**CURRICULUM VITAE**

University of Idaho

**NAME:** Cain, Kenneth D. **DATE:** August, 16, 2021

**RANK OR TITLE:** Distinguished Professor

**DEPARTMENT:** Fish and Wildlife Sciences

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**DATE OF FIRST EMPLOYMENT AT UI:** November 29, 1999

**DATE OF TENURE:** July 1, 2005

**DATE OF PRESENT RANK OR TITLE:** May 1, 2021

**EDUCATION BEYOND HIGH SCHOOL:**

**Degrees:**

Ph.D., Washington State University, Pullman, Washington, 1997, Animal Sciences (Fish Immunology)

M.S., Michigan State University, East Lansing, Michigan, 1993, Fish and Wildlife (Fish Nutrition)

B.S., Michigan State University, East Lansing, Michigan, 1990, Fish and Wildlife

**EXPERIENCE:**

**Teaching, Extension and Research Appointments:**

2021 - Present, Distinguished Professor (Aquaculture and Fish Health), University of Idaho

2015 - Present, Adjunct Faculty, Center for Reproductive Biology, Washington State University

2011 - 2021, Professor (Aquaculture and Fish Health), University of Idaho

2011 Honorary Research Associate, Australian Maritime College, University of Tasmania

2002 - 2020, Associate Director, Aquaculture Research Institute, University of Idaho

2005 - 2011, Associate Professor (Aquaculture and Fish Health), University of Idaho

1999-2005, Assistant Professor (Aquaculture and Fish Health), University of Idaho

1998-99, Research Scientist (Postdoctoral Research Fellow), University of Technology, Sydney, Australia

1994-97, Graduate Research/Teaching Assistant, Animal Sciences Department, Washington State

University

1991-93, Graduate Research Assistant, Department of Fish and Wildlife, Michigan State University

**Academic Administrative Appointment:**

2002 - 2020, Associate Director (Aquaculture Research Institute), University of Idaho

**Non-Academic Employment including Armed Forces:**

1993-94, Fish Health Technician/Fish Culturist, Clear Springs Foods, Inc., Buhl, Idaho

1989-90, Fish Culturist, Bay Port Aquaculture Systems, Inc., West Olive, Michigan

1988, Biologist’s Aide, Idaho Department of Fish and Game, McCall, Idaho

**Areas of Specialization:**

Conservation Aquaculture

Aquaculture Vaccine Development

Fish Health/Diseases

Fish Nutrition

Fish Immunology/Pathology

Molecular Diagnostics

Proteomics

Aquaculture Development (new species)

**TEACHING ACCOMPLISHMENTS:**

**Courses Taught (UI courses in bold):**

AQU 411 – Fish Diseases (Kentucky State University): provided online guest lecture (invited) for

KSU Fish Disease course highlighting fish vaccines and research. October, 2020

Western Fish Disease Workshop, Flavobacterial Disease Management (invited), June 2019

**Coldwater Aquaculture Workshop, Fish 503**, Summer 2017, summer 2019 Developed for Idaho

Fish and Game training (Co-taught with Dr. Brian Small, Matt Powell, Gary Fornshell, etc.)

Salmon Disease Workshop, Corvalis, OR, July, 2009; July 2013, July 2019 (Participating/invited

instructor): Intensive 2 wk disease course for fish health professionals

Fish Health Management Workshop, August 2018 (Industry focused, Hagerman, ID)

**Fish 498** – Aquaculture Internship, Fall/Spring

**Hatchery/Wild Fish Interactions,** **Fish 525),** Fall Alt yrs (Co-teach with Dr. Dennis Scarnecchia)

Fish Nutrition/Disease Workshop (Mt. Lassen trout farms) 2017

Coldwater Fish Culture Workshop (UI and Hagerman), 2011

Fish Immunology Workshop, Wellington, New Zealand, 2011

Biosecurity workshop, shortcourse/workshop presented to Idaho trout industry, Hagerman, Idaho, Summer 2009

Current and Emerging Pathogens of Fishes in the Pacific Northwest (Workshop presented at annual Idaho Chapter AFS meeting), Boise, ID. Feb. 2007

Coldwater Disease Workshop, Annual extension shortcourse/workshop presented to Idaho trout

industry, Hagerman, Idaho, Summer 2004, 2005

Fish Disease/Health Management, Annual extension shortcourse presented to Idaho trout industry, Hagerman, Idaho, September 2000, August 2001, August 2002

**Fish Health Management, Fish 424**, Spring semesters (alt/yrs as of 2015)

**Concepts in Aquaculture, Fish 422**, Fall semesters through 2007; Spring semesters 2007-2014;

Spring alt/yrs as of 2015

**Current Topics in Fish Health, Fish 494**, Fall alt/yrs (no longer taught)

**Fish Disease Diagnostics and Control, Fish 524**, Fall alt/yrs (no longer taught)

**Sustainable Aquaculture, Fish 504**, Fall 2004 (Co-taught with Dr. Christine Moffitt)

**Directed studies, Fish 499**, Spring/Fall semesters as appropriate

**Fish 398 Aquaculture Internship**, every semester as arranged

Guest presentations annually in **Fish 102**

Served as poster judge and participate in course projects annually for the CNR college capstone course

“**NR 470**”

**Aquaculture and Fish Health, Fish 419**, Spring 2000

**Students Advised:**

Undergraduate Students:

Approximately 50 to completion

Advised during the 2019-2020 academic year: 7 major/program advisees, interacted with 10-

25 on-campus students, interacted with 10 or more former students

Advised during the 2018-2019 academic year: 12 major/program advisees, interacted with 10-

25 on-campus students, interacted with 10 or more former students

Advised during the 2017-2018 academic year: 12 major/program advisees, interacted with 10-

25 on-campus students, interacted with 10 or more former students

Advised during the 2016-2017 academic year: 12 major/program advisees, interacted with 10-

25 on-campus students, interacted with 10 or more former students

Advised during the 2015-2016 academic year: 15 major/program advisees, interacted with 10-25 on-campus students, interacted with 10 or more former students.

Advised during the 2014-2015 academic year: 15 major/program advisees, interacted with 10-25 on-campus students, interacted with 10 or more former students.

Advised during the 2012-2013 academic year: 13 major/program advisees, interacted with 10-25 on-campus students, interacted with 10 or more former students.

Advised during the 2011-2012 academic year: 11 major/program advisees, interacted with 10-25 on-campus students, interacted with 10 or more former students.

Advised during the 2010-2011 academic year: 12 major/program advisees, interacted with 10-25 on-campus students, interacted with 10 or more former students.

Advised during the 2009-2010 academic year: 12 major/program advisees, interacted with 10-25 on-campus students, interacted with 10 or more former students.

Advised during the 2008-2009 academic year: 12 major/program advisees, interacted with 10-25 on-campus students, interacted with 10 or more former students.

Advised during the 2007-2008 academic year: 15 major/program advisees, interacted with 10-25 on-campus students, interacted with 10 or more former students.

Advised during the 2006-2007 academic year: 20 major/program advisees, interacted with 10-25 on-campus students, interacted with 10-25 off-campus students.

Advised during the 2005-2006 academic year: 10 major/program advisees, interacted with 10-25 on-campus students, interacted with 10-25 off-campus students.

Aquaculture Club. (2000-2013) – Faculty advisor

Numerous directed study (DS: 299 or 499) students advised

Undergraduate Research Mentor:

Tifani Watson, Undergraduate Research Grant award recipient, 2019

Anthony Cianciotto, REU student, 2012

Marcy Swain, REU student, 2011

David Burbank, McNair Scholarship, 2008

Graduate Students advised to completion of degree-major professor; 24 grad students (19 completed to-date):

Brent Vuglar, M.S., in progress

Evan Jones, M.S., in progress

Luke Oliver, PhD., in progress

Neil Ashton, PhD., 2021

Moureen Matuha, PhD., in progress

Sinem Gulen, M.S., 2019

Rylee, Smith, MNR, 2019

Marc Terrazas, M.S., 2016

Bikram Ghosh, PhD (University of Tasmania co-advisor), 2015

Tyson Fehringer, M.S., 2013

Neil Ashton, M.S., 2013

Amy Long, Ph.D., 2012

James Barron, M.S., 2011

David Burbank, M.S., 2011

Tarah Johnson, M.S., 2010

Mark Polinski, M.S., 2009

Ben LaFrentz, Ph.D., 2007

Nicole Lindstrom, M.S., 2007

John Drennan, Ph.D., 2006

Christine Swan, M.S., 2006

Nathan Jensen, M.S., 2006

Leslie Grabowski, M.S., 2004

Wade Cavender, M.S., 2003

Ben LaFrentz, M.S., 2002

Served on graduate committee:

Aaron Black (FWS), MS, in progress

Amit Yadav, (AVS), PhD, in progress

Tracy Kennedy, (FWS), PhD, in progress

Jake Bledsoe, (FWS), PhD, 2021

Alexa Maine, (ENS), PhD, 2020

Kristen Meiler, (AVS), MS, 2020

Andreas Brezas, (Animal and Vet Sciences), Ph.D., 2019

Tucker A. Brauer, (FWS), M.S., 2018

Alf Seljenes Dalum (Norwegian School of Veterinary Sciences), 2017

Alejandro Villasante, (Animal and Vet Sciences), Ph.D., 2015

Carla Schubiger, Ph.D., (WSU vet med), 2014

Guro Løkka (Norwegian School of Veterinary Sciences), 2014

Carson Watkins, M.S., (Fish and Wildlife), 2014

Christopher Smith, M.S., (Fish and Wildlife), 2013

Karol Gliniewicz, Ph.D., (WSU vet med), 2012

Tom Loch, Ph.D., (Michigan State University), 2012

Scott Snyder (Animal and Vet Sciences), Ph.D., 2011

Heidi Henuguin (Biology), M.S., 2009

Derek Fryer, M.S., 2008

John Cheng (WSU), M.S., 2008

Shannon Amberg (CSS), Ph.D., 2008

Shannon Miller, M.S., 2007

Ryan Mann, M.S., 2007

Dustene Cummings, M.S., 2007

Johnathan Stodard (Biology), M.S., 2005

Luis Mazuera, M.S., 2005

Peggy Simpson, Ph.D., 2003

Darin Jones, M.S., 2002

Joel Green, Ph.D., 2001

Brian Peterson, Ph.D., 2001

Bill Johnson, M.S., 2000

Cameron Heuser, M.S. 2000

Tim Welker, Ph.D., 2000

Postdoctoral Researchers:

Jia Ma, 2017-present

Tim Bruce, 2017-2020

Sudheesh Ponnerassery, 2003-2008, 2013-2017

Karen Plant, 2006-2011

Tanuja Upadhyaya, 2006

Research Technicians/Lab Managers:

Luke Oliver 2017-present

Joe Evavold, 2013-present

Scott Williams, 2006-present

Dan Korbel, 2017-present

Evan Jones 2019-2020

Pat Blaufuss, 2012-2015

Neil Ashton, 2011-2012

Nate Jensen, 2006-2011

Najeeb Parvez, 2008-2010

Visiting Scholars:

Francis Baleta (Professor and Director, Isabela State University, Philippines) Jan.- June 2017

Jingfeng Sun (Faculty - Tianjin Agricultural University, China), Jan. 2013 –Jan. 2014

Bikram Ghosh (PhD student – University of Tasmania, Australia), Jan. 2013 – Sept. 2013)

Makesh Marappan (Central Inst. of Fisheries Education, India), October 2013-Feb. 2014)

**Materials Developed:**

Broodstock Management, 2020

Western Fish Health Workshop, 2019

Coldwater Aquaculture Workshop, 2017, 2019

Salmon disease workshop (adaptive immunity and Flavobacterial diseases), 2009, 2013, 2019

Fish Nutrition/Disease Workshop (Mt. Lassen trout farms) 2017

Coldwater Fish Culture workshop, 2011

Fish Immunology Workshop/shortcourse, 2011

Biosecurity workshop (notebook/manual and CD), 2009

Current and Emerging Pathogens of Fishes in the Pacific Northwest (notebook/manual and CD), 2007 Coldwater disease extension bulletin (published through Western Regional Aquaculture Center), 2004

Manual for Coldwater disease workshop, 2004

Manual for Fish Health shortcourse, 2000, 2001

Website development for Fish 422 and 424, Fall 2003 ([www.cnr.uidaho.edu/fish422and424/](http://www.cnr.uidaho.edu/fish422and424/))

Website development for Fish 422 and 424 (Blackboard)

**Courses Developed:**

Broodstock Management, 2020 (CE workshop at ID AFS meeting – organization and student/postdoc participation)

Coldwater Aquaculture Workshop, Fish 503, Summer 2017, 2019 (Co-taught with Dr. Brian Small)

Hatchery/Wild Fish interactions, Fish 525, Fall Alt years since 2010 (Co-taught with Dr. Dennis Scarnecchia)

Concepts in Aquaculture, Fish 422, Fall 2001 (now taught Alt years, Spring)

Fish Health Management, Fish 424, Spring 2001 (now taught Alt years, Spring)

Current Topics in Fish Health, Fish 494, Fall 2001, 2003, 2005

Sustainable Aquaculture, Fish 504, Fall 2004 (Co-taught with Dr. Chris Moffitt)

Fish Disease Diagnostics and Control, Fish 524, Fall 2002

Developed and implemented an Aquaculture Minor for undergraduate students, 2006

Aquaculture and Fish Health Management, Fish 419, Spring 2000

**Non-credit Classes, Workshops, Seminars, Invited Lectures, etc.:**

Broodstock Management, 2020 (CE workshop at ID AFS meeting – organization and student/postdoc participation)

Western Fish Disease Workshop, Flavobacterial Disease Management (invited), June 2019

Coldwater Aquaculture Workshop, Fish 503, Summer 2019 (Co-taught with Dr. Brian Small, Matt Powell, Gary Fornshell, etc.)

Salmon Disease Workshop, Corvalis, OR, July, 2009; July 2013, July 2019 (Participating/invited instructor): Intensive 2 wk disease course for fish health professionals

Fish Health Management Workshop, (Hagerman, ID) Aug. 2018

Coldwater Aquaculture Workshop, (Hagerman, ID) 2017

Fish Nutrition/Disease Workshop (Mt. Lassen trout farms) 2017

Governor Butch Otter’s IGEM promotional tour - University of Idaho. (Invitation to highlight fish health products developed in my lab). Jan. 2012.

Fish diseases caused by select *Flavobacterium spp*. (Invited Lecture). Online Fish Health Course offered to USFWS professionals. Aug. 2012.

