Toward a Permanent Human Presence on Mars
2. Session Organizer, Chair and Panelist at Astrobiology Science Conference, held in Atlanta, GA, 2012.
3. Session Chair at the Astrobiology Science Conference in League City, 2010, and in Santa Clara, 2008.
4. Chair of the "Astrobiology Research Priorities for the outer Solar System" Group to write a White Paper for the Planetary Science Decadal Survey, commissioned by the ***National Academy of Sciences***, 2009.
5. Co-chair of NASA's Icy Satellites Focus Group, 2008-2009
6. Session Chair at the Gordon Research Conference on the Origin of Life, Ventura, 2008
7. Guest Editor of a Special Issue of Astrobiology journal: Methodologies and Techniques to Detect Extraterrestrial (Microbial) Life, 2003
8. Chairperson organizing a Union Session at the American Geophysical Union Meeting in San Francisco (Dec 2002)

9. RESEARCH EXPEDITIONS AND LEAD OF FIELD INVESTIGATIONS

Leader of the Scientific Group investigating the natural liquid asphalt in Trinidad (one of only three world-wide) with the latest publication: Schulze-Makuch et al. (2011) Microbial life in a liquid asphalt desert. *Astrobiology* 11, 241-258 (6 visits of the field site total)

A Topic Leader of the Scientific Group investigating the microbialite structures at Pavilion Lake in Canada with the two latest publications: Schulze-Makuch et al. (2012) The rise of complexity: Pavilion Lake Microbialites suggest a pathway toward macroorganismic communities; In press at *Hypotheses in the Life Sciences*, and Schulze-Makuch et al. (2012) Pavilion Lake Microbialites: morphological, molecular, and biochemical evidence for a cold-water transition to colonial aggregates; in press at *Life* (5 visits of the field site total).

10. MAJOR CONTRIBUTIONS TO EARLY CAREERS OF EXCELLENT RESEARCHERS

I supervised 2 PostDocs, and graduated 5 Ph.D. students and 10 M.S. students during the last 10 years, plus 3 Ph.D. and 2 M.S. students are currently still pursuing their degree with me as their major advisor. With many of these students I published together important research papers in which I routinely assign my students to be the first author. Given here are ten selected examples:

1. António, M.R.S. and Schulze-Makuch, D. (2012) *Hypotheses in the Life Sciences* 2, 4-14.
2. Brooks, H. and Schulze-Makuch, D. (2010) *Int. J. Astrobiology* 9, 89-99.
3. António, M.R.S. and Schulze-Makuch, D. (2009) *Bioscience Hypotheses* 2, 388-392.
4. Fan,C., Schulze-Makuch,D., and 2 authors (2009) *Planetary and Space Science* 57, 93-104.
5. Abbas, S. and Schulze-Makuch, D. (2008) *Int. J. of Astrobiology* 7, 193-203.
6. Fan, C., Schulze-Makuch, D., and 2 authors (2008) *Geophys. Res. Lett.* 35, doi 10.1029/2007GL033079.
7. Islam, M.R. and Schulze-Makuch, D. (2007*) Int. J. Astrobiology* 6, 199-215.
8. Muller, A.W.J. and Schulze-Makuch, D. (2006) *Physica A*, 362, 369-381.
9. Muller, A.W.J. and Schulze-Makuch, D. (2006) *Orig. Life and Evol. Biosph.* 36, 177-189.
10. Diaz, B. and Schulze-Makuch, D. (2006) *Astrobiology* 6, 332-347.

b. Participating Faculty/Scientists:
   - Kent Keller, School of the Environment, Washington State University
   - Mohammed Islam, PostDoc, Washington State University
   - Ron Crawford (University of Idaho)
   - Philip Goodell (University of Texas at El Paso)
   - Shirin Haque (University of the West Indies)
   - Louis Irwin (University of Texas at El Paso)
   - Harry Lehto (University of Turku, Finland)
   - Christoph Vogt (University of Bremen, Germany)
   - Wolfgang Fink (CalTech and University of Arizona)

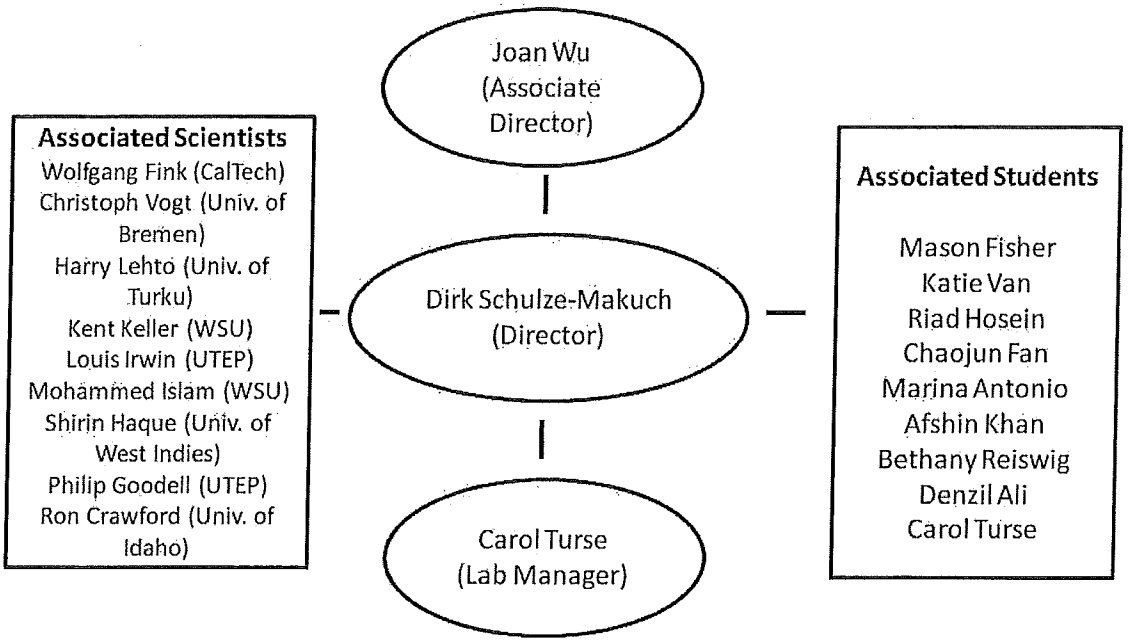
c. Interest in the research focus of the Laboratory of Astrobiological Investigations and Space Mission Planning . Depending on status (scientist or student) one can join as Associated Scientist or Associated Student

d. Members collaborate in the research either in form of a M.S. thesis or Ph.D. thesis or only as collaborator in a specific project

e. No outside support needed, lab is part of the School of the Environment

f. Dirk Schulze-Makuch (director), Joan Wu (Associated Director), Carol Turse (Lab Manager)

Organizational Flowchart



Organizational Resources

1. **Current and expected levels of support during the last three fiscal years**
   a. University: none
   b. State: none
   c. External awards: expected grants through NASA, particularly NASA Astrobiology Institute
   d. Gift sources: none

2. **Current and Needed**

   a. Space requirements: research lab in Webster 1132 is sufficient as is
   b. Staff support: sufficient as present (volunteered by faculty and students)
   c. Equipment: sufficient as is for current purposes
   d. Other support: possibly grant support (see 1c)

123838_cils_a

Laboratory for Biotechnology and Bioanalysis
Washington State University

Research Laboratory

Faculty Director
Dr. Michael D. Griswold
Regents Professor
School of Molecular Biosciences
College of Veterinary Medicine
Washington State University
Pullman, WA 99164-7520
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Co-Director
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E mail: pooch@wsu.edu

http://www.smb.wsu.edu/facilities/laboratory-for-biotechnology-and-bioanalysis

Year established: 1988

Organizational Summary

The Laboratory for Biotechnology and Bioanalysis (LBB) is a centralized facility administered through the Office of Research. Through this formal application, we are seeking Faculty Senate Research and Arts Committee approval. Our mission is to provide bioanalysis from utilizing unique, state-of-the-art equipment to support researchers at Washington State University (WSU). LBB also welcomes the opportunity to work with scientists from other universities and industry outside of WSU. We currently have a multitude of services and instrumentation available in the fields of molecular biology, genomics as well as proteomics.

Services provided by this laboratory include DNA and genomic sequencing, transcription array analysis, mass spectrometry of proteins and peptides and bioinformatic analysis of genomic data. We analyze samples provided by researchers that include hundreds of WSU faculty and a number of off-campus investigators. This often requires design and development of new approaches and/or methodologies, modifying and adapting them to fit research project goals. This puts the laboratory's scientists at the leading edge of new areas of study in biology, chemistry, genomics research as well as areas where these disciplines overlap with engineering, agricultural and global animal/human research conducted at Washington State University.