Coldwater Fish Culture Workshop (Participating instructor), 2 week shortcourse for aquaculture

professionals, attended by fish culturists from IDFG and Nez Perce tribe, Moscow and Hagerman, ID. June/July, 2011

Fish Immunology Workshop (Participating/Invited instructor), 1 week course with laboratory, National Institute of Water and Atmosphere, Wellington, New Zealand, March 2011

[JFA304 Aquatic Animal Physiology and Behavior,](http://www.utas.edu.au/units/JFA304) Guest speaker, University of Tasmania, March 2011

Fish 102, Guest speaker, Annually since 2011

Animal and Veterinary Sciences (AVS 471 – Domestic animal diseases), Guest Lecture, Oct 2010

University Core course CORS 224, Guest lecture, May 2010

Salmon Disease Workshop, Corvalis, OR, July, 2009, 2013 (Participating instructor): Intensive 2 wk disease course for fish health professionals

Biosecurity workshop, (instructor), August 14, 2009, Hagerman, ID

Nucleospora Workshop, (participant), August 19, 2009, Boise, ID

Current and Emerging Pathogens of Fishes in the Pacific Northwest, (instructor) February 20, 2007, Idaho Chapter AFS, continuing education (one day workshop)

CNR Outreach Workshop (invited participant/contributor), July 12, 2007

Northwest Reproductive Sciences Symposium (Invited speaker) Reproductive aspects associated with the development of a conservation aquaculture program for burbot (*Lota lota maculosa*), March 23, 2007

Lower Snake River Compensation Plan Office Annual Meeting (Invited Presenter), March 12-16, 2007

Palouse Unit AFS meeting (Invited Seminar) Research overview, November 28, 2007

*Flavobacterium* 2007 workshop (Invited participant/organizer), International meeting bringing over 80 researchers together from all over the world, May 2-4, 2007

Fish Immunology Workshop, (invited workshop/seminar), Oct 5, 2006, Benchmark Biolabs, Lincoln, NE

Coldwater Disease Workshop, Annual extension shortcourse presented to Idaho trout industry, Hagerman, Idaho, June 10, 2004, June 2005, August 2005

Aquaculture short course for Native Americans, (invited instructor) June 15-July 23, 2004, Hagerman, Idaho

WSU Vancouver (invited seminar), WSU Seminar Series, October 4, 2004

46th Western Fish Disease Workshop, (organizer, speaker and session chair) AFS/Fish Health Section, June 27-29, Boise, ID. 2005.

Coldwater disease workgroup meeting, (invited participation with Federal, State, and Tribal agencies to address coldwater disease problems), Seattle, Washington, February 5, 2004

Workshop for the Center for Reproductive Biology, (invited seminar) Stimulating protective immunity in rainbow trout to the fish pathogen *Flavobacterium psychrophilum*, Washington State University, Pullman, Washington, June 11, 2003

Fish Disease/Health Management workshop/shortcourse, Annual extension shortcourse presented to Idaho trout industry, Hagerman, Idaho, September 2000, August 2001, August 2002

Fish Immunology Workshop, Annual American Fisheries Society/Fish Health Section meeting, Gig Harbor, Washington, June 2000

Oregon State University, Fish Disease Laboratory (invited seminar), March 2001

FISH 102 (invited presentation), September 2000, 2008, 2009, 2011

8th Congress of the International Society of Developmental and Comparative Immunology (invited presentation) Cairns, Australia, July 2000

Idaho Aquaculture Association, annual meeting (invited presentation) June 2000

FISH 501 (invited presentation) April 2000

**SCHOLARSHIP ACCOMPLISHMENTS:**

**Publications:**

**Refereed:**

Ashton, N.K., Ross, T.J., Hardy, R.S., Stephenson, S.M., Evans, V., Jensen, N.R., Young, S.P., and

Cain, K.D. 2021. Effects of Temperature Fluctuation on Burbot Embryos: Implications of Hydropower and Climate Change. *Transactions of The American Fisheries Society* (online early) <https://doi.org/10.1002/tafs.103>

Bruce, T.J., Oliver, L.P., Ma, J., Small, B.C., Hardy, R.W., Brown, M.L., Craig, S.C. and Cain, K.D.

2021. An initial evaluation of fishmeal replacement with soy protein sources on growth and immune responses of burbot (*Lota lota maculosa*). *Aquaculture* (online early) <https://doi.org/10.1016/j.aquaculture.2021.737157>

Oliver, L.P., Evavold, J.T. and Cain, K.D. 2021. Out-of-season spawning of burbot (Lota lota) through

temperature and photoperiod manipulation. *Aquaculture* 543 (2021) 736917 DOI: 10.1016/j.aquaculture.2021.736917

Bruce, T.J., Ma, J., Jones, E.M., Vuglar, B.M., Oliver, L.P. Loch, T.P., Knupp, C. and Cain, K.D.

2021. Assessment of *Flavobacterium psychrophilum* strain virulence in Atlantic salmon *(Salmo salar)* and brook trout *(Salvelinus fontinalis*). *Journal of fish Diseases* DOI: 10.1111/jfd.13349

Bruce, T.J., J. Ma, Sudheesh, P.S. and K.D. Cain. 2021. Quantification and comparison of iron regulation and metabolism in a virulent and attenuated strain of *Flavobacterium psychrophilum*. *Journal of Fish Diseases* DOI: 10.1111/jfd.13354

Liu, W., Zhang, Y., Ma, J., Jiang, N., Zhou, Y., Fan, Y., Cain, K., Yi, M., Jia, K., Wen, H., Liu, W.,

Guan, W. and Zeng, L. 2020. Determination of a novel Parvovirus pathogen associated with

massive mortality in adult Tilapia. *PLOS Pathogens* 16(9): e1008765.

https://doi.org/10.1371/journal.ppat.1008765

Bruce, T.J., S. Gulen, L.P. Oliver, J. Ma, and K.D. Cain. 2020. Evaluation of commercial and

experimental grower diets for use in intensive burbot (*Lota lota maculosa*) culture. *Aquaculture* 528 (2020) 735490

Bruce TJ, Ma J, Knupp C, Loch TP, Faisal M, Cain KD. 2020. Cross-protection of a live-attenuated

Flavobacterium psychrophilum immersion vaccine against novel Flavobacterium spp. and Chryseobacterium spp. strains. J Fish Dis. 2020;00:1–14. <https://doi.org/10.1111/jfd.13201>

Bruce TJ, Ma J, Oliver LP, Jones EM, LaFrentz BR, Cain KD. 2020. Isolation and experimental

challenge of cultured burbot (*Lota lota maculosa*) with *Flavobacterium columnare* and *Aeromonas sp*. isolates. *J Fish Dis*. 2020;00:1–13. <https://doi.org/10.1111/jfd.13169>

Oliver, L.P., J. Ma, T.J. Bruce, J.T. Evavold, D.B. Korbel, and K.D. Cain. 2020. Triploid induction in

cultured burbot (*Lota lota*) using thermal and hydrostatic shock. *Aquaculture* 515:734582.

Ma, J., T.J. Bruce, E. Jones, and K.D. Cain. 2019. A review of fish vaccine development strategies:

Conventional methods and modern biotechnological approaches. *Microorganisms* 7(11):569.

Ashton, N.K., Jensen, N.R., Ross, T.J., Young, S.P., Hardy, R.S. and Cain, K.D. 2019. Temperature and Maternal Age Effects on Burbot Reproduction. *North American Journal of Fisheries Management.* doi.org/10.1002/nafm.10354.

Ma, J., Bruce, T.J., Oliver, L.P. and Cain, K.D. 2019. Co‐infection of rainbow trout (*Oncorhynchus mykiss*) with infectious hematopoietic necrosis virus and *Flavobacterium psychrophilum. Journal of Fish Disease.* DOI: 10.1111/jfd.13012

Knupp, C., Wiens, G., Faisal, M., Call, D., Cain, K., Nicolas, P., Van Vliet, D., Yamashita, C., Ferguson, J., Meuninck, D., Hsu, H., Baker, B., Shen, L. and Loch, T. 2019. Large-scale Analysis of *Flavobacterium psychrophilum* MLST Genotypes Recovered From North American Salmonids Indicates Both Newly Identified and Recurrent Clonal Complexes are Associated with Disease. Applied and Environmental Microbiology doi:10.1128/AEM.02305-18

Hutson, K.S. and Cain, K.D. 2019. Pathogens and Parasites, In: *Aquaculture: Farming Aquatic Animals and Plants*. Third Edition, pgs 217-247 (ed) John S. Lucas, Paul C. Southgate, Craig S. Tucker, Wiley-Blackwell publishing. 642 pgs

Ma, J., Bruce, T.J., Sudheesh, P.S., Knupp, C., Loch, T.P., Faisal, M. and Cain, K.D. 2018. Assessment of cross‐protection to heterologous strains of *Flavobacterium psychrophilum* following vaccination with a live‐attenuated coldwater disease immersion vaccine. *Journal of Fish Diseases* 42:75–84.

Nguyen P, Sudheesh, P.S. Sinnesael, M., Thomas, A. Haman, K. and Cain, K.D. 2018. Rapid Detection and Monitoring of *Flavobacterium psychrophilum* in Water by Using a Handheld Field-Portable qPCR System. *North American Journal of Aquatic Animal Health* 30(4): 302-311

Terrazas, M.M., Anderson, C.L. Jacobs, S.J. and Cain, K.D. 2018. Identification of Two Pathogenic *Aeromonas* Species Isolated during Production Related Epizootics from Juvenile Burbot *Lota lota maculosa.* *North American Journal of Aquatic Animal Health* 30(3): 201-209

Jaing, M.N, Fan, Yuding, Cain, K., Zeng, L. 2018. Development of cross-priming amplification coupled with vertical flow visualization for rapid detection of infectious spleen and kidney necrosis virus (ISKNV) in mandarin fish, *Siniperca chuatsi*. *Journal of Virological Methods* 253, 38-42

Terrazas, M.M., Adams, J.R., Sudheesh, P. and Cain, K.D. 2018. Effects of Diel Temperature Fluctuation on Growth, Stress Response, and Immune Function of Burbot. *Transactions of the American Fisheries Society*, Volume 146, 996 – 1007

Sudheesh, P.S. and Cain, K.D. 2017. Prospects and challenges of developing and commercializing immersion vaccines for aquaculture. *International Biology Review* 1(1): 1-20

Villasantea, A.,Powell, M.S., Murdoch, G.K., Overturf, K., Cain, K., Wacyke, J., Hardy, R.W. 2016. Effect of anthocyanidins on myogenic differentiation 1 in induced and non-induced primary myoblasts from rainbow trout (*Oncorhynchus mykiss*). *Comparative Biochemistry and Physiology Part B* 196–197: 102–108

Sudheesh, P.S. and Cain, K.D. 2016. Optimization of efficacy of a live attenuated *Flavobacterium psychrophilum* immersion vaccine. *Fish & Shellfish Immunology* 56: 169-180

Ashton, N.K., Campbell, M.R., Anders, P.J., Powell, M.S. and Cain, K.D. 2016. Evaluating Microsatellite Markers for Parentage-Based Tagging of Hatchery Burbot. *Northwest Science,* 90(3):249-259

Sudheesh, P.S., Zimmerman, J.K. and Cain, K.D. 2016. Dietary effects on immunity, stress, and efficacy of two live attenuated *Flavobacterium psychrophilum* vaccine formulations. *Aquaculture* 454 35-43

Ghosh, B., Cain, K.D., Nowak, B.F. and Bridle, A.R. 2016. Microencapsulation of a putative probiotic Enterobacter species, C6-6, to protect rainbow trout, *Oncorhynchus mykiss* (Walbaum), against bacterial coldwater disease. *Journal of Fish Diseases* 39(1):1-11

Karol Gliniewicz, Mark Wildung, Lisa H. Orfe, Gregory D. Wiens, Kenneth D. Cain, Kevin K. Lahmers, Kevin R. Snekvik and Douglas R. Call. 2015. Potential mechanisms of attenuation for rifampicin-passaged strains of *Flavobacterium psychrophilum*. *BMC Microbiology* 15:179

Long, A., Call, D.R. and Cain, K.D. 2015. Comparison of quantitative PCR and ELISA for detection and quantification of *Flavobacterium psychrophilum* in salmonid broodstock. *Diseases of Aquatic Organism* 115: 139–146

Ghosh, B., Bridle, A.R., Nowak, B.F. and Cain, K.D. 2015. Assessment of immune response and

protection against bacterial coldwater disease induced by a live-attenuated vaccine delivered orally or intraperitoneally to rainbow trout, Oncorhynchus mykiss (Walbaum). *Aquaculture* 446: 242–249

Makesh, M., Sudheesh, S.S. and Cain, K.D. 2015. Systemic and mucosal immune response of rainbow

trout to immunization with an attenuated *Flavobacterium psychrophilum* vaccine strain by different routes. *Fish and Shellfish Immunology* 44: 156-163

Schubiger, C.B., Orfe, L.H., Ponnerassery, S.P., Cain, K.D., Shah, D.H. and Call, D.R. 2015. Entericidin is requisite for a probiotic treatment (Enterobacter C6-6) to protect trout from coldwater disease challenge. *Applied and Environmental Microbiology* 81:658 –665

Egan, J.P., Johnson, R.D., Anders, P.J. and Cain, K.D. 2014. Initial Characterization of Embryonic Development in North American Burbot *Lota lota maculosa*.  *North American Journal of Aquaculture*  77:1, 37-42

Wiens, G.D., LaPatra, S.E., Welch, J.J., Rexroad 3rd, C., Call, D.R., Cain, K.D., LaFrentz, B.R., Vaisvil, B., Schmitt, D.P. and Kapatral, V. 2014. Complete genome of *Flavobacterium psychrophilum* strain CSF259-93 used to select rainbow trout for increased genetic resistance against bacterial cold water disease. *Genome Announcements* 2(5):e00889-14. doi:10.1128/genomeA.00889-14

Plant, K. P., LaPatra, S.E., Call, D.R., and Cain, K.D. 2014. Attempts at validating a recombinant *Flavobacterium psychrophilum* gliding motility protein N as a vaccine candidate in rainbow trout, *Oncorhynchus mykiss* (Walbaum) against bacterial cold water disease. *FEMS Microbiology Letters* 358, 14–20

Long, A., Fehringer, T.R., LaFrentz, B.R., Call, D.R. and Cain, K.D. 2014. Development of a waterborne challenge model for *Flavobacterium psychrophilum*. *FEMS Microbiology Letters,* 359, 154–160

LaPatra, S.E., Fehringer, T.R. and Cain, K.D. 2014. A probiotic Enterobacter sp. provides significant protection against *Flavobacterium psychrophilum* in rainbow trout (*Oncorhynchus mykiss*) after injection by two different routes. *Aquaculture,* 433, 361–366

Fehringer, T.R., Hardy, R.W. and Cain, K.D. 2014. Dietary inclusion of salmon testes meal from Alaskan seafood processing byproducts: Effects on growth and immune function of rainbow trout, *Oncorhynchus mykiss* (Walbaum). *Aquaculture,* 433, 34-39

LaFrentz, B.R., LaPatra, S.E., Call, D.R., and Cain, K.D. 2014. Immunization of rainbow trout

*Oncorhynchus mykiss* (Walbaum) with a crude lipopolysaccharide extract from *Flavobacterium*

*psychrophilum*. *Journal of Fish Diseases,* 45, 476–483

Ashton, N.K., Anders, P.J., Young, S.P. and Cain, K.D.. 2014. Coded Wire and Passive Integrated Transponder Implantations in Juvenile Burbot. *North American Journal of Fisheries Management,* 34:2, 391-400

Long, A., Call, D.R. and Cain, K.D. 2014. Investigation of the link between broodstock infection,

vertical transmission, and prevalence of *Flavobacterium psychrophilum* in eggs and progeny of rainbow trout and coho salmon. *Journal of Aquatic Animal Health,* 26(2):66-77.