The overarching function of this laboratory is to provide the analytical services for research in molecular biology, genomics, and proteomics. We provide these services on a fee for service basis and utilize state of the art instrumentation that is used in a centralized user facility. Use of the services by research faculty and students has been very high and we provide essential services that the individual investigator cannot obtain elsewhere on campus. ***(See Attachment # 1 for WSU departments served since 2008.)***

While the LBB is not an instructional unit many classes at undergraduate and graduate level visit the laboratory during the year to gain some insight on the state of the art techniques and equipment. LBB personnel provide lectures and demonstrations during these visits. The impact of LBB on the university clients is enormous and absolutely essential for productive research in the biological sciences. ***(See Attachment # 2 for individual researchers served in 2012.)***

In the past 5 years our primary service has changed from routine Sanger sequencing of DNA to high performance genomic sequencing. This change has been possible by the purchase of several new DNA sequencing systems. The primary functions of this laboratory are not duplicated by any other core facility on campus. This core laboratory currently provides DNA sequencing, DNA fragment analysis, protein sequencing, peptide synthesis, mass Spectrometry, proteomics, and some information services to researchers at Washington State University and beyond.

LBB is equipment intensive and the type of equipment we use is changing rapidly so in 5 years' time it is likely that most of our current equipment will be replaced and/or upgraded.

The following research faculty at WSU have attested to the laboratory's participation and impact on their research. A few illustrations of the laboratory's contribution and impact on the university community is provided below.

Mary Hunzicker-Dunn, Ph.D.
Edward R Meyer Distinguished Professor
School of Molecular Biosciences
Washington State University
Biotechnology Life Sciences Building, Room 202
Pullman, WA 99164-7520

My laboratory is investigating how the gonadotropin follicle stimulating hormone (FSH) signals in granulosa cells to promote cell proliferation and differentiation. Our results suggest that the transcriptional regulatory factor FOXO1 (forkhead box family O1) in its active unphosphorylated state maintains granulosa cells in an undifferentiated state by repressing a group of target genes and, alternatively, by activating other target genes. FSH signals via the phosphatidylinositol 3-kinase pathway to phosphorylate/inactivate FOXO1, a response we hypothesize is required for follicles to mature to the preovulatory stage. To test this hypothesis, we treated cells with an empty adenovirus or an adenovirus expressing constitutively active FOXO1 that cannot be phosphorylated, treated cells without and with FSH, collected RNA after 24 hours, and subjected RNA to ion torrent sequencing conducted by the Laboratory of Biotechnology & Bioanalysis (LBB). Results revealed a large group of genes whose expression was enhanced by FSH greater than 5-fold, and whose expression was prevented by constitutively active FOXO1. We also identified a second group of genes whose response was opposite, corresponding to genes that are activated by FOXO1 and repressed with FSH. One of the genes in the first category is Lhcgr, that encodes the luteinizing hormone receptor required for ovulation. We have a manuscript submitted to Molecular Endocrinology reporting the effect of FOXO1 on Lhcgr expression. We are planning to report on the entire data set, once we verify regulation of additional genes.

Thomas E Besser, DVM PhD
Professor of Microbiology
Food and Waterborne Disease Research Program
Veterinary Microbiology and Pathology
Washington State University College of Veterinary Medicine

The Laboratory of Biotechnology & Bioanalysis (LBB) has provided capillary fragment analysis work. We use this technology as a read-out for highly multiplexed PCR reaction products. For example, we have a 12-plex PCR that detects bacteriophage-bacterial chromosome junctions for three bacteriophages inserted in four different chromosomal loci of Escherichia coli O157:H7 as well as three different Shiga toxin gene subtypes. We use this for molecular epidemiology research, often analyzing hundreds of isolates per month. It's highly efficient and cost effective.

WASHINGTON STATE UNIVERSITY

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Fighting disease, improving crops

WSU among first in nation with DNA sequencer

Tuesday, Jan. 10, 2012

By Eric Sorensen, WSU science writer

Video by Matt Haugen, WSU News

PULLMAN, Wash. – Washington State University is among the first in the country to acquire a DNA sequencing machine that will let researchers across the university assemble and characterize genomes with dramatically improved speed and accuracy. The technology promises to improve researchers' understanding of the genetic blueprints of plants and animals and open new avenues for fighting diseases and improving the productivity of crops.

Genomicist Amit Dhingra is featured on a tongue-in-cheek magazine cover fashioned by student Ken Dorrance. Dhingra and other WSU researchers now have access to one of the fastest, most powerful DNA sequencing machines in the world.

"This catapults our faculty into a unique and enviable position," said Howard Grimes, vice president of research, whose office funded the $774,000 machine. "We expect this to drive our research programs into new territory extraordinarily quickly."

Grimes said WSU is the nation's first agriculture-veterinary medicine university in the country to acquire the Pacific Biosciences technology, which is up and running in the WSU Laboratory for Biotechnology and Bioanalysis.

The PacBio RS single molecule real time sequencer is effectively "a big laser with a really good camera," illuminating and identifying thousands of a DNA molecule's individual nucleotides at a time, said Derek Pouchnik, lab director. By decoding long, accurate sections of DNA that can later be pieced together, it will help researchers fathom "the cast of characters in a cell," said Mark Wildung, senior scientific assistant in the lab.

"It's hard to work with an organism anymore without understanding the genome," he said.

Possible applications include:

- Sequencing the genomes of crops with an eye toward isolating genes responsible for disease resistance, greater productivity or drought tolerance in an era of warming climates.
- Decoding the genes of germs central to infectious diseases.

- Finding enzymes that fungi use to crack cellulose, a major area of focus in developing a cost-effective biofuel from woody plants.

Horticultural genomicist Amit Dhingra, who led a team that in 2010 published the genome of the golden delicious apple, said the PacBio machine's large gene sequences will help researchers piece together the genomic puzzle more efficiently. It also will complement other sequencing technologies at WSU.

Already, he said, researchers are using the equipment to get new genetic information about apples, pears, sweet cherries and a plant that Regents Professor Gerry Edwards has found is particularly adept at photosynthesis.

With a full suite of sequencing technology, said Dhingra, "we will have a much clearer image of what novel genes underlie the unique biology of these plants. Then we can begin to find solutions to how to make pears productive sooner and how to make our crops fix carbon more efficiently to address burgeoning food and fuel demands."

Contacts:
Derek Pouchnik, WSU Laboratory for Biotechnology and Bioanalysis, 509-335-1174, pooch@wsu.edu
Eric Sorensen, WSU Science Writer, 509-335-4846, eric.sorensen@wsu.edu

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Research VP candidate to participate in public forum
Sinkholes claim Florida man, threaten second house
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WSU leads development of heat-tolerant grain

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Probing plant secrets in order to feed a changing world

Allison Coffin, PhD
Assistant Professor
Washington State University - Vancouver
Integrative Physiology and Neuroscience
VCLS Building room 208U
14204 NE Salmon Creek Avenue
Vancouver, WA 98686-9600

The Laboratory of Biotechnology and Bioanalysis (LBB) was instrumental in our current research to profile the inner ear transcriptome from the midshipman fish, a species where hormones influence hearing capabilities. Mark Wildung served as a consultant during the early phases of the project when we collected tissue samples and extracted RNA. We then sent the samples to Mark and he performed the reverse transcription and deep sequencing, yielding a dataset with over 12 million raw sequence reads. This dataset is the core of a paper currently in prep and sets the tone for additional research in our lab, research that will include further sequencing using this Core laboratory. Without LBB this project would be considerably more challenging and more expensive, and might not be possible given our limited resources. We are completely satisfied with the laboratory and look forward to working with them again in the future.

Organizational Structure

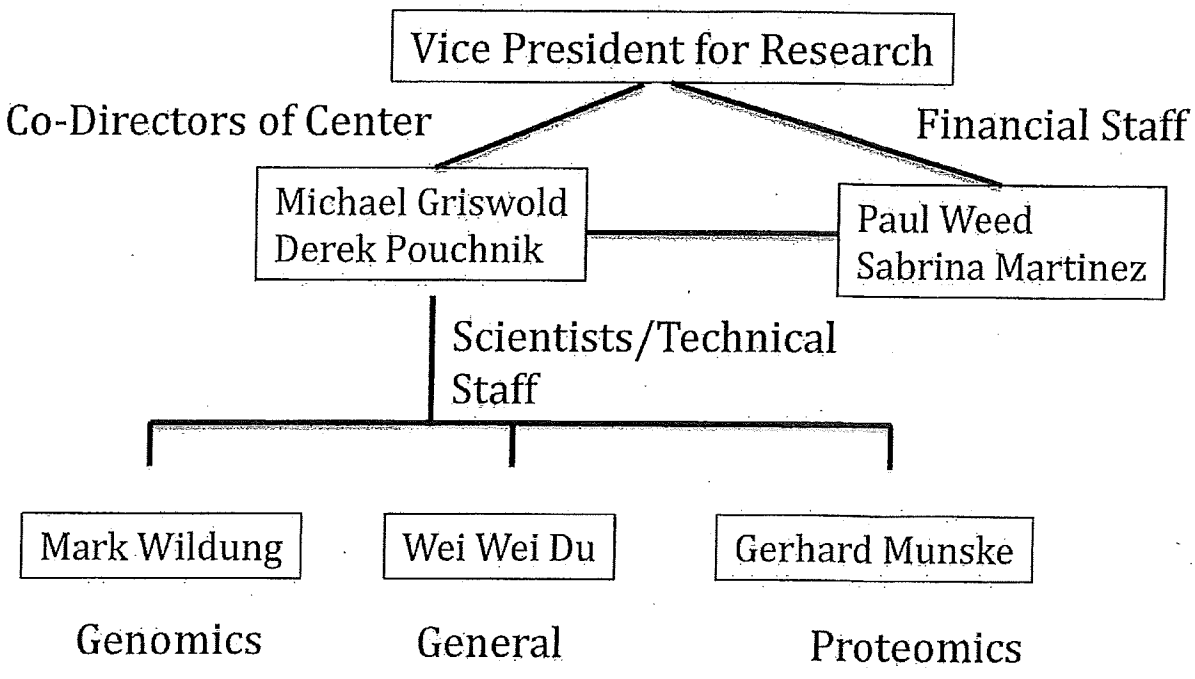
A founding group of scientists correctly predicted in 1986 that the techniques of protein sequencing, DNA synthesis and sequencing, and peptide synthesis would be of increasing importance in biological research and pointed out the need for a central research laboratory at WSU to perform analytical services. This initial idea led to a proposal in 1987 to the M. J. Murdock Foundation for funds to obtain the necessary equipment. This proposal was funded in 1988 and was supplemented with additional funds from NIH to found the laboratory. The Laboratory for Biotechnology and Bioanalysis (LBB) was created in 1988 and originally consisted of 3 separate units (LBB-1, LBB-2, LBB-3) designed to provide analytical services to research scientists across the campus. LBB-3 carried out amino acid analysis and that service was eventually folded into LBB-2 that carried out peptide and oligonucleotide synthesis. Now most of those services have become outmoded and only the unit previously termed LBB-1 remains.

The laboratory is currently identified as a core lab engaged by the Office of Research to support the University's mission for research. The directors of LBB partner with the Office of Research and other academic units to strategically obtain major research equipment and to build the research infrastructure designed to support faculty efforts in attracting sponsored program funding. Currently there are two co-directors for the laboratory. Professor Michael Griswold, a founder of the laboratory, serves as co-director with Derek Pouchnik who has been employed by LBB for 17 years. ***(See Attachment # 3 and # 4 for Directors' vitae.)*** Dr. Griswold has expertise in the needs of the research community. Mr. Pouchnik has expertise in the technical aspects of the laboratory functions. There are two scientists, Mark Wildung and Gerhard

Munske, and one research intern, Weiwei Du. Mr. Wildung is involved with enabling of genomics projects utilizing next generation sequencing. Mr. Munske continues operations involving analysis of mass spectrum measurement for both biomolecules and small synthetic agents. Ms. Du provides general technical laboratory assistance and testing. For the Spring 2013 semester, LBB also employed a Ph.D. student by providing a graduate research assistantship position with tuition waiver. This position has supported Mr. Wildung in bioinformatics development. The Office of Research provides administrative staff support from the Fiscal Analyst 3 and Director for Administrative Services. Specifically, they assist with executing business activities to make the laboratory financially stable, including the coordination of finance and accounting activities, equipment acquisition and infrastructure purchases, review of grant and contract proposals/awards, and personnel related administration.

In addition to supporting individual WSU faculty research, members of the Center for Reproductive Biology (CRB) also receive services from LBB. The CRB is an inter-institutional program involving sixteen departments and seven colleges at Washington State University and the University of Idaho interested in reproductive biology research. It is partially supported by funds from the Washington State Legislature for an Advanced Technology Initiative (ATI). Some of these resources are used to support LBB operations.

Organizational Chart



Organizational Resources

The current LBB carries out analysis on a fee for service basis and is subject to review annually by the Controller's office. Fees are charged for services to recover costs, which include advanced microchips & reagents, maintenance and service level agreements, other equipment costs, and to partially pay the salaries/benefits of the scientific staff.

The current equipment in the laboratory has been obtained through NIH grants, support from the Vice President for Research, and some contributions have been made by the College of Veterinary Medicine and the College of Arts and Sciences.

Revenue from fees for service are primarily derived from Principle Investigator grant and contracts already established with accounts at WSU.

Director Dr. Griswold salary is budgeted by the School of Molecular Biosciences resources. Director Derek Pouchnik's salary is budgeted from both fees charged for various services and from temporary annual allocation resources provided by the Office of Research. Gerhard Munske's salary is partially budgeted with Permanent Base Line resources. Mark Wildung's salary is supported from the Office of Research temporary annual allocations. Weiwei Du's salary is budgeted from fees charged for various services. The Office of Research administrative support staff does not derive any salary or resources from LBB.

LBB is currently housed in the Biotechnology and Life Sciences building in rooms 127 and 227. The size is adequate for our current needs. There are three servers hosted in the Information Technology building for data hosting, backup service and server management.

Services and Major Instrumentation:

- Sanger DNA sequencing and fragment analysis: DNA samples are analyzed on an ABI3730 DNA Analyzer providing single read sequence data and DNA sizing.
- Microarray services: RNA samples are processed and analyzed using two different microarray platforms. Either the Affymetrix platform or the Packard Biosciences 300XL platform. Each provides gene expression data.
- Real Time PCR: ABI 7500 Fast real time PCR instruments are also available for validation of gene expression studies.
- Protein Sequencing: Protein sequencing services are performed on a Bruker HTC-Ion Trap Mass Spectrometer.
- Accurate Mass Analysis: Accurate mass analysis service is performed on an ABI MALDI-TOF/TOF mass spectrometer.
- Peptide Synthesis: Peptide synthesis service is performed on an ABI 480 paptide synthesizer.
- Next Generation DNA sequencing: Three major instrumentation platforms are available for next generation DNA sequencing providing services for whole genome sequencing, RNAseq, metagenomics and more. These platforms are the Pacific Biosciences RS system, the Ion Torrent Personal Genome Machine, and the Roche GS FLX.

Listing of those users not associated with LBB

LBB continuously provides services for several different WSU colleges and departments that are not associated with LBB.

These include:

- **The College of Arts and Sciences:**

-Department of Chemistry
-Department of Anthropology
-School of Biological Sciences

- **The College of Agricultural, Human and Natural Resource Sciences:**

-Department of Animal Sciences
-Department of Biological Systems Engineering
-Department of Crops and Soils Sciences
-Department of Entomology
-Department of Food Sciences
-Department of Horticulture and Landscape Architecture

- **The College of Veterinary Medicine:**

-The Department of Veterinary Clinical Sciences
-Paul G. Allen School for Global Animal Health
-Department of Veterinary Microbiology and Pathology
-Department of Veterinary and Comparative Anatomy, Pharmacology and Physiology
-School of Molecular Biosciences

Outside the WSU main campus LBB also provides services for several WSU branch campuses as well as other universities and private industry:

These include:

- **WSU Branch Campuses:**

-WSU Vancouver
-WSU Tri-Cities
-WSU Spokane

- **WSU Agricultural Research Stations:**

-Prosser, WA
-Mount Vernon, WA
-Wenatchee, WA

- **Other Academic Institutions (within the last year):**

-N.C. State University
-University of Colorado
-North Dakota State Universtiy – Fargo
-Stanford University
-Simon Fraser University, BC, CA
-University of British Columbia, BC, CA
-Oklahoma University

- **Non-Academic or Private Industry:**

-Novozymes Inc.
-Amplicon Express

ATTACHMENT # 1 WSU DEPARTMENTS SERVED SINCE 2008

Agricultural Research Center

Animal Sciences

Center for Reproductive Biology

Bioengineering

Biological Systems Engineering

Chemical Engineering & Bioengineering

Chemistry

Chronic Illness Research Center

Crop and Soil Sciences

Center for Sustaining Ag-Nat Resources

Horticulture

Entomology

Institute of Biological Chemistry

Paul G. Allen SGAH

USDA-ARS Plant Introduction & Testing

School of Molecular Biosciences

School of Biological Sciences

School of the Environment - CAHNRS

School of Electrical Engineering & Computer Science

Veterinary Clinical Sciences

Veterinary and Comparative Anatomy, Pharmacy, Physiology

Veterinary Microbiology & Pathology

College of Veterinary Medicine

WSU Mount Vernon Research and Extension Unit

WSU Prosser Irrigated Agriculture Research & Extension Center

WSU Tri-Cities

WSU Vancouver

WSU Wenatchee Tree Fruit Research & Extension Center

WWAMI Medical Education Program

Plant Pathology

ATTACHMENT # 2 INDIVIDUAL RESEARCHERS SERVED IN 2012

The following is a comprehensive list of all researchers using LBB during 2012.