Cain, K.D. and Polinski, M.P. 2014. Infectious Diseases of Coldwater Fish in Fresh Water. Chapter 3. In: *Diseases and Disorders of Finfish in Cage Culture.* Volume 2, (eds) Woo, P.T.K., and Bruno, D.W. CABI publishing, New York, NY. pp.60-113

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**Presentations and Other Creative Activities:**

**Media/outreach highlights (past 3 years):**

Cain, K.D., 2021. Ken’s Corner, Sorting through the noise in the farmed-versus-wild debate. Aquaculture North America. July/August Vol 24 (4)

Cain, K.D., 2021. Ken’s Corner, Aquaculture Opportunities and Education. Aquaculture North America. May/June Vol 23 (3)

Cain, K.D., 2021. Ken’s Corner, Vaccines may be the biggest tool in the fish health toolbox. Aquaculture North America. March/April Vol 22 (2)

US researchers build case for burbot aquaculture. 2020. *Aquaculture North America*. Sept/Oct. Vol 11 (5), pgs, 1, 20. <https://mydigitalpublication.com/publication/?i=671490>

Burbot conservation effort spawns commercial aspirations. *Global Aquaculture Advocate*. Feb. 2020. <https://www.aquaculturealliance.org/advocate/burbot-conservation-effort-spawns-commercial-aspirations/>

The freshwater cod with a Lota potential for farming. *The Fish Site*. 2020. <https://thefishsite.com/articles/the-freshwater-cod-with-a-lota-potential-for-farming>

Idaho burbot researchers look to shift from conservation to commercial aquaculture. *Seafood Source*. Dec. 2019. <https://www.seafoodsource.com/news/aquaculture/idaho-burbot-researchers-look-to-shift-from-conservation-to-commercial-aquaculture>

Researching Burbot: Restoration of the Burbot Fishery in Idaho. *You Tube*. 2020. <https://m.youtube.com/watch?feature=share&v=-KvOjYUgAQc>

Burbot Bounce Back. Featured story on the University of Idaho’s *College of Natural Resources website*. 2019. <https://www.uidaho.edu/cnr/about/feature-stories/burbot-biology>

A Swimming Recovery (2020). Featured story for *Here We Have Idaho Magazine* and posted on UI campus website. <https://www.uidaho.edu/news/here-we-have-idaho-magazine/burbot-aquaculture>

Burbot Bounce Back. Featured story on the *University of Idaho’s College of Natural Resources* website <https://www.uidaho.edu/cnr/about/feature-stories/burbot-biology>

Aquaculture North America trade journal, Trout farming in the U.S. and Canada, 2019

[Here We Have Idaho](http://www.uidaho.edu/news/here-we-have-idaho-magazine) (Magazine) “Entrepreneurship and Innovation” Invention Pipeline: The Process of Technology Transfer: University researchers support Idaho economy with inventions and discoveries. Development of a Fish Vaccine. magazine (https://www.uidaho.edu/news/here-we-haveidaho-magazine/invention-pipeline), 2018.

Community presentations:

Cain, K.D. (Invited talk - Renfrew Colloquium) Idaho’s Freshwater Cod: Burbot in the Kootenai (Past, Present and Future), December 10th, 2019.

Cain, K.D. (Invited talk - Clearwater Flycasters presentation). Burbot conservation aquaculture and species recovery, December, 11th 2013.

Workshop/manual development (since 1999):

Cain, K.D. Western Fish Disease Workshop, Flavobacterial Disease Management, June 2019

Cain, K.D., Small, B., Powell, M. and Fornshell, G. Coldwater Aquaculture Workshop, June

2019

Cain, K.D., Salmon Disease Workshop, Flavobacterium section, 2009, 2013, 2019

Cain, K.D., Fornshell, G., Fish Health Management Workshop, (Hagerman, ID) Aug. 2018

Salinas, I., Nowak, B., and Cain, K.D., Fish Immunology Workshop (Notebook/manual), 2011

Hardy, R., Cain, K.D., Powell, M., Fornshell, G., and Patterson, T. Coldwater Fish Culture

Workshop (notebook/manual and materials), 2011

Fornshell, G., and Cain, K.D. Biosecurity workshop (notebook/manual and CD), 2009

Cain, K.D., Johnson, K., Heindel, J., Emerging Pathogens of Fishes in the Pacific Northwest, Workshop manual and CD, February 20, 2007

Cain, K.D. and LaFrentz, B.R. Coldwater Disease Workshop and Shortcourse. UI Cooperative Extension System. June 10, 2004.

Cain, K. Overview of the Fish Immune System. Fish Immunology Workshop Manual. AFS/FHS continuing education, June 27, 2000.

Cain, K. Stress and the Immune Response. Fish Immunology Workshop Manual. AFS/FHS continuing education, June 27, 2000.

Cain, K. Bacterial and Viral Diseases in Aquaculture. Trout Disease/Health Management Short Course Manual. UI Cooperative Extension System and Hagerman Fish Culture Experiment Station. September 12-13, 2000, August 2001.

**Professional Meeting Papers, Workshops, Showings, Recitals:**

Presentations and Posters (since 1999)

Cain, et al., Characterization of maternal immunity following vaccination of broodstock against IHNV and *Flavobacterium psychrophilum*. Aquaculture America. US Trout Farmers Session. Aug. 11-14th, 2021. San Antonio, TX (**Invited Presentation)**

Cain, K.D. SOLUTIONS THROUGH SCIENCE: RESEARCH AS A CRITICAL COMPONENT TO ENHANCING FISH CULTURE AND FISHERIES. Idaho Chapter American Fisheries Society annual meeting. March 1-5th, 2021 (**Invited Plenary Talk**)

Oliver, L., Evavold, J. and Cain, K.D. CONTROL OF BURBOT (LOTA LOTA) SPAWNING INDEPENDENT OF NATURAL SEASON USING PHOTOTHERMAL MANIPULATION. Idaho Chapter American Fisheries Society annual meeting. March 1-5th, 2021

Matuha, M., Oliver, L., Evavold, J. and Cain, K.D. EARLY WEANING OF BURBOT (LOTA LOTA MACULOSA) LARVAE ONTO ARTIFICIAL ARTEMIA (EZ ARTEMIA) AND GEMMA MICRO DIET. Idaho Chapter American Fisheries Society annual meeting. March 1-5th, 2021

Bruce, T., Jie, M., Jones, E., Vuglar, B., Oliver, L., Cain, K. ASSESSMENT OF *Flavobacterium psychrophilum* STRAIN VIRULENCE IN ATLANTIC SALMON (*Salmo salar*) AND BROOK TROUT (*Salvelinus fontinalis*). Conference of Research Workers in Animal Diseases. Dec. 5-8, 2020

Ma, J., Trushenski, J., Jones, E., Bruce, T., Vuglar, B., Oliver, L., McKenney, D., Kurath, G., Cain, K. CHARACTERIZATION OF MATERNAL IMMUNITY FOLLOWING VACCINATION OF BROODSTOCK AGAINST IHNV OR F. PSYCHROPHILUM IN TROUT. 2020 Conference of Research Workers in Animal Diseases (CRWAD), Dec. 5-8, 2020. Virtual Conference

Ma, J., Bruce, T., Sepahi, A., Casadei, E., Cain, K., Salinas, I. LONG-TERM EFFICACY OF NASAL VACCINATION AGAINST ENTERIC RED MOUTH (ERM) DISEASE AND INFECTIOUS HEMATOPOIETIC NECROSIS (IHN) IN JUVENILE RAINBOW TROUT (ONCORHYNCHUS MYKISS). American Fisheries Society - Fish Health Section Online Seminar Series. Friday afternoons, May 15-Aug. 17, 2020. Virtual Conference.

Bruce, T., Jones, E., Jie, M., Knupp, C., Loch, T., Cain, K. LIVE-ATTENUATED BACTERIAL COLDWATER DISEASE (DCWD) VACCINE PROVIDES CROSS-PROTECTION AGAINST NOVEL Flavobacteriaceae. Idaho Chapter of the American Fisheries Society Annual Meeting. Mar. 11-13, 2020 Coeur d’Alene, ID

Oliver, L., Bruce, T., Ma, J., Cain, K. Development of an anti-IgM monoclonal antibody for burbot (*Lota lota*). Conference of Research Workers in Animal Diseases. Dec. 5-8, 2020 Virtual Conference.

Oliver, L., Ma, J., Bruce, T., Evavold, J., Korbel, D., Cain, K. Triploid Induction in Cultured Burbot (Lota lota) Using Thermal and Hydrostatic Shock. Idaho Chapter American Fisheries Society Annual Meeting. March. 11-13, 2020 Coeur d'Alene, ID

Matuha, M., Oliver, L.P., Evavold, J., Oliver, L.P., Ma, J., Bruce, T. J., and Cain, K.D. 2020. Evaluation of early larval weaning of live feed for burbot (*Lota lota maculosa*). Idaho Chapter of the American Fisheries Society (ICAFS) Annual Meeting. March. 10-13, 2020. Coeur d’Alene, ID.

Cain, K.D. (Invited talk) IDAHO FRESHWATER COD: DEVELOPING BURBOT AQUACULTURE FROM A CONSERVATION FOCUS TO A POTENTIAL HIGH VALUE COMMERCIAL PRODUCT! Aquaculture America. Feb. 9-12, 2020 Honolulu, HI

Rubio Benito, M.M., Bruce, T.J., Ma, J., Jones, E.M., Cain, K.D., Kumar, V.K. INSECT PROTEIN AS AN ADDITIVE IN FISH FEEDS: EFFECTS ON GROWTH AND IMMUNE PERFORMANCE IN RAINBOW TROUT Oncorhynchus mykiss. Aquaculture America. Feb. 9-12, 2020 Honolulu, HI

Welker, T., Overturf, K., Abernathy, J., Cain, K. UNDERLYING MECHANISMS FOR SELECTED DISEASE RESISTANCE AND ENHANCED NON-SPECIFIC RESISTANCE IN RAINBOW TROUT. Aquaculture America. Feb. 9-12, 2020 Honolulu, HI

Ma, J., Bruce, T., Oliver, L., Cain, K. CO-INFECTION OF RAINBOW TROUT Oncorhynchus mykiss WITH INFECTIOUS HEMATOPOIETIC NECROSIS VIRUS AND Flavobacterium psychrophilum. Aquaculture America. Feb. 9-12, 2020 Honolulu, HI

Bruce, T.J., Oliver, L.P., Ma, J., Small, B.C., Hardy, R.W., Brown, M.L., Craig, S.R., Cain, K.D. GROWTH AND IMMUNE RESPONSES OF CULTURED BURBOT Lota lota maculosa FED VARIED INCLUSIONS OF SOY PROTEIN SOURCES. Aquaculture America. Feb. 9-12, 2020 Honolulu, HI

Bruce, T.J., Ma, J., Knupp, C., Loch, T.P., Cain, K.D. CROSS-PROTECTION OF A LIVE-ATTENUATED COLDWATER DISEASE IMMERSION VACCINE AGAINST NOVEL *Flavobacterium spp*. AND *Chryseobacterium spp*. Aquaculture America. Feb. 9-12, 2020 Honolulu, HI

Cain, K.D. (Invited talk - Renfrew Colloquium) Idaho’s Freshwater Cod: Burbot in the Kootenai (Past, Present and Future), December 10th, 2019.

Bruce, T.J., Ma, J., Knupp, C., Loch, T.P., and Cain, K.D. Live-attenuated bacterial coldwater

disease (BCWD) vaccine provides cross-protection against novel Flavobacteriaceae. Northwest Fish Culture Concepts. December 3-5th, 2019. Victoria, BC Canada

Cain, K.D. Aquaculture Research at UI: On-campus ARI Research, Facilities, and Services.

Proceedings of the First Annual ARI Industrial Affiliates Meeting, Research Review, and Workshop on Global Aquaculture. University of Idaho. October 2019, Moscow, ID

Bruce, T.J., Ma, J., Knupp, C., Loch, T.P., and Cain, K.D. Live-attenuated bacterial coldwater

disease (BCWD) vaccine provides cross-protection against novel Flavobacteriaceae. Northwest Fish Culture Concepts. December 3-5th, 2019. Victoria, BC Canada

Cain, K.D. Evaluation of Commercial Feasibility of Burbot (freshwater cod) as a New

Aquaculture species. Western Regional Aquaculture Center annual meeting, October, 2019, Spokane, WA

Cain, K.D. Current and Future Management Tools for Coldwater Disease (CWD). US Trout

Farmers Annual Meeting/Conference, (Invited talk) September 4-6th, 2019, Seattle, WA

Bruce, T.J. and Cain, K.D. Common and Emerging Pathogens in Domestic Salmonid

Production, US Trout Farmers Annual Meeting/Conference, (Invited talk) September 4-6th, 2019, Seattle, WA

Cain, K.D. Coldwater Disease Vaccine research update. Lower Snake River Compensation

Program Annual Meeting. (Invited talk) April 23rd, 2019. Lewiston, ID

Cain, K.D. Burbot Aquaculture Development at UI. Lower Snake River Compensation

Program Annual Meeting. (Invited talk) April 23rd , 2019. Lewiston, ID

Cain, K.D.  *Flavobacterium psychrophilum:* How CWD impacts hatchery programs and how

can impacts be managed? (Invited workshop presentation) Western Fish Disease Workshop/AFS FHS Annual Meeting. June 2019. Ogden, UT.

Bruce, T. J., Ma, J., Oliver, L.P., and Cain, K.D. Immunological parameters in cultured burbot

(*Lota lota*) following long-term feeding of soy protein variants and exposed to pathogenic *Aeromonas spp*. Platform presentation. Western Fish Disease Workshop/AFS FHS Annual Meeting. June 2019. Ogden, UT.

Ma, J., Bruce, T. J., Oliver, L.P., Lafrentz, B.R., and Cain, K.D. Disease diagnostics in cultured

burbot (Lota lota) and experimental challenge with novel Flavobacterium columnare and Aeromonas spp. isolates. 2019. Platform presentation. Western Fish Disease Workshop/AFS FHS Annual Meeting. June 2019. Ogden, UT.

Oliver, L.P, Ma, J., Bruce, T.J., Evavold, J.T., Korbel, D.B. and Cain, K.D. Triploid induction in

cultured burbot (lota lota) using thermal and hydrostatic shock. Idaho Aquaculture Association Annual Meeting. June 2019. Twin Falls, ID.

Bruce, T. J., Oliver, L.P., Small, B.C., Hardy, R.W., Brown, M.L., Craig, S.R., and Cain, K.D.