DNA Sequencing and Fragment Analysis 2012		
PI	**CRB**	**# Samples**
Amplicon Express	X	210
Ahring		58
An	X	373
Baszler		4
Besser		3695
Black		168
Brayton		11
W. Brown		44
Browse	X	78
Burke		51
Busch	X	156
Call	X	4
Cousins		16
Chandra		24
S. Chen		1
W. Chen		78
X. Chen		14
Coyne		24
Crespi		10
M. Davis		72
Bill Davis		12
Dong		12
Edwards		196
Gang		446
Gloss		55
Griswold	X	18
Hellman	X	145
Her	X	168
Hines		172
Hufford		2686
Hunzicker-Dunn	X	136

Jiang	X	352
Kahn		303
Kang		180
Kim	X	5
Kleinhofs		310
Knoblauch	X	70
Knowles		42
Konkel		9
Kostyukova		5
kyriss		15
LCSC-Shuttleworth		1
Lau		85
Lavine	X	235
Lewis		540
James Cook Univ-Schwarzkept		744
McCubbin	X	142
K. Mealey		8705
B. Mealey		136
Moffett		400
Morris		40
Muralidharan		4
NCSU-K. Meurs		350
Neibergs	X	34
Nilson	X	40
Noh		5
Oatley	X	3
O'Rourke		1121
PNL		202
Peace		1344
Poovaiah	X	215
Roalson	X	2107
Shah		534
M. Skinner	X	74
Sischo		1315
Spencer	X	86
Storfer		3866
Steber		12

Suarez		45
Tegeder	X	17
Thomashow		10
Thorgaard	X	320
Ul-Z. Hong	X	631
Ul-R,Briones		12
Ul-Arrizabalaga	X	36
Ul-Cole	X	35
Ui-Johnson	X	199
Ul-Nagler,J	X	12
Ul-Minnich		19
Ul-Hartzell		19
Wayman		225
Watts	X	42
VMRD		38
Varnum		22
Wettstein	X	2053
White		8405
WSU-Prosser-Oraguzie		16
WSU-Prosser-Rayapati		43
WSU-Prosser-Grove		50
WSU-Wenatchee-Xiao,ChangLin		177
Wyrick	X	708
Users 91	**CRB - 31**	**45,902**

Peptide Synthesis - 2012		
PI	**CRB**	**Samples**
Kahn		2
Harding		4
Total 6		**6**

HTC-Ion Trap Mass Spec - 2012		
PI	**CRB**	**Samples**

Black		2
Browse	X	14
Besser		1
Kumar		1
Ul-Cole	X	11
Davis VMP		5
Weller		2
Kostylukova		2
Powers		14
Kahn		1
Kang	X	4
Dahl		24
Wang		1
Neff		1
Hadwiger		2
Total 15	**CRB-3**	**85**

ABI Maldi TOF/TOF Mass Spec - 2012		
PI	**CRB**	**Samples**
Tang		2
Wang		2
Black		16
Weller		2
Berkman		229
Kahn		105
Powers		8
Garner		23
Dong		68
Kang	X	2
Kostylukova		2
Schmidt LCSC		1
Total Users 12	**CRB 1**	**Total 460**

Microarray Users 2012		
PI	**CRB**	**Samples**
Mike Griswold	X	66
Tom Spencer	X	103
Kwan Hee Kim	X	6

John Oatley	X	6
Mark Lange	X	9
James Pru		6
John McNamara	X	48
UI-Peter Fuerst	X	16
UN-Reno-Wei Yan		19
Total Users 9	**7**	**279 Samples**

Roche 454 GS FLX Users 2012		
PI	**CRB**	**Runs (fractional plates)**
K. Brayton		1 1/5
WSU-Vanc.-R. Phillips	X	1/5
B. Schroeder		1/5
M. Konkel		1/5
T. Murray		1/5
L. Lavine	X	1
Total Users 6	**CRB 2**	**Total Runs 3**

Ion Torrent Users - 2012		
PI	**CRB**	**Runs**
T. Spencer	X	1
M. Hunzicker-Dunn	X	10
D. Call	X	8
J. Browse	X	2
J. Watts	X	4
A. Kleinhoffs		2
NDSU-R. Bruggeman		7
D. Shaw		4
M. Konkel		1
M. Kahn	X	2
WSU-Van.-A. Coffin		4
Amplicon Express	X	5
T. Hassold	X	4
Total Users 13	**8**	**Total Runs 54**

Pacific Biosciences Users 2012			
PI	**CRB**	**Projects**	**SMRT Cells**
D. Main		1	35
A. Dhingra		4	64
G. Edwards		1	8
K. Lahmers		8	72
Amplicon Express	X	1	1
UC-T. Castoe		2	15
L. Carris		1	4
B. Schroeder		2	12
L. Thomashow		1	28
K. Brayton/Abi		1	8
USDA-Albany		6	9
UBC-J. Boellman		1	50
UC-Berkley-D. Bachtrog		1	7
Novozymes Inc.		1	2
SalveReginaUniv. -J.D.Swanson		1	7
M. Konkel		1	7
J. Stanton		3	3
UA-D. Kudrna		2	4
SFU-J. Rodriguez		1	4
NDSU-R. Bruggeman		4	11
C. Coyne		1	27
Total Users-21	**CRB-1**	**Total-43**	**Total-378**

Agilent 2100 Users - 2012		
PI	**CRB**	**# Runs**
Cousins		2
Dhingra,A		32
Lange, M		3
Skinner, M	X	6
Griswood	X	2
Gill		3
Edwards,G		1
Hassold	X	1
Hulbert		1
Hunt		1

Hunzicker-Dunn	X	10
McNamara		5
Karatsoreos		1
Kim	X	6
Kleinhofs		1
Nilson	X	10
Oatley	X	2
See		15
Skinner,D		1
Spencer	X	26
Total Users 20	**CRB 8**	**Total Runs 129**

Real Time PCR

PI	
Konkel	Nilson
Skinner	White
Haseltine	An
Spencer	Hunzicker-Dunn
Kim	Lange
Neff	Watts
Kemp	Griswold
Total Users 14	**CRB Members 8**

ATTACHMENT # 3 CURRICULUM VITAE for CO-DIRECTOR

MICHAEL D. GRISWOLD

Place of Birth: Norman, Oklahoma Marital Status: Married

Date of Birth: February 17, 1944 Children: 3

Education:
University of Wyoming, Sept., 1962 to Jan., 1964
University of Wisconsin, Feb., 1964 to Sept., 1964
University of Wyoming, Sept., 1964 to Sept., 1966, B.S. in Chemistry
University of Wyoming, Sept., 1966 to June, 1969, Ph.D. in Biochemistry

Positions Held:
Aug 15, 2008-present Regents Professor of Molecular Biosciences
July 1, 2003- June 30, 2010 Dean, College of Sciences
July 1, 2002- June 30, 2003 Interim Dean, College of Sciences
July 1, 1999 - June 30, 2002, Director, School of Molecular Biosciences: Biochemistry, Biophysics, Cell Biology, Genetics, Microbiology.
August 15, 1995-August 14, 1998 Edward R. Meyer Professorship in Science
August 15, 1990- August 15, 1994 , Chairman, Department of Biochemistry and Biophysics, Washington State University, Pullman, Washington
July 1, 1989- July 30, 1990 Acting Dean, Division of Sciences, Washington State University, Pullman, Washington
August 15, 1986- June 30, 1989 Chairman, Program in Biochemistry /Biophysics, Washington State University, Pullman, Washington
August 15, 1984-April 14, 1986 Associate Chairman, Department of Chemistry, WSU
August 15, 1984- present Professor of Biochemistry
September 15, 1981 Associate Professor of Biochemistry and Basic Medical Sciences
September 15, 1976 Assistant Professor of Biochemistry and Basic Medical Sciences (WAMI), Washington State University, Pullman, Washington.
August, 1974-July, 1976 Research Associate in Laboratory of Dr. Irving Fritz, C. H. Best Institute, University of Toronto, Toronto, Canada.
July, 1973-July, 1974 Assistant Professor of Pharmacology, Baylor College of Medicine, Houston, Texas.
September, 1972-August, 1973 EMBO Postdoctoral Fellow, Laboratory of Cell Biology, Rome, Italy in Laboratory of Dr. Glauco P. Tocchini-Valentini.
September, 1969-August, 1972 NIH Postdoctoral Fellow, Department of Physiological Chemistry, University of Wisconsin, Madison, Wisconsin in the laboratory of Dr. Philip P. Cohen.