Evaluation of fishmeal replacement with soy protein sources on the growth response and health of cultured burbot (*Lota lota*). Poster presentation. Aquaculture America. March 2019. New Orleans, LA.

Bruce, T. J., Ma, J., Oliver, L.P., Gulen, S., Lafrentz, B.R., and Cain, K.D. Disease diagnostics

and evaluation of immunological parameters in cultured burbot (*Lota lota*). Platform presentation. Aquaculture America. March 2019. New Orleans, LA.

Oliver, L.P, Ma, J., Bruce, T.J., Evavold, J.T., Korbel, D.B. and Cain, K.D. Triploid induction in

cultured burbot (lota lota) using thermal and hydrostatic shock. Aquaculture America. March 2019. New Orleans, LA.

Nguyen, P., Ponnerassery, S., Thomas, A., Sinnesael, M., Haman, K. and Cain, K. Field

detection and monitoring of aquaculture bacteria using a handheld qPCR system. Northwest Fish Culture Conference. December 2018, Portland, OR

Ma, J., Bruce, T.J., Sudheesh, P.S., Loch, T.P. and Cain, K.D. Cross-protective Ability of a

Live Attenuated Coldwater Disease Vaccine in Juvenile Rainbow Trout. International Symposium on Aquatic Animal Health, Prince Edward Island, Canada, September 6-8, 2018

Ma, J., Bruce, T.J., Sudheesh, P.S., Loch, T.P. and Cain, K.D. Cross-protective ability of a live

attenuated coldwater disease vaccine against heterologous strains of *Flavobacterium psychrophilum* in juvenile rainbow trout. Western Fish Disease Workshop, Bozeman, MT. June 2018.

Ma, J., Bruce, T.J. and Cain, K.D. Co-infection of Rainbow trout (*Oncorhynchus mykiss*) with

Infectious hematopoietic necrosis virus and *Flavobacterium psychrophilum.* Western Fish Disease Workshop, Bozeman, MT. June 2018.

Cain, K.D. Development and Optimization of a Bacterial Coldwater Disease Vaccine. Western

Division AFS Annual Meeting, Anchorage, AK. (Invited talk) May, 2018

Cain, K.D. Challenges to the development of new disease management tools/products for

aquaculture. Aquaculture America Conference, Las Vegas, NV. (Invited talk) February 19-22, 2018

Ashton, N., Ross, T.J., Hardy, R., Young, S., Nemeth, D. and Cain, K. Identification of thermal

bottlenecks affecting burbot embryo development: Implications for restoring the lower Kootenai River population. Idaho Chapter American Fisheries Society. March 2018

Cain, K.D. 2017. Challenges to the development of new disease management tools/products for

a growing aquaculture industry. 8th International Conference on Fisheries & Aquaculture. Toronto, Canada, October 2017 (**Invited Keynote Speech**)

Cain, K.D. and P.S. Sudheesh. Cross-protection to emerging flavobacterial pathogens following

vaccination with a live attenuated *Flavobacterium psychrophilum* vaccine (Fp-B.17-ILM). World Aquaculture Society Conference. Cape Town, South Africa. June 2017

Baleta, F.N., Sudheesh, P.S. and Cain, K.D. Utilization of *Sargassum* extracts as immunostimulant for rainbow trout: effects of route administration on growth and immune response. 58th Western Fish Disease Workshop, Suquamish, WA June 20-22, 2017

Burbank, D.R. and Cain, K.D. Probiotics in aquaculture; development of a probiotic to reduce

coldwater disease associated mortality. 58th Western Fish Disease Workshop, Suquamish, WA June 20-22, 2017

Cain, K.D. and P.S. Sudheesh. Cross-Protection To Emerging Flavobacterial Pathogens and

Divergent *Flavobacterium psychrophilum* strains following Vaccination with a Live Attenuated Vaccine (Fp-B.17-ILM). Eastern Fish Health Workshop. (Invited talk) East Lansing, MI. April 3rd – 6th, 2017

Cain, K.D., Schubiger, C.B., Burbank, D.R., Ghosh, B. and D.R. Call. Characterization of a putative probiotic enterobacter strain (C6-6) and potential mechanisms associated with protection of rainbow trout challenged with *Flavobacterium psychrophilum.* Aquaculture America Conference, San Antonio, Texas. February 20-23, 2017.

Cain, K.D. Emerging and Re-emerging Flavobacterial diseases. Special session of the US Trout Farmers Association (Invited talk), Aquaculture America Conference, San Antonio, Texas. February 20-23, 2017.

Cain, K.D. Overview of Aquaculture and Fish Health Research at the University of Idaho. Norwegian School of Veterinary Medicine. (Invited Seminar) Oslo, Norway. February 9th, 2017.

Cain, K.D., Schubiger, C.B., Burbank, D.R., Ghosh, B. and D.R. Call. Characterization of a putative probiotic Enterobacter strain (c6-6) and potential mechanisms associated with protection of rainbow trout challenged with *Flavobacterium psychrophilum*, the causative agent of coldwater disease/rainbow trout fry syndrome. 17th International Symposium on Fish Nutrition and Feeding (ISFNF), (Invited) Sun Valley, Idaho. June 5-10, 2016.

Cain, K.D. and Terazzas, M. Stress and disease susceptibility of burbot. Kootenai Tribe of Idaho

Annual Planning Meeting. (Invited) July 2016.

Cain, K.D. and Wilson, M. Can “freshwater cod” be produced in Southern Idaho: overview of

pilot trials at the University of Idaho (UI) and the College of Southern Idaho (CSI). Idaho Aquaculture Association annual meeting. (Invited) Twin Falls, ID June 11th, 2016.

Cain, K.D. 2016. Developing “freshwater cod” or burbot (*Lota lota*) into a viable commercial

aquaculture species in the United States. Western Regional Aquaculture Center Annual meeting. Proposal presentation. Oct. 12th.

Cain, K.D. 2016. Emerging and Re-emerging Flavobacterial Pathogens of Salmonids. Proposal

presentation. Oct. 12th.

P.S. Sudheesh, and KD Cain. Efficacy of an improved live attenuated *Flavobacterium psychrophilum* immersion vaccine. FLAVOBACTERIUM 2015. 4th International Conference on Flavobacterium, October 27-29, 2015, Auburn University, Auburn, AL, USA

P.S. Sudheesh, Katherine H., and KD Cain. A Novel *Flavobacterium sp.* Causes Bacterial Cold Water Disease-like Symptoms in Steelhead and Rainbow Trout. American Fisheries Society, 145th Annual Meeting, Portland, August 16 - 20, 2015

Cain, K.D. and Sudheesh, P. 2015. Optimizing the efficacy of a live attenuated *Flavobacterium psychrophilum* vaccine for coldwater disease. World Aquaculture Society (Aquaculture America conference). New Orleans, LA. February 19-22nd.

Cain, K.D. 2015. Idaho Department of Commerce (IGEM council). Licensing and Commercialization of a Live Attenuated Aquaculture Vaccine (proposal finalist – invited presentation). Boise, ID. September 30th.

Cain, K.D. 2015. Lower Snake River Compensation Program (Annual Meeting). Coldwater Disease – Working toward a Vaccine (Invited). Clarkston, WA. March 10th.

Cain, K.D. 2014. Research overview presentation (Invited). Skretting ARC – Stavanger, Norway October, 29th.

Cain, K.D. 2014. Conservation aquaculture as a critical tool for recovery of native fish

Populations. (Invited seminar) Iowa State University. October 10th.

Cain, K.D. 2014. Developing “freshwater cod” or burbot (*Lota lota*) into a viable commercial

aquaculture species in the United States. Western Regional Aquaculture Center Annual meeting. Oct. 8th.

Cain, K.D. 2014. Defining the relationship between stress, immune function and disease

resistance in rainbow trout fed immunostimulants and functional feed additives. Western Regional Aquaculture Center Annual meeting. Oct. 8th.

Terazzas, M. and Cain, K.D. 2014. Determining Juvenile Burbot Susceptibility to Stress

Mediated Pathogens. 65th Annual Northwest Fish Culture Conference. Pendleton, OR. Dec 2-4.

Blaufuss, P. and Cain, K.D. 2014. Aquaculture developments for Burbot *Lota lota* intended for

population restoration in the Kootenai River. 65th Annual Northwest Fish Culture Conference. Pendleton, OR. Dec 2-4.

Cain, K.D. 2014. Coldwater Disease (CWD) Vaccine. Pacific Northwest Fish Health Protection Committee Meeting. (Invited) Lewiston, ID. September 27th.

Cain, K.D. Sudheesh, P. and Zinn, J. 2014. Coldwater Disease (CWD)Vaccine: Myth or Reality?(Invited)US Trout Farmers Annual Meeting Twin Falls, ID. September 22nd-23rd.

Sudheesh, P. and Cain, K.D. 2014. Optimizing the efficacy of a live attenuated *Flavobacterium psychrophilum* vaccine for coldwater disease. International Symposium of Aquatic Animal Health. Portland OR. August 31st – September 4th.

LaPatra, S., Feringer, T. and Cain, K.D. 2014. Probiotic Provides Significant Protection Against *Flavobacterium psychophilum* in Rainbow Trout After Injection by Two Different Routes. International Symposium of Aquatic Animal Health. Portland OR. August 31st – September 4th.

Cain, K.D. and Sudheesh, P. 2014. Dietary Effects on Immunity, Stress, and Efficacy of a Live Attenuated *Flavobacterium Psychrophilum* Vaccine. International Symposium of Aquatic Animal Health. Portland OR. August 31st – September 4th.

Ghosh, B., Cain, K.D., Nowak, B.F. and Bridle, A.R. 2014. Oral immunoprophylaxis of finfish using alginate microencapsulation. International Symposium of Aquatic Animal Health. Portland OR. August 31st – September 4th.

Blaufuss, P.C., Cain, K.D., Evavold, J. and Young, S. 2014. Aquaculture development for burbot *Lota lota*. Aquaculture America. February 9th-12th.

Cain, K.D., Call, D.R., Long, A. and LaFrentz. 2013. New Tools And Potential Management Strategies For Coldwater Disease. (Invited special session talk) 38th Annual Eastern Fish Health Workshop, Gettysburg, PA. April 29th – May 3rd.

Long, A., Call, D.R. and Cain, K.D. 2013. Use Of Diagnostic Assays For Identification Of *Flavobacterium psychrophilum* Isolates. (Invited special session talk) 38th Annual Eastern Fish Health Workshop, Gettysburg, PA. April 29th – May 3rd.

Ashton, N. Young, S., Anders, P., Campbell, M., Powell, M. and Cain, K.D. 2013. Evaluations of Artificial and Natural Markers for Monitoring Hatchery Releases of Juvenile Burbot (*Lota lota*). Idaho Chapter/Western Division American Fisheries Society Annual Meeting, April 15-18.

Ashton, N. Young, S. and Cain, K.D. 2013. Advancements in Aquaculture and Supplementation of Imperiled Burbot in the Kootenai River. Idaho Chapter/Western Division American Fisheries Society Annual Meeting, April 15-18.

Cain, K.D. 2013. Commercializing specific naturally occurring probiotic bacterial strains to aid in fish disease management for aquaculture. Idaho State Board of Education, Legislative lunch (Invited presentation to Idaho legislature), Feb. 4th.

Cain, K.D. 2013. Burbot production and research update. Kootenai Tribe of Idaho annual program review and planning meeting. Bonner’s Ferry. Jan. 17th.

Cain, K.D., Long, A., Ownbey, R., and Zinn, J. 2012. Coldwater Disease Research: Update on Vaccine Licensing and Commercialization Status. (Invited) Northwest Fish Culture Conference, Portland, OR. December 10-13.

Ashton, N., Young, S. and Cain, K.D. 2012. Advancements in Aquaculture and Supplementation of Imperiled Burbot in the Kootenai River. Northwest Fish Culture Conference, Portland, OR. December 10-13.

LaFrentz, B.R., Cain, K.D., Shoemaker, C. and Klesius, P.H. 2012. Vaccination of fish against *Flavobacterium columnare* and *F. psychrophilum.* Joint meeting with USGS Western Fisheries Center and Russian Fisheries Scientists. Seattle. WA. Nov.

Cain, K.D. 2012. Update on coldwater disease vaccine development. (Invited) Western Regional Aquaculture Center annual meeting, Oct. 10-12.

Long, A., Fehringer, T.R., Swain, M.A., LaFrentz, B.R., Call, D.R. Zinn, J. and Cain, K.D. 2012, Culturing a Live Attenuated Flavobacterium psychrophilum Vaccine in Iron Limited Media Enhances Efficacy. Annual AFS/Fish Health Section meeting. Lacross, WI. Aug.

Barron, J.M., Jensen, N.R., Anders, P.J., Egan, J.P., Ireland, S.C., and Cain, K.D. 2012.

Effects of Stocking Density on Survival and Yield of North American Burbot Reared Under Semi-intensive Conditions. International Congress on Fish Biology (Burbot Symposium). Madison, WI. July.

Fehringer, T.R., Hardy, R.W. and Cain, K.D. 2012. Assessing the ability of gonad meal to act as a nucleotide immunostimulant in rainbow trout *(Oncorhynchus mykiss*). 53rd Annual Western Fish Disease Workshop. Boise, ID. June.

Long, A., Fehringer, T.R., Swain, M.A., LaFrentz, B.R., Call, D.R. and Cain, K.D. 2012. Culturing of a live attenuated *Flavobacterium psychrophilum* strain vaccine by culturing in iron limited media enhances efficacy. 53rd Annual Western Fish Disease Workshop. Boise, ID. June.

Cain, K.D. 2012. Conservation aquaculture as a critical tool for recovery of native fish populations. (Invited) James Cook University. Queensland, Australia. March 27th.

Cain, K.D. 2012. Thinking outside the box: new and innovative ways to prevent or control disease in aquaculture. (Invited) James Cook University. Queensland, Australia. March 28th.

Gliniewicz, K., Plant, K., LaPatra, S.E., Cain, K.D., Snekvik, K.R., LaFrentz, B.R. and Call, D.R. 2012. Comparative Proteomic Analysis of Virulent and Rifampicin Attenuated Strains of *Flavobacterium psychrophilum.* Idaho Chapter of American Fisheries Society Meeting. Coure d Alene, ID. Feb.

Long, A., Fehringer, T.R., Swain, M.A., LaFrentz, B.R., Call, D.R. and Cain, K.D. 2012. Culturing of a live attenuated *Flavobacterium psychrophilum* strain vaccine by culturing in iron limited media enhances efficacy. Idaho Chapter of American Fisheries Society Meeting. Coure d Alene, ID. Feb.

Cain, K.D. 2012. Identification of specific probiotics capable of enhancing resistance to bacterial coldwater disease (CWD) in rainbow trout. (Invited) Rocky Plains Fish Pathology Meeting. Boise, ID. Jan. 25-26.

Cain, K.D. 2012. A potential vaccine to control bacterial coldwater disease (CWD). (Invited) Rocky Plains Fish Pathology Meeting. Boise, ID. Jan. 25-26.

Cain et al. 2011. Identification of specific Autochthonous probiotics capable of enhancing

resistance to bacterial coldwater disease. (Invited) Northwest Fish Culture Conference, Victoria, BC Canada. December 6-8.

Cain et al. 2011 A potential vaccine for coldwater disease. (Invited) Northwest Fish Culture

Conference, Victoria, BC Canada. December 6-8.

Cain et al. 2011 Conservation aquaculture as a critical tool to recover burbot populations in

Idaho’s Kootenai River. (Invited) Northwest Fish Culture Conference, Victoria, BC Canada, December 6-8

Cain et al. 2011. Identification of specific Autochthonous probiotics capable of enhancing

resistance to bacterial coldwater disease. AADAP meeting Bozeman, MT August 1-4.

Cain et al. 2011. Identification of specific Autochthonous probiotics capable of enhancing

resistance to bacterial coldwater disease. (Invited) Pacific Northwest Fish Health Protection Committee (PNFHPC) meeting, Portland OR. September 21-22.

Cain et al. 2011 A potential vaccine for coldwater disease. (Invited) Pacific Northwest Fish

Health Protection Committee (PNFHPC) meeting, Portland OR. September 21-22.

Cain et al. 2011. Identification of specific Autochthonous probiotics capable of enhancing

resistance to bacterial coldwater disease. (Invited) US Trout Farmers and Idaho Aquaculture Association annual conference, Twin Falls, ID September 29-Oct 1.

Cain et al. 2011 A potential vaccine for coldwater disease. (Invited) US Trout Farmers and

Idaho Aquaculture Association annual conference, Twin Falls, ID September 29-Oct 1.

Cain, K.D. 2011. Research overview and update. (Invited) University of Tasmania. February

10th, Launceston, Tas, Australia

Cain, K.D. 2011. Fish Health Research and Development. CSIRO laboratories. March,

Hobart, Tas, Australia (invited presentation to Salmon industry)

Cain, K.D., 2011. Aquaculture in Idaho and the Pacific Northwest of the US: Research at the

University of Idaho. (Invited) Department of Primary Industries, Mount Pleasant Laboratories, May 7th, Launceston, Tas, Australia

Cain et al. 2011 Conservation aquaculture as a critical tool to recover native fish species. May

18th, University of Tasmania, Launceston, Tas, Australia (invited seminar speaker)

Gliniewicz, K, KP Plant, SE LaPatra, KD Cain, KR Snekvik, BR LaFrentz, and DR Call.

Comparative proteomic analysis of virulent and rifampicin attenuated strains of *Flavobacterium* *psychrophilum*. *American Fisheries Society Annual Meeting*, Seattle, WA, 5-7 September 2011.

Swain, MA, A Long, TR Fehringer, BR LaFrentz, DR Call, and KD Cain. Vaccine efficiency in

Coho salmon against *Flavobacterium psychrophilum*. Talk presented at the Center for Research on Invasive Species and Small Populations end of summer presentations*.* Moscow, Idaho, August 4, 2011.

Cain et al., 2011. Assessing probiotic use for the control of *Flavobacterium psychrophilum* in

rainbow trout (*Oncorhyncus mykiss*). 1st Australasion Scientific conference on Aquatic Animal Health. (Invited talk), July 5-8

Burbank, D.R., LaPatra, S.E., Fornshell, G. and Cain, K.D., 2011. Assessing probiotic use for

the control of *Flavobacterium psychrophilum* in rainbow trout (*Oncorhyncus mykiss*). Eastern Fish Health Workshop. (Invited talk) March.

Long, A, MP Polinski, DR Call, and KD Cain. Validation of Diagnostic Assays to Screen

Broodstock for *Flavobacterium psychrophilum* Infection. Talk presented at the *Idaho Chapter of the American Fisheries Society Annual Meeting.* Boise, Idaho, March 2-4, 2011.

Long, A, J Bertolini, C Olson, DR Call, and KD Cain. 2011. Use of Diagnostic Assays to

Evaluate Transmission of Bacterial Coldwater Disease. Presented at American Fisheries Society 141st Annual Meeting. Seattle, Washington.

Gliniewicz, K., Plant, K., LaPatra, S.E., Cain, K.D., Snekvik, K.R., LaFrentz, B.R., and

Call, D.R. 2011. Comparative Proteomic Analysis of Virulent and Rifampicin Attenuated Strains of *Flavobacterium psychrophilum*. American Fisheries Society Annual meeting, Seattle, WA September.

Burbank, D.R, S.E. Lapatra, G. Fornshell, and K.D. Cain. 2010. Assessing Candidate Probiotic

Use for the Possible Control of Flavobacterium psychrophilum in Rainbow Trout Oncorhynchus mykiss. Aquaculture America 2010, San Diego, CA, Book of Abstracts, p. 150.

Johnson, T.J., Parvez, N., Call, D.R., LaFrentz, B.R., Miura, T., and Cain, K.D. (2010)

Confirmation of Safety and Efficacy for a Live Attenuated *Flavobacterium psychrophila* Vaccine. Sixth International Symposium of Aquatic Animal Health, September 5-9th, Tampa, FL

Long, A., Call, D.R., and Cain, K.D. (2010) Use of Diagnostic Assays to Screen Rainbow Trout

(*Oncorhynchus mykiss*) Broodstock for *Flavobacterium psychrophilum.* Sixth International Symposium of Aquatic Animal Health, September 5-9th, Tampa, FL

Cain, K.D., Burbank, D.R., Cavender, W.P., Swan, C.M., Wilson, C. and LaPatra, S.E. (2010)

Assessing candidate probiotic use for the possible control of *Flavobacterium psychrophilum* in rainbow trout. American Fisheries Society (Fish Health Section) 51st Annual Western Fish Disease Workshop, Corvallis, OR June 22-24

Plant, K.P., LaPatra, S.E., Call, D.R. and Cain, K.D. (2010) Is vaccination with *Flavobacterium*

*psychrophilum* gliding motility protein N (GldN) effective? American Fisheries Society (Fish Health Section) 51st Annual Western Fish Disease Workshop, Corvallis, OR June 22-24

Cain, K.D., Burbank, D.R., Wilson, C. and LaPatra, S.E. (2010) Assessing candidate probiotic

use for the possible control of *Flavobacterium psychrophilum* in rainbow trout. Idaho Aquaculture Association annual meeting, Twin Falls, ID June

Johnson, TJ, BR. LaFrentz, DR. Call, and KD Cain (2010).  Characterization of an attenuated

*Flavobacterium psychrophilum* vaccine.  Idaho Chapter of the American Fisheries Society Annual Meeting, Pocatello, ID March 2-5

Gliniewicz, Snekvik, Cain, LaPatra and Call, “Assessing the immune-protective potential of

FP1493 against coldwater disease in rainbow trout Washington State University Showcase, March 2010.

Lanier, Shah, Kumar, LaPatra, Gliniewicz, Snekvik, Cain, and Call, “Production of recombinant

*in vivo* induced proteins of *Flavobacterium* *psychrophilum* for development of a coldwater disease vaccine in rainbow trout. Washington State University Showcase, March 2010.

Gliniewicz, Snekvik, Cain, LaPatra, and Call, “Assessing the immune-protective potential of

FP1493 against coldwater disease in rainbow trout. American Society for Microbiology,

San Diego, CA, 23-27 May 2010.

Gliniewicz, Cain, Snekvik, and Call. “The role of *rpoB* gene in rifampicin attenuation of

*Flavobacterium* *psychrophilum.* 11th Annual College of Veterinary Medicine Research Symposium, October 27, 2010.

Cain, K.D. (2010) Conservation aquaculture as a critical tool to recover burbot populations in

Idaho’s Kootenai River. Idaho Chapter of the American Fisheries Society

Annual Meeting, Pocatello, ID March 2-5

Cain, K.D. (2010) Conservation aquaculture as a critical tool for recovery of burbot populations

in the Kootenai River. Kootenai Valley Resource Initiative annual Burbot subcommittee

meeting. May 25th, Bonner’s Ferry, ID.

Lloyd, S.J., LaPatra, S.E., Snekvik, K.R., Cain, K.D., and Call, D.R. (2010) Quantitative PCR

demonstrates a positive correlation between a *Rickettsia*-like organism and severity of strawberry disease lesions in rainbow trout (*Oncorhynchus mykiss*). American Society of Microbiology annual meeting, Mach, San Diego, CA.

LaFrentz BR, Peterson MP, Jensen NR, Cain KD (2010) Conservation aquaculture: a tool for

recovering declining fish populations. 2010 USDA-ARS Auburn Location Earth Day Celebration and Annual Environmental Management System Awareness Training, April 22, Auburn, AL, USA

Gliniewicz, KS, KD Cain, KR Snekvik, and DR Call. The role of *rpoB* in the attenuation of

*Flavobacterium* *psychrophilum* after passage with rifampicin. Poster presented at the *10th Annual College of Veterinary Medicine Research Symposium*, Pullman, WA, October 14, 2009.

Cain, K.D. (2009) Coldwater disease research update. Idaho Aquaculture Association annual

meeting, Twin Falls, ID June

Cain, K.D., Jensen, N., Ireland, S., Siple, J. and Neufeld, M. (2009) Development of aquaculture

methods for burbot *lota lota .* Idaho Chapter of the American Fisheries Society Annual Meeting, Boise, ID March 4-6

Cain, K.D., LaFrentz, B.R., LaPatra, S.E. and Call, D.R. (2009) Development and

characterization of rifampicin resistant *Flavobacterium psychrophilum* strains and their

potential as live attenuated vaccine candidates. Aquaculture America, Seattle, WA Feb.15-18

Cain, K.D., Jensen, N., Ireland, S., Siple, J. and Neufeld, M. (2009) Development of intensive

culture methods for burbot *lota lota.* Aquaculture America, Seattle, WA Feb.15-18

Barron JM, Jensen NJ, Jones RN, Ireland SC, Siple JT, Neufeld MD, Paragamian VL, Cain KD

(2009). Development and Optimization of Culture Techniques for the North American Burbot (*Lota lota maculosa*) US Fish and Wildlife Service Pacific Region Hatchery Management Workshop, November 3-5, Richland, WA

Johnson, TJ., BR. LaFrentz, and KD Cain (2009).  Development and optimization of a potential

vaccine for *Flavobacterium psychrophilum*, the bacterial agent of cold water disease. Fish Health Section of the American Fisheries Society annual meeting, June 8-10th, Park City, Utah

Johnson, TJ, BR. LaFrentz, DR. Call, and KD Cain (2009).  Characterization of an attenuated

*Flavobacterium psychrophilum* vaccine.  American Fisheries Society annual meeting, Aug 30th-Sept 3rd, Nashville, Tennessee

Burbank DR, LaPatra SE, FornshellG, Cain KD (2009) Assessing Candidate Probiotic use for

the Possible Control of *Flavobacterium psychrophilum* in Rainbow Trout (*Oncorhynchus mykiss*) Joint Meeting of the Fish Health Section and Western Fish Disease Workshop, June 7-10th, Park City, Utah, USA

Long A, Call DR, Cain KD (2009) Comparison of Diagnostic Techniques for Detection of

*Flavobacterium psychrophilum* in Ovarian Fluid. Joint Meeting of the Western Fish Disease Workshop and Fish Health Section of the American Fisheries Society Annual Meeting, June 7-10, Park City, Utah.

Plant KP, LaPatra SL, Call D, Cain KD (2009) recombinant protein vaccination with

Flavobacterium psychrophilum elongation factor Tu and iron-sulphur assembly protein SufB. Western Fish Disease Workshop and AFS Fish Health Section Annual Meeting, June 7-10th, Park City, Utah.

Polinski MP, Johnson KA, Snekvik KR, LaFrentz BR, Cain KD (2009) Investigation into the susceptibility of burbot *Lota lota maculosa* to select aquatic pathogens. Fish Health Section annual meeting and 50th annual Western Fish Disease Workshop of the American Fisheries Society, June 8-11, Park City, UT, USA

Polinski MP, Johnson KA, Snekvik KR, Drennan JD, Batts WN, Cain KD (2009) The

development of a cell line from burbot *Lota lota maculosa* with characterization of

susceptibility to IHNV, IPNV, and VHSV. Fish Health Section annual meeting and 50th

annual Western Fish Disease Workshop of the American Fisheries Society, June 8-11,

Park City, UT, USA

Polinski MP, Johnson KA, Ireland SC, Jensnen NR, Cain KD (2009) Evaluation of formalin and hydrogen peroxide used during egg incubation of burbot *Lota lota maculosa*. Annual Fish Health Section meeting and 50th annual Western Fish Disease Workshop of the American Fisheries Society, June 8-11, Park City, UT, USA

Jensen, N., Ireland, S., Siple, J., Neufeld, M., and Cain, K. (2008) Burbot hatchery design, development and renovations at the University of Idaho. 59th NWFCC, Spokane, WA December 2-4 2008.

Jensen, N., Williams, S., Ireland, S., Siple, J., Neufeld, M., and Cain, K. (2008) Development of intensive culture methods for burbot *Lota lota maculosa*. 59th NWFCC, Spokane, WA December 2-4 2008.

Polinski MP, Johnson KA, Snekvik KR, Ireland SC, Drennan JD, Cain KD (2008) Evaluation of formalin and hydrogen peroxide use during egg incubation. 59th NWFCC, Spokane, WA December 2-4 2008.

Cain, KD, and LaFrentz, BR (2008) Defining acquired immunity to *Flavobacterium psychrophilum*: implications for developing a coldwater disease (CWD) vaccine. 8th International Congress on the Biology of Fish, July 28-August 1, Portland, OR, USA

Cain, KD. (2008) Coldwater Disease Research Update: Vaccine Development. Idaho Aquaculture Association Annual Meeting, June 21, Twin Falls, ID

Polinski MP, Johnson KA, Snekvik KR, Ireland SC, Drennan JD, Cain KD (2008) Investigations into Disease Susceptibility and Diagnostic Tools for Burbot (Lota lota maculosa) Fish Health Section of the American Fisheries Society annual meeting, July 15-18th, Prince Edward Island, Canada

Plant, KP, LaPatra, SE, and Cain, KD (2008) Recombinant Protein Vaccination with

*Flavobacterium psychrophilum* Heat Shock Proteins 60 and 70 Induces a Strong Antibody Response. 49th Annual Western Fish Disease Workshop of the American Fisheries Society, June 23-25, Seattle, WA, USA

Polinski MP\*, Johnson KA, Snekvik KR, Ireland SC, Cain KD (2008) Evaluation of formalin and hydrogen peroxide use during egg incubation and preliminary investigations into diseases susceptibility of burbot (*Lota lota maculosa)* 49th Annual Western Fish Disease Workshop of the American Fisheries Society, June 23-25, Seattle, WA, USA

Polinski MP\*, Johnson KA, Snekvik KR, Ireland SC, Drennan JD, Cain KD (2008) Preliminary investigations into disease susceptibility of burbot (*Lota lota maculosa*) Annual Meeting of the Idaho Chapter of the American Fisheries Society, February 6-8, Post Falls, ID, USA

LaFrentz BR, LaPatra SE, Call DR, Cain, KD (2007) Characterization of attenuated strains of *Flavobacterium psychrophilum* generated by selection for rifampicin resistance. 48th Western Fish Disease Workshop and AFS Fish Health Section Annual Meeting, June 4-6, Jackson Lake Lodge, Grand Teton National Park, WY, USA

Plant, K., LaPatra, S., and Cain, K (2007) Heat shock proteins as DNA vaccine candidates against *Flavobacterium psychrophilum*. 48th Western Fish Disease Workshop and AFS Fish Health Section Annual Meeting, June 4-6, Jackson Lake Lodge, Grand Teton National Park, WY, USA

Lindstrom, N.M., LaFrentz, B.R., Hugunin, H., Call, D.R., and Cain, K.D. (2007) Proteomic analysis of a distinct molecular mass fraction of *Flavobacterium psychrophilum*. 48th Western Fish Disease Workshop and AFS Fish Health Section Annual Meeting, June 4-6, Jackson Lake Lodge, Grand Teton National Park, WY, USA

Cain, K.D., and Call, D.R. (2007) Comparative genomics and proteomics of *Flavobacterium psychrophilum*: Moving toward vaccine development. FY 07 Aquaculture ID and WA Annual Meeting, January 16-17, University Inn, Moscow, ID.