Research Interests: For the past several years my research interests have centered on investigations of the function of Sertoli cells in spermatogenesis. Sertoli cells are the somatic cells of the testis which interact with and regulate the development of germinal cells into spermatozoa. Sertoli cells are secretory cells and their secretory products may be a very important part of the overall biological function of these cells. We utilize the techniques of modern protein biochemistry, cell biology and molecular biology in these studies. Much of the current work involves the cloning and sequencing of important hormone-responsive Sertoli cell gene products.

Active Grants:

HD 10808 continuous from July, 1977 to 2/28/13 current year 34 (MERIT awarded 1996) Hormonal Control of the Maturation of Sertoli cells M. D. Griswold, P.I. The current goals of this grant are to determine the role of Vitamin A in the onset and maintenance of the cycle of the seminiferous epithelium. Current renewal received 4.2%tile.
U54 42454 July 1, 2002- August 1, 2016 Male Contraception Center, William Bremner, PI, Griswold sub-contract Project 2 This project continues our work on retinoic acid and the action of BDADs.
1 R21 HD067775 April 2011- March 2013 The Role of Retinoic Acid-regulated microRNAs in Spermatogonial Differentiation M Griswold and M. Tong co-PIs, This R21 is to examine the role of the Let 7 family of miRNAs in spermatogonial differentiation.

Honors, Awards and Appointments:
N.D.E.A. Predoctoral Fellowship, 1967-1969
N.I.H. Postdoctoral Fellowship, 1969-1972 (P.H.S.)
E.M.B.O. Postdoctoral Fellowship, 1972-1973 (European Mol. Biol. Assoc.)
N.I.H. Career Development Award, 1979-1984
N.I.H. Reproductive Biology Study Section, reviewer, June, 1982
N.I.H. Reproductive Biology Study Section, 1983-1987
N.I.H. Biochemical Endocrinology Study Section, ad hoc, Jan. 1993
Society for the Study of Reproduction, Board of Directors, 1989-92
Testis Workshop, 1993, Program Committee
Society for the Study of Reproduction, Program Committee for 1992
WSU-College of Arts and Sciences Faculty Achievement Award, May 1992.
Alexander Nalbandov Lecturer, U. of IL, 1993
American Society of Andrology, Education Policy Committee, 1993
WSU-Distinguished Faculty Address- 1994
Andrology Society- Serono Lecturer, March 1994
Society for the Study of Reproduction, Program Committee, 1995
Testis Workshop, Program Committee, 1995
Second International Clusterin Workshop- Chairman and organizer-Sept. 1994
Andrology Society- Program Chairman, 1996 meeting
Edward R. Meyer Professorship in Science, WSU, 1995-1998
N.I.H. MERIT Award, April 1997
NIH Reprod. Biol. Study Section 1997-2001
Society for the Study of Reproduction- program chair for 1998 annual meeting
Society for the Study of Reproduction- President elect 1997-98
University of Michigan, Program review of Reproductive Biology, Dec. 1997
Society for the Study of Reproduction- President 1998-99
WSU Sahlin Excellence in Research Award- 1999
Testis Workshop Program Committee- 2000
Andrology Society of America, Board of Directors member, 2000-2003
Larry Ewing Lecture, Johns Hopkins Univ., October 2001
Visiting Scholar, Melbourne, Sidney, Brisbane Australia,Nov. 2005
Society for the Study of Reproduction, research award, 2006
Testis Workshop Program Chair, Tampa, FL April 2007
Asdell Lecture, Cornell University, April2, 2008
Frontiers in Reproduction Beacon Award, June 14, 2008 Woods Hole, MA
WSU Eminent Faculty Award (highest faculty honor at WSU)
AAAS Fellow- 2009

Society for the Study of Reproduction Carl Hartman Award 2013

Editorial Review:
Editorial board member- Endocrinology 11/87-6/91, Journal of Andrology, 1990-1993, Biology of Reproduction, 1990-1995, Endocrine Journal, 1993-1998, Mol. Cell. Endo. 1996- 1998, Molecular Cellular Endo. 1997-2001, Spermatogenesis, 2010- current. Ad hoc reviewer for Analytical Biochemistry, Endocrinology, Journal of Reproduction and Fertility, Journal of Gamete Research, Biochimica Et Biophysica Acta., Proc. Nat. Acad. Sci., Science, J. Biol. Chem.

Invited Addresses at Major Meetings and Colloquia:
Gordon Conference on Mammalian Genital Tract, 1980, invited speaker
Gordon Conference, Embryogenesis and Gametogenesis, 1982, invited speaker
Testis Workshop, at NIH, October, 1983, invited speaker
FASEB Conference on Vitamin A, Saxton's River, Vermont, June, 1984, invited speaker
FASEB Annual Meeting, April 21-26, 1985, Anaheim, invited speaker (2 symposium talks)
Reproductive Biology Study Section Workshop, October, 1985, invited speaker, Bethesda
Gordon Conference on Embryology and Gametogenesis, August, 1986, invited speaker
NIH Testis Workshop, Bethesda MD. invited speaker, Dec. 1988
Serono Symposium, Seillac, France, invited speaker, May, 1989.
Serono Symposium, Rome, Italy, invited speaker, April. 1990
Gordon Conference on Gametogenesis, summer, 1990, invited speaker
Serono Symposium, Oct. 1990, Northwestern Univ., invited speaker
Soc. for Study of Reprod.- July 1990-symposium speaker
NIH Workshop on Molecular Endocrinology, Feb. 1991, invited speaker
Laurentian Hormone Conference, Puerto Rico, Nov. 1991, invited speaker.
Endocrine Society annual meeting, June ë92, symposium speaker
IX Ovarian Workshop, Chapel Hill, NC.July ë92 invited speaker
First Clusterin Workshop, Cambridge, England, Sept. 1992, invited speaker
Fifth International Congress of Andrology, Tokyo, Japan, May 1993, invited colloquium speaker
Serono Testis Workshop, Tampa, FL, April 1993, invited speaker
A. Nalbandov Lecture, University of Ill., April 1993
Society for the Study of Reproduction, speaker, Fort Collins, CO, August 1993
Cell and Molecular Biology of the Testis, Majorca, Spain, September, 1993, invited speaker
American Society of Andrology, Serono Keynote Lecturer, April 1994, Springfield, IL.
Gordon Conference on Reproductive Tract, invited speaker, 1994
Society for the Study of Reproduction, President's symposium speaker, August 1994. Ann Arbor, MI
The Germ Line Conference, NIH, Nov. 1994, invited speaker
Second International Androgen Workshop, Feb. 1995, Long Beach, CA. Invited speaker
Faseb Meeting symposium speaker April 1996
Society for Study of Reproduction Annual Meeting, minisymposium speaker, August 1997
Gordon Conference on Reproductive Tract Biology- summer 1998
Woods Hole Frontiers in Reproduction Symposium- summer 1998
Gordon Conference on Clusterin and Apo J, Keynote speaker, Jan. 1999
Testis Workshop-Serono Symposium- April 1999
NICHD Workshop on Male Contraception- September 1999 invited speaker
American Society of Reproductive Medicine- annual meeting, September 1999
Society for Gynecologic Investigation, Technology Symposium, Feb. 2000
Andrology Society of America, annual meeting April 2000
Gordon Conference on Gametogenesis, Invited speaker, July 2000
Gender Differences in Reproductive Biology and Toxicology, Tucson, AZ, Nov. 2000, invited Speaker
Population Center, Rockefeller University, outside reviewer, March 2001