Cain, K.D. (2007) Reproductive aspects associated with the development of a conservation aquaculture program for burbot (*Lota lota maculosa*), 9th Annual Northwest Reproductive Sciences Symposium, March 23, University Inn, Moscow, ID.

Chen, J., LaFrentz, S.A., Davis, M.A., LaPatra, S.E., Cain, K., and Call D.R. (2007) Genetic variation of *Flavobacterium psychrophilum* examined by pulse-field gel electrophoresis. *Flavobacterium* 2007 Workshop, May 2-4, Shepherdstown, WV.

Cain, K., Sudheesh, P.S., LaFrentz, B.R., Call, D.R., Siems, W.F., LaPatra, S.E., and Wiens, G.D. (2007) Identification of potential vaccine target antigens by immunoproteomic analysis of a virulent and non-virulent strain of the fish pathogen *Flavobacterium psychrophilum*. *Flavobacterium* 2007 Workshop, May 2-4, Shepherdstown, WV.

Shah, D.H., Cain, K.D., and Call, D.R. (2007) Effects of codon usage bias on recombinant expression of *Flavobacterium psychrophilum* proteins in *E. coli*. *Flavobacterium* 2007 Workshop, May 2-4, Shepherdstown, WV.

Cain, K.D., LaFrentz, B.R., Lindstrom, N.M., LaPatra, S.E., and Call, D.R. (2007) Electorphoretic and western blot analyses of the lipopolysaccharide and glycocalyx of *Flavobacterium psychrophilum. Flavobacterium* 2007 Workshop, May 2-4, Shepherdstown, WV.

Cain, K.D., Lindstrom, N.M., Hamilton, M.J., House, M.L., and Call, D.R. (2007) A quantitative enzyme-linked immunosorbent assay (ELISA) and filtration-based fluorescent antibody test as potential tools for screening *Flavobacterium psychrophilum* in broodstock. *Flavobacterium* 2007 Workshop, May 2-4, Shepherdstown, WV.

Call, D.R., Soule, M., Shah, D., LaFrentz, S., Cheng, J., Ramsrud, A., Kang, M., LaFrentz, B.R., Cain, K.D., LaPatra, S.E., and Wiens, G.D. (2007) *Flavobacterium psychrophilum* is composed of two distinct gentetic lineages. *Flavobacterium* 2007 Workshop, May 2-4, Shepherdstown, WV.

Lloyd, S., Snekvik, L., St-Hilaire, S., LaPatra, S., Cain, K., and Call, D. (2007) A rickettsia-like organism is associated with strawberry disease lesions in rainbow trout. WSU Research Symposium, Fall 2007.

Cain, K. D. (Presenter & Author), CRB workshop, "Development of Burbot aquaculture techniques", CRB, Pullman, WA. (December 13, 2006).

Cain, K. D. (Presenter & Author), Western Regional Aquaculter Center Meeting, "Coldwater disease prevention and control through vaccine development and diagnostic improvements", Reno, NV. (October 5, 2006).

Cain, K. D. (Author Only), LaFrentz, B. (Presenter & Author), Lindstrom, N. (Author Only), LaPatra, S. (Author Only), Call, D. (Author Only), International Symposium on Aquatic Animal Health, "Analysis of *Flavobacterium psychrophilum* carbohydrate antigens and their potential role in protective immunity", San Francisco, CA. (September 4, 2006).

Cain, K. D. (Author Only), LaFrentz, B. (Presenter & Author), 47th Western Fish Disease Workshop, "An analysis of Flavobacterium psychrophilum carbohydrate antigens and their potential role in protective immunity", Victoria, BC. (June 27, 2006).

Cain, K. D. (Author Only), Maddox, T. (Presenter & Author), 47th Annual Fish Disease Workshop, "Development of autochthonous probiotics to control *Flavobacterium psychrophilum, Aeromonas salmonicida,* and *Yersinia ruckeri* in aquaculture", Victoria, BC. (June 26, 2006).

Cain, K. D. (Presenter & Author), Jensen, N. (Author Only), CRB annual retreat, "Cryopreservation of burbot semen", CRB, Dworshak Dam, Idaho. (June 1, 2006).

Cain, K. D. (Presenter & Author), Call, D. . (Presenter & Author), Aquaculture Initiative annual review, "CWD vaccine development", WSU/UI, Pullman, WA. (March 8, 2006).

Cain, K. D. (Presenter & Author), Aquaculture Initiative annual review, "Development of Probiotics for disease control in aquaculture", WSU/UI, Pullman, WA. (March 8, 2006).

Cain, K. D. (Author Only), LaFrentz, B. (Presenter & Author), Idaho Chapter of the Wildlife Society, Northwest Scection of the Wildlife Society, Northwest Scientific Association, and Northwest Lichenologists Annual Meeting, "An analysis of Flavobacterium psychrophilum carbogydrate antigens and their potential role in protective immunity", Boise, ID. (March 7, 2006).

Cain, K. D. (Author Only), LaFrentz, B. (Presenter & Author), Annual meeting of the Idaho chapter of the American Fisheries Society, "SDS-PAGE and western blot analysis of Flavobacterium psychrophilum carbohydrate antigens and their poteintial role in protective immunity", Idaho Falls, ID. (February 16, 2006).

Cain, K. D. (Presenter & Author), Fish Reproductive Biology monthly meeting, "Understanding transmission factors for WSIV in white stugeon", WSU, Pullman, WA. (January 2006).

Cain, K.D., and Drennan, J.D. 2005. Transmission of White Sturgeon Iridovirus in Kootenai River White Sturgeon (*Acipenser transmontanus*). Center for Reproductive Biology, Fish Reproduction Meeting (*Invited presentation*). December 15.

Jensen, N., Williams, S., Ireland, S., Siple, J., Neufeld, M., and Cain, K.D., 2005.

Development of conservation aquaculture strategies for restoration of burbot (*Lota lota maculosa*) in Idaho's Kootenai River. Northwest Fish Culture Conference. Boise, ID. December 2-6.

Cain, K.D., Jensen, N., Williams, S., Anders, P., and Ireland, S. 2005. Conservation aquaculture strategies for restoration of Burbot (*Lota lota*) in Idaho's Kootenai River. American Fisheries Society National Meeting. Anchorage, AK. (*Invited presentation*)September 11-16.

Cain, K.D., Sudheesh, P.S., LaPatra, S.E., Wiens, G.D., LaFrentz, B.R., and Call, D.R. 2005. Identification and expression of an immuno-reactive heat shock protein from *Flavobacterium psychrophilum*. AFS Annual Fish Health Section Meeting,. Minneapolis, MN July 25-28.

Drennan, J.D., LaPatra, S.E., Sampson, C. A., Ireland, S., and Cain, K.D. 2005.

Evaluation of Lethal and Non-lethal Sampling for the Detection of WSIV Infection in White Sturgeon (*Acipenser transmontanus*). AFS Annual Fish Health Section Meeting,. Minneapolis, MN July 25-28.

Soule, M., LaFrentz, S., Cain, K.D., LaPatra, S.E., and Call, D.R. 2005. Combining suppression subtractive hybridization and microarrays to map the intra-specific phylogeny of *Flavobacterium psychrophilum.* AFS 45th Western Fish Disease Workshop, Boise, ID, June 27-29.

Lindstrom, N.M., LaFrentz, S.A., Call, D.R., and. Cain, K.D. 2005. Development of an enzyme-linked immunosorbent assay (elisa) for detection of *Flavobacterium psychrophilum*. AFS 45th Western Fish Disease Workshop, Boise, ID, June 27-29.

Drennan, J.D., LaPatra, S.E., Sampson, C. A., Ireland, S., and Cain, K.D. 2005.

Evaluation of lethal and non-lethal sampling for the detection of WSIV infection in Kootenai river white sturgeon (*Acipenser transmontanus*). AFS 45th Western Fish Disease Workshop, Boise, ID, June 27-29.

Cain, K.D., LaPatra, S.E., and Fornshell, G. 2005. Development of autochthonous probiotics to control disease outbreaks in aquaculture. Idaho Aquaculture Association Meeting (*Invited presentation*). June 18.

Cain, K.C., Call, D.R., Sudheesh, P.S., LaFrentz, B.R., LaPatra, S.E., and Soule, M. 2005. Comparative genomics and proteomics of *Flavobacterium psychrophilum*. Annual WSU/UI Aquaculture Review. February 2005.

Cain, K.C., LaPatra, S.E., and Fornshell, G. 2005.Development of autochthonous probiotics to control disease outbreaks in aquaculture. Annual WSU/UI Aquaculture Review. February 2005.

Sudheesh, P.S., LaFrentz, B.R., LaPatra, S.E., Call, D., and Cain, K.D. 2004. Differential proteomic analysis of virulence associated and immunoreactive antigens of the salmonid pathogen, *Flavobacterium psychrophilum*. AFS Annual Fish Health Section Meeting, Kearneysville, West Virginia, July 25-28.

Drennan, J.D., LaPatra, S.E., Siple, J.T., Ireland, S., and Cain, K.D. 2004. Transmission of White Sturgeon Iridovirus in Kootenai River White Sturgeon (*Acipenser transmontanus*). AFS Annual Fish Health Section Meeting, Kearneysville, West Virginia, July 25-28.

Grabowski, L.D., LaPatra, S.E., and Cain, K.D. 2004. Relative Percent Survival and Antibody Response in Tilapia (*Oreochromis niloticus*) Following Immunization and Challenge with *Flavobacterium columnare*. AFS Annual Fish Health Section Meeting, Kearneysville, West Virginia, July 25-28.

LaFrentz, B.R., LaPatra, S.E., Jones, G.R. and Cain, K.D. 2004. An Investigation Into The protective Nature Of *Flavobacterium psychrophilum* Lipopolysaccharide Against Coldwater Disease. AFS Annual Fish Health Section Meeting, Kearneysville, West Virginia, July 25-28.

Cain, K.D., LaFrentz, B.R., Williams, S., Jones, G.R., and LaPatra, S.E. 2004. Transfer of maternally derived antibody to eggs and fry following broodstock immunization with *Flavobacterium psychrophilum* AFS 45th Western Fish Disease Workshop, Juneau, Alaska, June 22-24.

LaFrentz, S.E., Williams, S., Jones, G.R. and Cain, K.D. 2004. Potential for Broodstock Immunization as a Method to Reduce CWD in rainbow trout (*Oncorhynchus mykiss*) Fry. Idaho Aquaculture Association Annual Meeting, June 12-13 (invited presentation)

Cain, K.D., LaFrentz, B.R., and LaPatra, S.E. 2004. Can maternal transfer of immunity enhance disease resistance in rainbow trout fry? World Aquaculture Society Meetings, Honolulu, Hawaii, March 1-5.

Soule, M., LaFrentz, S., Oatley, M., Krug, M., LaFrentz, B., Cain, K., and Call, D. 2004. Comparative Genetics of Virulent and Avirulent Strains of *Flavobacterium psychrophilum*, Etiological Agent for Coldwater Disease in Salmonids, American Society of Microbiology, annual meeting.

Cain, K.D., LaFrentz, B.R., Jones, G.R., and LaPatra, S.E. 2003. Stimulating protective immunity to *Flavobacterium psychrophilum*. AFS Annual Fish Health Section Meeting and 44th Western Fish Disease Workshop, Seattle, Washington, July 14-17.

Cavender, W.P., Wood, J.S., Powell, M.S., Overturf, K., and Cain K.D. 2003. A quantitative PCR (QPCR) approach to rapidly identify *Myxobolus cerebralis* and determine infection severity in rainbow trout. AFS Annual Fish Health Section Meeting and 44th Western Fish Disease Workshop, Seattle, Washington, July 14-17.

Grabowski, L.D., LaPatra, S.E., and Cain, K.D. 2003. Systemic and mucosal antibody response to *Flavobacterium columnare* vaccine preparations in tilapia (*Oreochromis niloticus*). AFS Annual Fish Health Section Meeting and 44th Western Fish Disease Workshop, Seattle, Washington, July 14-17.

LaFrentz, B.R., LaPatra, S.E., and Cain, K.D. 2003. Characterization of protective antigens of *Flavobacterium psychrophilum.* AFS Annual Fish Health Section Meeting and 44th Western Fish Disease Workshop, Seattle, Washington, July 14-17.

Cain, K.D., Cavender, W.P., and Johnson, K.A. 2003. Understanding *Myxobolus cerebralis* distribution during the migration period for juvenile anadromous salmonids: Implications for the use of propagated fish in positive waters. AFS special symposium: Propagated Fish in Resource Management, Boise, Idaho, June 16-18 (invited presentation)

Cain, K.D., LaFrentz, B.R., Jones, B.R., and LaPatra, S.E. 2003. Identification of vaccine target antigens of *Flavobacterium psychrophilum*, the causative agent of coldwater disease and rainbow trout fry syndrome. World Aquaculture society Annual Meeting, Salvador, Brazil, May 19-23.

LaFrentz, B.R., LaPatra, S.E., Jones, G.R., Congleton, J.L., Sun, B., and Cain, K.D. 2003. Characterizaton of serum and mucosal antibody responses in rainbow trout (*Oncorhynchus mykiss*) following immunization with *Flavobacterium psychrophilum*. 3rd International Symposium on Fish Vaccinology, Bergen, Norway, April 9-11.

Cain, K.D., LaPatra, S.E., and LaFrentz, B.R. 2003. Identification of Immunoprotective Antigens of *Flavobacterium psychrophilum* and the Potential for Broodstock Vaccine Development. WSU/UI Center for Reproductive Biology and National Marine Fisheries Service Mini Symposium, Seattle, Washington, March 20-21 (invited presentation)

Cavender, W.P., Johnson, K.A., and Cain, K.D. 2003. Distribution of *Myxobolus cerebralis* within a free-flowing river system during the migration period for juvenile anadromous salmonids in Idaho. Whirling Disease Symposium, Seattle, Washington, February 6-7.

Cavender, W.P., Wood, J.S., Powell, M.S., and Cain, K.D. 2003. A quantitative PCR (QPCR) approach to rapidly identify *Myxobolus cerebralis* and determine infection severity in rainbow trout. Whirling Disease Symposium, Seattle, Washington, February 6-7.

Simpson, P.R., Peterson, B.C., Cain, K.D., Hardy, R.W., Overturf, K., and Ott, T.L. 2002. Physiological effects of recombinant bovine somatotropin (rbST) in rainbow trout (*Oncorhynchus mykiss*). First Joint Symposium GH-IGF, Boston, Massachusetts, October 5-9.

LaPatra, S.E., LaFrentz, B.R., Jones, G.R., Morton, A.W., Higgins, M., and Cain, K.D. 2002. Susceptibility of passively immunized rainbow trout and challenge survivors to *Flavobacterium psychrophilum*. 4th International Symposium on Aquatic Animal Health, New Orleans, Louisiana, September 1-5.

LaFrentz, B.R., LaPatra, S.E., Jones, G.R., Congleton, J.L., Sun, B. and Cain, K.D. 2002. Characterization of serum and mucosal antibody responses and relative percent survival in rainbow trout (*Oncorhynchus mykiss*) following immunization and challenge with *Flavobacterium psychrophilum*. 4th International Symposium on Aquatic Animal Health, New Orleans, Louisiana, September 1-5.

Cain, K.D., LaFrentz, B.R., Grabowski, L.G., and LaPatra, S.E. 2002. Antigenic and immunogenic properties of *Flavobacterium psychrophilum*. 4th International Symposium on Aquatic Animal Health, New Orleans, Louisiana, September 1-5.

LaFrentz, B.R., LaPatra, S.E., Jones, G.R., and Cain, K.D. 2002. Passive immunization of rainbow trout *(Oncorhynchus mykiss*) against *Flavobacterium psychrophilum*. 4th International Symposium on Aquatic Animal Health, New Orleans, Louisiana, September 1-5.

Drennan, J.D., Ireland, S., Siple, J., LaPatra, S., and Cain, K.D. 2002. Investigating the role of vertical transmission of WSIV and characterizing mechanisms of viral immunity in White Sturgeon (*Acipenser transmontanus*). Columbia River Basin White Sturgeon Symposium, Vancouver, Washington, August 12-14.

LaPatra, S.E., LaFrentz, B.R., Jones, G.R., Morton, A.W., Higgins, M., and Cain, K.D. 2002. Susceptibility of passively immunized rainbow trout and challenge survivors to *Flavobacterium psychrophilum*, 43rd AFS/Western Fish Disease Workshop, Corvallis, Oregon, June 25-26.

Cain, K.D., LaFrentz, B.R., Jones, G.R., and LaPatra, S.E. 2002. Passive immunization of rainbow trout against *Flavobacterium psychrophilum*. 43rd AFS/Western Fish Disease Workshop, Corvallis, Oregon, June 25-26.

Cain, K.D. 2002. Fish Vaccine development: Implications for Improved Reproductive Efficiency. Center for Reproductive Biology 6th Annual Retreat, Camp Larson – Coeur d’Alene Lake, Idaho, June 13-14 (invited presentation)

LaFrentz, B.R., LaPatra, S.E., Jones, G.R., Congleton, J.L., Sun, B., and Cain, K.D. 2002. Characterization of serum and mucosal antibody responses and relative percent survival in rainbow trout (*Oncorhynchus mykiss*) following immunization and challenge with *Flavobacterium psychrophilum*. Idaho Aquaculture Association annual meetings, Twin Falls, Idaho, June 8 (invited presentation)

Cain, K.D. 2002. Broodstock immunization: A potential strategy to reduce disease related mortality in ESA listed stocks. Salmon Recovery Symposium: Issues on Pacific Salmon Recovery in the Northwest: Reproduction and Conservation, Moscow, Idaho, March 28-29 (invited presentation)

Cavender, W.P., Johnson, K.A., and Cain, K.D. 2002. Distribution of *Myxobolus cerebralis* during the migration period for juvenile anadromous salmonids in the Snake and Salmon rivers of Idaho. 8th Annual Whirling Disease Symposium, Denver, Colorado, February 13-15.

Cain, K.D. 2002. Pathology and disease dispersal in supplemented systems: Identification of disease-related risks. Tribal supplementation workshop. Moscow, Idaho, January 24-25(invited presentation)

Cain, K.D. 2001. Broodstock vaccination strategies for enhanced reproductive efficiency through disease resistance, Center for Reproductive Biology (WSU/UI): Salmon Recovery Program & National Marine Fisheries Service Meeting, Spokane, Washington, November 13 (invited presentation)

Cain, K.D., Grabowski, L., and LaPatra, S.E. 2001. Separation and comparison of proteins from virulent and nonvirulent strains of the fish pathogen *Flavobacterium psychrophilum*, AFS/Fish Health Section meetings, Victoria, B.C. Canada.

LaFrentz, B.R., Grabowski, L., LaPatra, S.E., and Cain, K.D. 2001. Characterization of serum and mucosal antibody responses to *Flavobacterium psychrophilum*: Is antibody important for protection? AFS/Fish Health Section meetings, Victoria, B.C. Canada.

LaPatra, S.E., Shewmaker, W., Jones, G., Cain, K., and Overturf, K. 2001. Understanding aquatic animal virus survival and its role in risk assessment. AFS/Fish Health Section meetings, Victoria, B.C. Canada.

Cain, K.D., Mucosal and Systemic Immunity in Fish. Oregon State University’s Fish Disease Laboratory Seminar series, Corvallis, Oregon. March 2001 (invited presentation)

Cain, K.D. 2000. Immune responses in fish: What affects resistance to disease? Idaho Aquaculture Association annual meetings, Twin Falls, Idaho (invited presentation)

Cain, K.D., Jones, D.R. and Raison, R.L., 2000. Antibody-antigen kinetics following immunization of rainbow trout (*Oncorhynchus mykiss*) with a T-cell dependent antigen. 8th Congress of the International Society of Developmental and Comparative Immunology, Cairns, Australia (invited presentation)

Prasad, S.S., Cain, K.D., Jones, D.R. and Raison, R.L. 1999. Identification of cell surface proteins using 2-D gel electrophoresis. *Conference proceedings* Royal North Shore Hospital/ University of Technology, Sydney, Australia.

**Patents (issued and pending), invention disclosures, and licensed technology:**

McBride, B., Gibson, C., Alajmi, H., Cain, K. and Swenson, M. “Fish Vaccination System”. Invention Disclosure (Filed December 2020)

**Cain, K.D. and Burbank, D.R. “Probiotic Bacterial Strains For Use to Decrease Mortality In Fish Due to Bacterial Disease”. Issued on August 27th, 2013. US Patent No. 8,518,413**

Cain, K.D. and Burbank, D.R. Probiotic Bacterial Strains and Method of Use to Decrease Mortality Due to Bacterial Disease. Full patent application filed on April 5th, 2012 (PCT Application PCT/US2012/029896)

**Cain, K.D. Enhanced efficacy of an attenuated CWD vaccine following culture in iron limited media.**

**Provisional patent application filed August 25th, 2011, case number 11-019.**

Cain, K.D. and Burbank, D.R. Discovery of specific probiotics bacterial strains capable of reducing disease-

related mortality in aquaculture. Provisional patent application filed April 7th, 2011.

**Cain, K.D., LaFrentz, B.R., and LaPatra, S.E. "Vaccines for Diseases of Fish," issued on June 22, 2010**

**as US Patent No.** **7,740,864 – Patent Licensed from UI by Merck Animal Health (confidential)**

**Cain, K.D. An antibody for screening salmon and trout broodstock for the aquatic pathogen *Flavobacterium psychrophilum*, which causes bacterial coldwater disease and rainbow trout fry syndrome. Technology licensed to ImmunoPrecise Antibodies, Ltd. (2009)**

Cain, K.D., Probiotic bacterial strain C6-6 (*Enterobacter sp.*) for use in fish disease control. Invention disclosure (OTT case number 09-002; filed: 2009)

Cain, K.D., LaFrentz, B.R., and LaPatra, S.E. Vaccines for diseases of fish. Non-provisional patent filed 6/2/08; patent application number 12/156,509

Cain, K.D., LaFrentz, B.R., and LaPatra, S.E. Development of a rifampicin resistant strain of *Flavobacterium psychrophilum* for use as a live attenuated vaccine for the prevention of bacterial coldwater disease and rainbow trout fry syndrome, (Provisional patent application filed on 6/22/2007, application number 60/936,756).

Cain, K.D., Call, D., and Lindstrom, N. Development of a quantitative ELISA to detect *Flavobacterium psychrophilum*, Invention Disclosure, (Filed: February 2007).

Cain, K.D. and Cavender, W. QPCR diagnostic probe for detecting the whirling disease parasite in fish: Real-time quantitative polymerase chain reaction (QPCR) technique composed of a forward and reverse primer and a TazMan® Minor Groove Binding (MGB) probe specific for the genetic sequence that encodes the Heat shock protein 70 (Hsp 70) gene of *Myxobolus cerebralis*. Invention Disclosure, (Filed: October 2003).

**Grants and Contracts Awarded:**

**Funded:**

Cain, K.D. (PI) Utilization of copepods as alternatives to rotifers and/or Artemia for weaning of larval burbot (*Lota lota maculosa*). Reed Mariculture (private company). **$12,480** (May 15 – Dec 31, 2021)

Kumar, V. (PI), Cain, K.D. (Co-PI) Dietary evaluation of Black soldier fly larval meal (full fat and defatted) in plant protein-based diets for improving the growth and health of rainbow trout (*Oncorhynchus mykiss*). Enviroflight (private company). **$65,864** (June 1, 2021 to May 31, 2022)

Cain, K.D. (PI) Evaluation of survival and immune response to IHNv challenge in juvenile rainbow trout fed commercial health-promoting diets. Zeigler (private company), **$29,970** (Oct. 1, 2020 – June 1, 2021)

Cain, Kenneth (PI) Coldwater vaccine optimization for licensing and commercialization. Private Animal Health Company. **$222,250 (**Oct. 2020 – Sept. 2021)

Cain, Kenneth, Evaluation of commercial and experimental starter (and grow out) diets for Atlantic Salmon. Skretting (private aquaculture feed company) **$25,880** (July 2020 - Dec 2020)

Cain, K.D. (PI), Soto, E. (Co-PI), Fornshell, G. (Co-PI), Bruce T.J. (Co-PI), Ma, J. (Co-PI) Emerging and Re-emerging Flavobacterial Pathogens in Aquaculture, Western Regional Aquaculture Center (WRAC), **$417,000** (Sept. 2019 – Aug. 2022)

Cain, K.D. (PI), Hawkard, M. (Co-PI OSU), Bruce, T.J. (Co-PI), Ma, J. (Co-PI). Development of oral vaccine delivery methods for prevention of disease in finfish culture, Western Regional Aquaculture Center (WRAC), **$479,000** (Sept. 2019 – Aug. 2023)

Bruce, T.J. (PI), Cain, K.D. (Co-PI). Investigation of gut microbiota, physiological stress response, and immune parameters in cultured burbot (*Lota lota*), USDA-NIFA Postdoctoral Fellowship award. **$159,829.00** (June 2019 -May 2021)

Welker, Tom (PI), Overturf, Ken, Cain, Ken (Co-PI). Underlying Mechanisms For Selected Disease Resistance And Enhanced Non-Specific Resistance In Rainbow Trout. USDA-NIFA Special Aquaculture Grant program. **$309,489** (Oct. 2018 – Sept. 2020)

Cain, Kenneth, “Evaluation of Atlantic salmon starter feed formulations” Skretting (aquaculture feed company) **$43,017** (July 2019- Oct. 2020)

Cain, Kenneth, “Evaluation of IHNv vaccination response/efficacy” Pacific Seafoods (aquaculture company) **$8,215.00** (July 2019- Dec 2019)

Cain, Kenneth, “Effects of feed additives on BKD susceptibility” Bren School of Environmental Science & Management, University of California, **$14,425.00** (Jan 2019- July 2019)

Kumar, Vikas (PI), Cain, K.D. (Co-PI). OREKA Natural Gut Health. **$20,000** (Cain lab component), (Aug. 2019 – October 2019)

Cain, Ken (PI), Hardy, Ron, Bruce, Tim, Small, Brian. Effects of dietary soy replacement on burbot (freshwater cod) growth and immune function: implications for commercial culture of this new and novel species. Soy Aquaculture Alliance. **$92,998** (Oct. 2018 – Sept. 2019)

Cain, Kenneth (Principal), Coldwater vaccine optimization for licensing and commercialization. Private Animal Health Company. ($93,735 (2014) + $34,695 (2015) +$36,600 (2016) + $187,298 (2017) + $207,000 (2018) + $217,696 (2019) + : Cumulative total = $786,981 (Jan. 2015 – September 2020)

Cain, K.D. (PI). Temperature effects on early life stages of the North American Burbot: Implications for restoring the lower Kootenai River population. Kootenai Tribe of Idaho, **$20,199** (Jan. 2019 - Feb. 2020)

Cain, K.D. (PI). Temperature effects on early life stages of the North American Burbot: Implications for restoring the lower Kootenai River population. Kootenai Tribe of Idaho, **$50,884** (Jan. 2018 - Feb. 2019) – funded

Cain, K.D. (PI). ORED FY19 EIS - CNR Aquatic Animal Laboratory (AAL) ORED FY19 EIS Infrastructure Support Request, UI Office of Research and Economic Development, **$38,791** (Jan. 2019-April 2019) – funded

Cain, Kenneth (Principal), “Evaluating an experimental IHNV RP vaccine” Research Services. Private Industry Partner. **$8,800** (Feb. 2018-Dec 2018)

Cain, K.D. (PI) ORED FY19 Generator tie in (infrastructure improvement request), UI Office of Research and Economic Development, **$10,000** (Feb – May 2019)

Small, Brian (PI), Cain, Ken (CO-PI), Hardy, Ron (Co-PI), Overturf, Ken (Co-PI) Developing critical knowledge of intestinal microbiota and mucosal immune system influence on early fish health using a unique trout model. USDA-NIFA **$149,949.00** (1/1/18 – 12/31/19)

Salinas, Irene (PI), Cain, Ken (Co-PI) Understanding the duration and mechanisms of long-lasting protection of nasal vaccines in rainbow trout. USDA-NIFA **$500,000** ($50,000 to UI)(8/1/17-7/31/21)

Cain, Ken (PI), Myrick, Chris (CoPI), Fornshell, Gary (Co-PI). Developing “freshwater cod” or burbot (Lota lota) into a viable commercial aquaculture species in the United States. USDA-Western Regional Aquaculture Center (WRAC), **($444, 783**) (Oct. 2017-Oct. 2021)