Endocrine Society Annual Meeting, invited speaker, June 2001
Department of Physiology, Southern Illinois University, external reviewer, Nov. 2001
European Testis Workshop, April 2002, Netherlands, invited speaker
Gordon Conference on Gametogenesis, July 2002 invited speaker
Gordon Conference on Reproductive Tract, July 2002, session chair.
Testis Workshop, March 2003, Phoenix. Keynote Address
Institute of Medicine Symposium on Contraception, July 15,16.2003 Washington DC, invited speaker.
NICHHD, Reproductive biology symposium, Sept. 2003 Bethesda, invited speaker
Gordon Conference on Gametogenesis, June 2004, session chair
Society for the Study of Reproduction Annual Meeting, Invited Speaker, August 2004
Testis Workshop, vice-chair 2005
International Andrology Society, Seoul, Korea, Invited Speaker, June 2005
Testis Workshop Chair, 2007.
ARC Visiting Scholar, Melbourne, Brisbane and Newcastle Australia, Nov. 8-30 2005
Australian Society of Medical Research, Couran Cove, Queensland, Nov 20-24 2005 invited speaker
Endocrine Society, Annual Meeting, Boston, MA, invited symposium speaker, June 2006
American Society of Reproductive Medicine, New Orleans, Oct. 2006
Keystone Conference, February 2007, invited speaker
Society for the Study of Reproduction annual meeting, President's symposium, San Antonio, August 2007.
Keystone Conference, February 2009 speaker
2009 AAAS Fellow
Frontiers in Reproduction, Woods Hole, MA. May 2009 Invited lecture
Andrology Society, symposium speaker, March 2010
Gordon Conference on Gametogenesis and Embryogenesis, August 2011 Keynote
Testis Workshop, Benchmark Lecture April 2013
Carl G. Hartman Award 2013, SSR's highest award is given in recognition of a research career and scholarly activities in the field of reproductive biology
Osborne Lecture UKMC, April 2013

Invited Departmental Seminars:
Oregon Regional Primate Center, March, 1978
University of Idaho, March, 1978
WSU Animal Sciences Department, 1979
University of Minnesota, Department of Anatomy, May, 1980
Colorado State University, Department of Physiology and Biophysics, May, 1981
University of Wyoming, Department of Biochemistry and Physiology, May, 1981
Texas Tech, Department of Anatomy, October, 1981
Vanderbilt University, Population Center, April, 1983
University of New Mexico, April, 1983
Johns Hopkins, Department of Uro. Obs. and Gyn. and Pop. Dynamics, October, 1983
University of Virginia, Department of Anatomy, February, 1985
University of Texas at Houston, October, 1985, Department of Biochemistry
Georgetown University, Department of Anatomy, February, 1986,
Pennsylvania State University, Department of Biochemistry, February, 1986
Colorado State University, Department of Physiology and Biophysics, November, 1986
Texas Tech University, Reproductive Biology Program, November, 1986
University Texas Health Science Center, Dallas, Department of Physiology, Nov, 1986
University of Michigan, Reproductive Sciences, March 1987
Univ. Cal. San Diego, Reproductive Biology, April, 1988
Calif. Institute of Tech., Dept. of Biology, April 1988

Vanderbilt University, Reproductive Biology, Dec. 1988
Northwestern University Medical School, Feb. 1990
University of Missouri, Dept. of Animal Sciences, March 1990
University of Southern Illinois, Department of Physiology, March 1990
EPA, Research Triangle, North Carolina, March 1990
University of Washington, Seattle, Reprod. Physiol. Program, Oct. 1990,i
University of Toronto, C.H. Best Institute , April 1991
University of Kentucky, Endocrine symposium, May 1991.
University of Idaho, Dept. Biochemistry/Physiol., Aug. 1991
University of Cincinnati, Dept. Pharmacology/Cell Biophysics, March 1992
University of Toronto; Hospital for Sick Children, March 1992
University of Pittsburgh, Center for Reproductive Biology, March 1992.
University of Iowa, Dec. 1992
University of California, San Francisco, Center for Reproduction, Dec. 1992
Oregon Regional Primate Research Center, Jan. 1993
Rockefeller U., Population Council, New York City, Nov. 1993
University of California, Davis Reproductive Biology Program, Dec. 1993
Northwestern University, April, 1994
University of Kansas Medical Center. April 1994
Johns Hopkins University, Division of Reproductive Sciences, March, 1995
University of Michigan Trainee Invited Speaker, April, 1995.
University of Virginia, Reproductive Sciences, Sept. 1995
Population Council, Rockefeller U., Oct. 1997
Center for Reproduction, Stanford Univ., Nov. 1997
University of Nebraska Biotechnology Center, Feb. 1998
Clay Center, USDA, Lincoln, Nebraska, Feb. 1998
University of Pennsylvania, Feb. 1999
UCLA Harborview , May 1999
Texas Tech University, April 1999
Northwestern Univ., March 2002
Baylor College of Medicine, May 2002
University of Kansas Medical Center, Feb. 2005.
University of Pennsylvania Medical School, Oct. 2005
Monash Institute of Medical Research, Melbourne, Aus. Nov. 2005
University of Newcastle, Aus. Nov. 2005
University of Brisbane, Aus. Nov. 2005
Clark Atlanta University, March 2006
University of Pittsburgh, March 2007
University of Minnesota, April 2007
University of Nevada, Reno, September, 2009
Southern Illinois University, Bially lecture, March 2010
University of Hawaii, May 2012
McGill University, June 2012

Professional Societies:
N.Y. Academy of Sciences, 1969-1978
Society for Developmental Biology, 1975-1977
Endocrine Society, 1976-present
American Society of Cell Biology, 1976-present
Society for the Study of Reproduction, 1981-present
American Society of Biological Chemists, 1984-present

Andrology Society, 1988-present

Teaching Experience:
BC/BP 364, Basic Biochemistry. Taught 1/3 of course with 200 students for 3 years.
Currently teach 1/3 of this course every other year.
BC/BP 561, Biochemical Signalling. Taught every other year for graduate students. I currently teach about 1/2 of this course and serve as course chairman.
Basic Medical Sciences. Biochemistry for first-year medical students. Taught this course for 10 years.
BC/BP 565/566, Molecular biology I and II. Gave 1/3 of course in 1993-94.
BC/BP 563 Basic Biochemistry 1/3 of course for majors and graduate students

Graduate Students :
MS:
Charles Kissinger, M.S., 1982, "Analysis of Sertoli Cell Secreted Proteins by Two-Dimensional Gel Electrophoresis"
Tracy Lloyd M.S., "Role of the Inr and Methylation in the Promoter of the FSH Receptor" 1996
Kris Graf, M.S., 1997, Autoimmunity and the Rat Follicle Stimulating Hormone Receptor
Cara Plata, MS "Structure and function of the FSH receptor"1999
Elizabeth Wolkenhauer, M.S. "HMGI and Spermatogenesis" 2000
Krista Fuhrman, MS 2001 "Clusterin Function During mammary involution"
Crystal Putnam, MS 2007

Ph.D
1. James Merryweather, Ph.D., 1981 "Hormone Stimulation of Cultured Sertoli Cells: An Examination of RNA Synthesis and Cell-Free Translation Products"
2. Michael Skinner, Ph.D., 1983, "Structure and Secretion of Testicular Transferrin"
3. JoAnne Marzowski, Ph.D., 1983, "Characterization of Sertoli Cell Plasma Membranes"
4. Steve Sylvester, Ph.D., 1983, "Localization and Function of Sertoli Cell Secretion Products in the Rat Testis"
5. Jodi Huggenvik, Ph.D., 1984, "Molecular Cloning of Rat Transferrin cDNA and Regulation of Transferrin mRNA in the Testis"
6. Suzanne Hugly, Ph.D., 1986, "Regulation of Levels of Specific Sertoli Cell mRNA's by Vitamin A and Hormones"
7. Michael Collard, Ph.D, 1987, "Biosynthesis and Molecular Cloning of Sulfated Glycoproteins 1 and 2 Secereted by Rat Sertoli cells"
8. Ken Roberts, Ph.D, 1990, "Testosterone and Transferrin Receptor in Spermatogenesis"
9. Robert Gilmont, Ph.D, 1990, "Transferrin in Bull Sertoli cells and in Bull Semen"
10. Barbara Stallard, Ph.D, 1990, "Regulation of Gene Expression During Spermatogenesis"
11. Leslie Heckert, PhD, 1991, ìStructure and Expression of FSH Receptor Geneî
12. Jim Tsuruta- PhD 1991, ìCharacterization of Two Secreted Sertoli cell Proteins: Sulfated Glycoprotein 2 and Cystatin Cî
13. Lynn Law- PhD 1992 "Characterization of SGP 2 in Physiological Fluids and the Analysis of Apolipoproteins E and A1 in the Male Reproductive Tract"
14. Insuk Han- PhD 1993 " Basic FGF and FGF Receptor Involvement in Testicular Cell-Cell Interactions and Expression of FSH Receptor and SGP-2 Fusion Proteins"
15. Tamara Goetz- PhD 1995, "Characterization of the FSH Receptor Promoter"
16. Elena Lymar, Ph.D, 1998 "Sertoli cell Specific Regulation of the Clusterin Gene Expression in the Rat Testis"
17. Walter Tribley, PhD, 1998 ìHomologous Regulation of the Follicle Stimulating Hormone Receptor Gene in Sertoli Cellsî
18. Jeong-Seon Kim, Ph.D 1999 "Cell specific regulation of the follicle stimulating hormone receptor

gene in Sertoli cells"
19. Matt Anway, Ph.D 2000, "Sertoli and germ cell specific gene transcription"
20. Robert Bailey, Ph.D, 2000 "Role of Clusterin in male reproduction"
21. Patricia Sadat, Ph.D 2003 "Testosterone and FSH Action in Reproduction"
22. Ted Chauvin, Ph.D 2004 "Gene array analysis of the epididymis and inositol biosynthesis in the testis."
23. Elizabeth Snyder. Ph.D 2010 "Retinoic acid regulation of spermatogenesis in the mouse"
24. Elizabeth (Lisa) Balconi Evans, Ph.D, anticipated 2014
25. Travis Kent Ph.D
26. Kelly O'Rourke, Ph.D

Postdoctoral Fellows and Research Associates:
Wes Cosand, Research Associate, 1981-1983
Carlos Morales, Postdoctoral Fellow, 1985-1987
Ping Ren, Visiting Scholar from China, 1986-1987
Jes Siiteri, Postdoctoral Fellow, 1987- 1989
Paul Bishop, Research Associate, 1983-1987
Steve Sylvester, Research Associate, 1983-1985
Kwan Hee Kim, Research Associate, 1987-1989
Monny Choongkittaworn, Postdoctoral Fellow, 1989-1993
Carol Linder, Postdoctoral Fellow, 1990-1994
Michael McGuinness, Postdoctoral Fellow. 1991-1996
Sharon MaGuire, Postdoctoral Fellow, 1994 -1995
Ann Clark, Postdoctoral Fellow, 1993-1998
Dan Johnston, Postdoctoral Fellow, 1996- 2000
Derick McLean, Postdoctoral Fellow, 1998- 2001
Walter Tribely, Postdoctoral Fellow, 1998-99
Lihua Yang, Postdoctoral Fellow, 2000- 2002
Ying Li. Postdoctoral Fellow, 2000-2009
Richard Lizhong Yang, Postdoctoral fellow, 2000-2009
Matt Anway, Postdoctoral Fellow, 2000-2001
Dong Key Jeong, Postdoctoral fellow, 2001-2003
Chris Hostetler, Postdoctoral Fellow, 2003-2006
Qing Zhou, Postdoctoral Fellow, 2003 to 2008
Cathryn Hogarth, Postdoctoral Fellow, 2007- current
Minghan Tong, Research associate, 2009- current
Vanmathy Kasimanickam, Research associate, 2009-2010
Elizabeth Snyder, Postdoctoral Fellow 2010

WSU Committees:
Advisory Committee on Aging - 1977-1978
Biohazards Committee - 1982-1987(Chairman, 1986-87)
American Cancer Society Institutional Grant Committee –
Radiation Safety Committee - 1981-1983
Biochemistry Program Executive Committee - 1982 to 1986
Undergraduate Coordinator for Program in Biochemistry - 1983-1987
WAMI Director Search Committee-1987
Athletic Director Search Committee, 1993
Distinguished Faculty Address Committee, 1995-96
Faculty Status Committee, 1994-97
Search Committee for IBC faculty, 1995

Plant Physiology graduate review committee 1997
Co-chair, Committee for the Reorganization of Biological Sciences-1997
Chair, Biotechnology Design Team 2000-2001
Sahlin Award Committee 2000-2001
Eminent Faculty Award Committee 2009-

Publications:

1: Griswold MD, Miller GJ. Histones and their modifications during amphibian metamorphosis. Comp Biochem Physiol B. 1971 Jul 15;39(3):445-54. PubMed PMID: 5315898.

2: Griswold MD, Cohen PP. Alteration of deoxyribonucleic acid-dependent ribonucleic acid polymerase activities in amphibian liver nuclei during thyroxine-induced metamorphosis. J Biol Chem. 1972 Jan 25;247(2):353-9. PubMedPMID: 4536680.

3: Griswold MD, Fischer MS, Cohen PP. Temperature-dependent intracellular distribution of thyroxine in amphibian liver. Proc Natl Acad Sci U S A. 1972 Jun;69(6):1486-9. PubMed PMID: 4537638; PubMed Central PMCID: PMC426732

4: Griswold MD, Cohen PP. Thyroxine-mediated control of ribonucleic acid polymerase activity in liver of Rana catesbeiana. J Biol Chem. 1973 Aug 25;248(16):5854-60. PubMed PMID: 4541883.

5: Griswold MD, Brown RD, Tocchini-Valentini GP. An analysis of the degree ofhomology between 28S rRNA from Xenopus laevis and Xenopus mulleri. Biochem Biophys Res Commun. 1974 Jun 18;58(4):1093-103. PubMed PMID: 4834689.

6.Michael D. Griswold, Early Events in the Mechanism of Action of Thyroxine During Metamorphorsis, Medikon, 5 , 27 (1974).

7.Griswold MD, Mably E, and Fritz IB, Stimulation by Follicle Stimulating Hormone and Dibutyryl Cyclic AMP of Incorporation of 3H-Thymidine into Nuclear DNA of Cultured Sertoli Cell-Enriched Preparations from Immature Rats, in "Hormonal Regulation of Spermatogenesis," F. S. French, V. Hansson, E. M. Ritzen and S. N. Nayfeh, eds., Plenum Press, New York, pp. 413-422 (1975).

8. Fritz IB, Louis BG, Tung PS, Griswold M, Rommerts FG, Dorrington JH.Biochemical responses of cultured Sertoli cell-enriched preparations to follicle stimulating hormone and dibutyryl cyclic AMP. Curr Top Mol Endocrinol.1975;2:367-82. Review. PubMed PMID: 195772.

9. Griswold M, Mably E, Fritz IB. Stimulation by follicle stimulating hormone and dibutyryl cyclic AMP of incorporation of 3H-thymidine into nuclear DNA of cultured Sertoli cell-enriched preparations from immature rats. Curr Top Mol Endocrinol. 1975;2:413-20. PubMed PMID: 195775.

10. Griswold MD, Mably ER, Fritz IB. FSH stimulation of DNA synthesis in Sertolicells in culture. Mol Cell Endocrinol. 1976 Feb;4(3):139-49. PubMed PMID: 174964.

11: Fritz IB, Griswold MD, Louis BG, Dorrington JH. Similarity of responses of cultured Sertoli cells to cholera toxin and FSH. Mol Cell Endocrinol. 1976 Aug-Sep;5(3-4):289-94. PubMed PMID: 182580.

12: Griswold MD, Solari A, Tung PS, Fritz IB. Stimulation by follicle-stimulating hormone of DNA synthesis and of mitosis in cultured Sertoli cells prepared from testes of immature rats. Mol Cell Endocrinol. 1977 Apr;7(2):151-65. PubMed PMID: 193747

13: Fritz IB, Louis BG, Griswold MD, Dorrington JH. Paradox of the dose response to polypeptide hormones. Natl Cancer Inst Monogr. 1978 May;(48):381-2. PubMed PMID: 219363.

14: Fritz IB, Griswold MD, Louis BG, Dorrington JH. Metabolic responses of Sertoli cells in culture to various concentrations of follicle stimulating hormone and cholera toxin. Can J Biochem. 1978 Sep;56(9):875-9. PubMed PMID: 215290.

15: Giannetto BO, Griswold MD. Hormone-supplemented medium enhances androgen binding protein secretion in sertoli cell cultures. Horm Metab Res. 1979 Jan;11(1):80-1. PubMed PMID: 311751.

16: Wilson RM, Griswold MD. Secreted proteins from rat Sertoli cells. Exp Cell Res. 1979 Oct 1;123(1):127-35. PubMed PMID: 488176

17: Karl AF, Griswold MD. Actions of insulin and vitamin A on Sertoli cells.Biochem J. 1980 Mar 15;186(3):1001-3. PubMed PMID: 6249257; PubMed Central PMCID: PMC1161741.

18. 17: Karl AF, Griswold MD. Prolonged ABP synthesis by Sertoli cells cultured indefined medium. Cell Biol Int Rep. 1980 Jul;4(7):669-74. PubMed PMID: 6772310.

19: Merryweather JP, Griswold MD. Synthesis of 3H-FSH by cultures ovine pituitary cells. Horm Metab Res. 1980 Feb;12(2):87-8. PubMed PMID: 6768663.

20: Skinner MK, Griswold MD. Sertoli cells synthesize and secrete transferrin-like protein. J Biol Chem. 1980 Oct 25;255(20):9523-5. PubMed PMID:6776100.

21: Huggenvik J, Griswold MD. Retinol binding protein in rat testicular cells. JReprod Fertil. 1981 Mar;61(2):403-8. PubMed PMID: 6782244.

22: Smith BC, Griswold MD. Primary culture of supporting cells from bovine testes. In Vitro. 1981 Jul;17(7):612-8. PubMed PMID: 6276290.

23: Griswold MD, Merryweather J. Insulin stimulates the incorporation of 32Pi into ribonucleic acid in cultured sertoli cells. Endocrinology. 1982 Aug;111(2):661-7. PubMed PMID: 6178581.

24: Kissinger C, Skinner MK, Griswold MD. Analysis of Sertoli cell-secretedproteins by two-dimensional gel electrophoresis. Biol Reprod. 1982 Aug;27(1):233-40. PubMed PMID: 7115849.

25: Skinner MK, Griswold MD. Secretion of testicular transferrin by culturedSertoli cells is regulated by hormones and retinoids. Biol Reprod. 1982Aug;27(1):211-21. PubMed PMID: 6810965.

26. 25: Skinner MK, Griswold MD. Fluorographic detection of radioactivity in polyacrylamide gels with 2,5-diphenyloxazole in acetic acid and its comparison with existing procedures. Biochem J. 1983 Jan 1;209(1):281-4. PubMed PMID: 6847617; PubMed Central PMCID: PMC1154087.

27: Skinner MK, Griswold MD. Multiplication stimulating activity (MSA) can substitute for insulin to stimulate the secretion of testicular transferrin by cultured Sertoli cells. Cell Biol Int Rep. 1983 Jun;7(6):441-6. PubMed PMID: 6411361.

28: Skinner MK, Griswold MD. Sertoli cells synthesize and secrete a ceruloplasmin-like protein. Biol Reprod. 1983 Jun;28(5):1225-9. PubMed PMID: 6871315.

29: Skinner MK, Cosand WL, Griswold MD. Purification and characterization of testicular transferrin secreted by rat Sertoli cells. Biochem J. 1984 Mar 1;218(2):313-20. PubMed PMID: 6712616; PubMed Central PMCID: PMC1153343.

30: Huggenvik J, Sylvester SR, Griswold MD. Control of transferrin mRNA synthesis in Sertoli cells. Ann N Y Acad Sci. 1984;438:1-7. PubMed PMID: 6598316.

31: Sylvester SR, Griswold MD. Localization of transferrin and transferring receptors in rat testes. Biol Reprod. 1984 Aug;31(1):195-203. PubMed PMID: 6087946.

32: Sylvester SR, Skinner MK, Griswold MD. A sulfated glycoprotein synthesized by Sertoli cells and by epididymal cells is a component of the sperm membrane. Biol Reprod. 1984 Dec;31(5):1087-101. PubMed PMID: 6394059.

33.J. Huggenvik, S. R. Sylvester and M. D. Griswold, Control of Transferrin mRNA Synthesis in Sertoli Cells, Annals of NY Acad. Sci. 438, 1-7 (1984).

34.S. R. Sylvester and M. D. Griswold, Rat Sertoli Cells and Epididymal Epithelium Secrete a Protein Found in Mature Sperm, Annals of NY Acad. Sci. 438, 561-562 (1984).

35.M. D. Griswold, J. Huggenvik, M. K. Skinner and S. R. Sylvester, The Interactions of Sertoli Cell Glycoproteins with Germinal Cells in the Testis, in Endocrinology (F. Labrie and L. Prouix, eds.) pp. 619-622. Elsevier Science publishers, New York (1984).

36: Marzowski J, Sylvester SR, Gilmont RR, Griswold MD. Isolation and characterization of Sertoli cell plasma membranes and associated plasminogen activator activity. Biol Reprod. 1985 Jun;32(5):1237- 45. Erratum in: Biol Reprod 1986 Aug;35(1):following 251. PubMed PMID: 2990584.

37: Griswold MD, Collard M, Hugly S, Huggenvik J. The use of specific cDNA probes to assay Sertoli cell functions. Adv Exp Med Biol. 1986;205:301-17. PubMed PMID: 3788717.

38.Bridges, C. D. B., Peters, T., Smith, J. E., Goodman, D. S., Fong, S. L., Griswold, M. D. and Musto, N. A. (1986) Biosynthesis and Secretion of Transport Proteins: Interstitial and Serum Retinol Binding Proteins, Transthyretin, Transferrin, Serum Albumin, and Extracellular Sex Steroid Binding Proteins. Fed. Proc. 45, (9), 2291-2303

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Sertoli Cell Biology (M. Skinner and M. D. Griswold, Eds) Elsevier, San Diego (2005).

ATTACHMENT # 4 CURRICULUM VITAE for CO-DIRECTOR

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Education

1996	M.S., Graduation Date : May, 1996 Department of Biochemistry and Biophysics Washington State University Pullman, WA
1992	B.S., Graduation Date : May 1992 Department of Chemistry Bemidji State University Bemidji, MN

Awards and Honors

1992	Vice President Chemistry Club
1991-1992	Dean's List
1988-1991	Partners in Excellence Scholarship

Publications 7

1. Amy M. Martin, Derek J. Pouchnik, Jennifer L. Walker and John J. Wyrick. Redundant Roles for Histone H3 N-Terminal Lysine Residues in Subtelomeric Gene Repressions in *Saccharomyces cervisiae*. Genetics 167:1123-1132, July 2004.

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Research Experience

DNA: DNA sequencing, Mini-preps, Agarose Gels, Cloning, PCR, Gene expression,PCR, Differential Display, Microsattallite analysis, AFLP, SSCP, RNA analysis. Library preparation for Next Generation Sequencing technologies. DNA fragmentation techniques including shearing and sonication.

Genomics: Affymetrix Microarray processing and analysis, Printing custom arrays, Colony picking, printing Macroarrays, Next Generation DNA sequencing platforms including –Roche 454-GSFLX, Ion Torrent and Pacific Biosciences. Genome assembly, RNA-Seq analysis.

Protein: SDS PAGE, protein isolation/purification, crosslinking, sequence analysis, HPLC, Fluorescence spectroscopy, UV/Vis Spectroscopy.

Current Project

Currently I am Co-Director of the Laboratory for Biotechnology and Bioanalysis (LBB) at Washington State University. LBB is a state-of-the art core laboratory that specializes in providing genomics research services to the WSU research community and beyond. I have been working with this laboratory for over 17 years and during that time I have been instrumental in the evolution of LBB. When I began work at LBB in 1996 the lab performed simple sanger dye-deoxy cycle sequencing providing primarily WSU researchers single read DNA sequence data. Although LBB still performs this simple function on a daily basis the lab has also been incredibly good at keeping pace with new technologies and incorporating them into the services that are provided.

During my time at LBB I have orchestrated the implementation of many new technologies. These include the simple linear upgrade of the Applied Biosystems Genetic Analyzers from low output slab gel analyzers to the newer high throughput capillary systems. Increasing throughput from hundreds of samples per month to thousands.

With funding from the MJ Murdock Charitable Trust in 2001, LBB began providing Microarray analysis to our list of services. I facilitated the installation and incorporation of a complete Affymetrix microarray system as well as a micoarray printing robot and automated array scanner. Although the array spotter has since been outdated I still run and maintain the Affymetrix system and process several hundred microarrays on that platform on an annual basis.

To complement the array work and expression analysis I have also incorporated two real time PCR instruments into our lab services as well.

Most recently, I have assisted the progression of LBB into the field of Next Generation DNA sequencing. With primary funding assistance through the Office of Research at WSU, LBB has incorporated three different Next Generation DNA sequencing platforms into the provided services. These include the Ion Torrent PGM, the Roche 454 GS FLX, and the Pacific Biosciences RS instruments.

Other duties include lab tours and short tutorials for undergraduate and graduate students.