Loch, T. (PI), Faisal, M. (PI), Cain, Kenneth (PI), and Call, D. (PI), Flavobacterial diversity and its effect on disease in aquaculture. **$360,428** ($79,526 to UI) (Jan. 2016-Jan 2019)

Cain, Kenneth (Principal), Thermal bottlenecks affecting reproductive success of burbot. Sponsored by the Kootenai Tribe of Idaho (BPA), Federal, (**$106,194**) (Feb. 2017-Jan. 2018)

Cain, Kenneth (Principal), “Kootenai River Burbot egg/embryo/larval Temperature dependent survival study. USFWS. (**$45,000+$55,000 + $55,000)** (July 2015 – June 2018)

Cain, Kenneth (Principal), “Identification of critical thermal bottlenecks affecting embryo and early life-stage development for Burbot Lota lota: Implications for Kootenai River hydro-management” (Idaho Department of Fish and Game. (**$104,371**) (May 2015-May 2018)

Cain, Kenneth (Principal), “Development of Burbot (Lota lota) conservation aquaculture and evaluation of disease susceptibility”, Sponsored by the Kootenai Tribe of Idaho (BPA), Federal, (**$170,889**) (January 2014 – January 2016)

Cain, Kenneth (Principal),”Licensing and Commercializing a live attenuated aquaculture vaccine” (Idaho Department of Commerce – Idaho Global Entrepreneurial Mission), State funding, (**$105,452**) (September 2015 – June 2017)

Cain, Kenneth (Principal),” Commercializing newly developed aquatic animal health products to benefit aquaculture through disease reduction” (Idaho Department of Commerce – Idaho Global Entrepreneurial Mission), State funding, (**$124,021**) (July 2013 – November 2014)

Cain, Kenneth (Principal), “Performance Analysis of Algae Meal as a Feed Ingredient in Salmonids”, Research and Development Contract, Algal Scientific (Private Company) (**$13,753**) February 2013 – July 2013)

Cain, Kenneth (Principal), “Development of Burbot (Lota lota) conservation aquaculture and evaluation of disease susceptibility”, Sponsored by the Kootenai Tribe of Idaho (BPA), Federal, (**$170,889**) (January 2013 – January 2014)

Cain, Kenneth (Principal), Ashton, Neil (student), Measuring the effectiveness of coded wire tagging as a potential tool for mass marking juvenile burbot (*Lota lota*) for population recovery efforts in the Kootenai river of Idaho and British Columbia, Northwest Marine Technologies (Biomark -Private Company), ($**15,000**) (September 2012-January 2013)

Cain, Kenneth (Principal), Finalizing Critical Needs for Commercialization and Licensing of a Coldwater

Disease Vaccine, Research and Development Contract, Aquatic Life Sciences (Private Company), **($20,000**) (November 2012-February 2013)

Cain, Kenneth (Principal), “Development of Burbot (*Lota lota*) conservation aquaculture and evaluation of disease susceptibility”, Sponsored by the Kootenai Tribe of Idaho (BPA), Federal, **$172,295** (January 2012 – January 2013)

Cain, Kenneth (Principal), “Development of Burbot (*Lota lota*) conservation aquaculture and evaluation of disease susceptibility”, Sponsored by the Kootenai Tribe of Idaho (BPA), Federal, **$167,930** (January 2011 – January 2012)

Cain, Kenneth (Principal), “Development of Burbot (*Lota lota*) conservation aquaculture and evaluation of disease susceptibility”, Sponsored by the Kootenai Tribe of Idaho (BPA), Federal, **$161,741** (January 2010 – January 2011)

Cain, Kenneth D (Principal), "Commercializing autochthonous probiotics to control fish diseases in

aquaculture", Idaho State Board of Education, Incubation fund grant, **$34,848** (April 2011 – July 2012)

Cain, Kenneth (Principal), “Pilot testing of potential phyto-therapeutics for inhibition of bacterial pathogens important to aquaculture”, Research service agreement, Private company (Liveleaf Biosciences), $5,489 (October 2010 – April 2011)

Gilman, Vladimir (Prinicpal) Cain, Kenneth (Co-Principal) Development of a High Sensitivity and Specificity Quantitative Aptamer Assay for Coldwater Disease Management Applications. Sponsored by Infoscitex Corporation as a USDA/SBIR phase I subcontract, Federal, **$100,000** ($27,000 to UI), (July 2010 – Jan 2011)

Cain, Kenneth D (Principal), "Comparative genomics and proteomics of *Flavobacterium psychrophilum*:

moving toward vaccine development", Sponsored by WSU/UI Aquaculture Initiative

(USDA/CSREES), Federal**, $96,000** ($43,000 UI). (October 2010 - October 2011).

Cain, Kenneth D (Principal), "Comparative genomics and proteomics of *Flavobacterium psychrophilum*:

moving toward vaccine development", Sponsored by WSU/UI Aquaculture Initiative

(USDA/CSREES), Federal**, $100000** ($50,000 UI). (October 2009 - October 2012).

Cain, Kenneth D (Principal), "Development of autochthonous probiotics to control fish diseases in

aquaculture", Sponsored by WSU/UI Aquaculture Initiative (USDA/CSREES), Federal, **$30,000**

(October 2009 - October 2012).

Hardy, McIver, Cain, Murdock, Powell, Rodnick. Transforming environmental and physiological assessments using fish erythrocyte gene expression to measure responses. *National Science Foundation.* **$600,000** (12/09-12/11).

Hardy, Ron (Principal); Cain, Kenneth (Co-Principal), “Converting Alaska fish byproducts into value added ingredients and products” Sponsored by USDA, ARS (University of Alaska), Federal, $**234,956** (September 2009 – September 2012)

Cain, Kenneth (Principal); Plant, Karen (Co-Principal), “Understanding innate defense mechanisms to enhance control strategies for infectious hematopoietic necrosis virus in rainbow trout.” Sponsored by WSU/UI Aquaculture Initiative (USDA/CSREES), Federal, **28,000** (October 2009 - October 2010)

Cain, Kenneth (Principal), “Development of Burbot (*Lota lota*) conservation aquaculture and evaluation of disease susceptibility”, Sponsored by the Kootenai Tribe of Idaho (BPA), Federal, **$154,151** (November 2008 – January 2010)

Cain, Kenneth D (Principal), "Comparative genomics and proteomics of *Flavobacterium psychrophilum*:

moving toward vaccine development", Sponsored by WSU/UI Aquaculture Initiative

(USDA/CSREES), Federal, **$100000** ($40,000 UI). (October 2008 - October 2009).

Cain, Kenneth D (Supporting), Douglas Call (Co-Principal - WSU), "Identifying the etiologic agent of

Strawberry Disease in rainbow trout", Sponsored by WSU/UI Aquaculture Initiative, Federal, $**25,000 UI**.

(October 2008- October 2009).

Cain, Kenneth D (Principal), Douglas Call (Co-Principal - WSU), Fornshell, Gary CG (Supporting), "Coldwater disease prevention and control through vaccine development and diagnostic improvements", Sponsored by Western Regional Aquaculture Center (USDA/CSREES), Federal, **$324,874**: $158,230 to UI. (October 2007 - October 2011).

Cain, Kenneth D (Principal), "Comparative genomics and proteomics of *Flavobacterium psychrophilum*:

moving toward vaccine development", Sponsored by WSU/UI Aquaculture Initiative

(USDA/CSREES), Federal, **$100,000**: $50,000 to UI. (October 2007 - October 2008).

Cain, Kenneth (Principal), “Development and Evaluation of Extensive Larval and Juvenile Rearing Techniques and Systems for Burbot (*Lota Lota maculosa*) to meet Conservation Aquaculture Needs”, Sponsored by USFWS, Federal, **$66,000** (October 2007 – September 2011).

Cain, Kenneth (Principal), “Development of Burbot (*Lota lota*) conservation aquaculture and evaluation of disease susceptibility”, Sponsored by the Kootenai Tribe of Idaho (BPA), Federal, **$143,362** (November 2007 – November 2008)

Cain, Kenneth (Principal), Tim Alefantis (Co-Principal) “Bacterial Ghosts as a Vaccine for the Prevention of Cold Water Disease Affecting the Salmonid Aquaculture Industry”, Sponsored by Vital Probes, Inc. as a USDA/SBIR phase I subcontract, Federal**, $75,000:** $22,624 to UI, (July 2007 – Jan 2009)

St. Hilaire, Sophie (Principal – ISU), Cain, Kenneth (Co-investigator with many others), “The development of an oral delivery system for DNA vaccines in aquatic species”, Idaho State Board of Education (SBOE) One-time grant, **$550,000**: $24,150 to UI. (January 2008 – January 2010)

Strom, Mark (Principal-NOAA), Cain, Kenneth (Co-Principal), “Genomic and proteomic expression profiling of *Renibacterium salmoninarum* during the infection of Chinook salmon”, NOAA Fisheries, Federal**, $90,088** (September 2007 – September 2009)

Cain, Kenneth D (Supporting), "Identifying the etiologic agent of Strawberry Disease in rainbow trout",

Sponsored by WSU/UI Aquaculture Initiative, Federal**, $35000**. (October 2007 - October 2009).

Cain, Kenneth D (Principal), "Development of Burbot (Lota lota) conservation aquaculture and evaluation

of disease susceptibility", Sponsored by Kootenai Tribe of Idaho (BPA), Federal, **$126963**. (December

2006 - December 2008).

Cain, Kenneth D (Principal), "Comparative genomics and proteomics of *Flavobacterium psychrophilum*:

moving toward vaccine development", Sponsored by WSU/UI Aquaculture Initiative

(USDA/CSREES), Federal, **$100000**. (October 2006 - October 2007).

Cain, Kenneth D (Principal), "Development of autochthonous probiotics to control fish diseases in

aquaculture", Sponsored by WSU/UI Aquaculture Initiative (USDA/CSREES), Federal**, $34987.**

(October 2006 - October 2009).

Cain, Kenneth D (Supporting), "Identifying the etiologic agent of Strawberry Disease in rainbow trout",

Sponsored by WSI/UI Aquaculture Initiative, Federal**, $35000**. (October 2006 - October 2007).

Cain, Kenneth D (Co-Principal), "Control of BKD by Inactivation of the *Renibacterium salmoninarum*

Sortase as an Alternative to Antibiotics", Sponsored by NOAA/NMFS, Federal, **$79720**. (September

2006 - September 2007).

Cain, Kenneth D (Principal), "ELISA detection of antibody response in fish", IDFG, **$700.** (September 2006

- November 2006).

Cain, Kenneth D (Co-Principal), "Genomic and proteomic expression profiling of Renibacterium

salmoninarum during the infection of Chinook salmon", Sponsored by NOAA/NMFS, Federal,

**$24600.** (May 2006 - September 2006).

PI: Dr. Ken Cain, Co-PI: Dr. Keith Johnson (IDFG), Distribution of *Mxyobolus cerebralis* during the Migration Period for Juvenile Anadromous Salmonids in the Snake and Salmon Rivers of Idaho, Whirling Disease Foundation, 9/00-12/01**, $29,954.**

PI: Dr. Scott LaPatra Co-PI: Dr. Ken Cain, Immunological Responses of Rainbow Trout to Coldwater Disease, USDA/SBIR phase I proposal with Clear Springs Foods, 5/01-11/01**, $75,000** (subcontract: $22,212).

PI: Dr. Charles Hatch, Co-investigators: Brannon, Hardy, Powell, Cain, Overturf. Innovative Seafood Production: Customizing Feeds/Fish in Sustainable Aquaculture, NSF, 1/01-12/04, **$564,709.**

Support (to date) under this funding:

PI: Dr. Ken Cain, Immune response to *Flavobacterium columnare* in tilapia *(Oreochromis niloticus):* implications for an ornamental fish vaccine, approx.: $100,000.

PI: Dr. Ken Cain, Effects of Density on Manifestation of WSIV in White Sturgeon, Kootenai Tribe of Idaho, 4/01-12/01, **$10,000.**

PI: Dr. Ken Cain, Co-PI: Dr. Keith Johnson (IDFG), Distribution of *Mxyobolus cerebralis* during the Migration Period for Juvenile Anadromous Salmonids in the Snake and Salmon Rivers of Idaho, continued funding through LSRCP and Idaho Power, 1/01-12/01, **$16,092.**

PI: Dr. Ken Cain, Beneficial Use Reconnaissance Program (BURP), Idaho DEQ, 8/01- 11/01, **$164,080.**

Co-PI: Dr. Ken Cain, USDA/CSREES: Aquaculture Idaho and Washington: Congressional initiative in support of aquaculture research at UI and WSU: FY02 $600,000: FY03 $750,000: FY04 $650,000. Funding supports small individual and larger WSU/UI collaborative projects.

Support (to date) under this funding:

PI: Dr. Ken Cain, Mucosal Immunity in Fish: Triggering the First Line of Defense, 9/02- 9/05, FY02 $30,000: FY03 $35,000: FY04 **$35,000.**

PI: Dr. Ken Cain, Co-PI: Dr. Doug Call, Collaborators: Scott LaPatra, Gary Thorgaard, Ken Overturf. Comparative genomics and proteomics of *Flavobacterium psychrophilum* and regulation of host genes during a protective immune response, 9/02-9/04, **FY02 $100,000{$50,000 (UI)}: FY03 $100,000 {$50,000 (UI)}: FY04 $100,000 {$50,000 (UI)}.**

PI: Dr. Ken Cain*,* Separation and comparison of proteins from virulent and nonvirulent strains of the fish pathogen *Flavobacterium psychrophilum,* using a 2-D electrophoretic approach, Bio-Rad company, 3/01**, $500**.

PI: Dr. Ken Cain, (Service contract), Histology and data analysis, Clear Springs Foods, Inc., 9/00-1/01, **$7,000**.

PI: Dr. Ken Cain, (Service contract), Data analysis for Tilapia diet study, Hartz Mountain Corporation, 1/01-5/01, **$4,500.**

PI: Dr. Ken Cain, (Service contract), Analysis of fish T-cell antibodies, Immuno-Precise Antibodies Ltd., 1/02- 10/02, **$3,800.**

PI’s: Dr. Ken Cain, Dr. Douglas R. Call, Dr. Rollin Hotchkiss, Dr. Frank J. Loge, Development of a Comprehensive Monitoring Protocol to Characterize the Concentration and Associated Health Risks of Salmonid Pathogens Suspended in Water, Washington Water Resources, December 2001, **$19,997.**

PI’s: Cain, Cloud, Nagler, Thorgaard, Ingermann, Byrne, McElwain, Passavant, Phillips, WSU/UI Center for Reproductive Biology, WSU and UI Salmon Restoration Program – “Broodstock Vaccination Strategies for Enhanced Reproductive Efficiency Through Disease Resistance” and 8 other projects,USFWS **($500,000 FY02; $375,000 FY03)**

Support (to date) under this funding:

PI: Dr. Ken Cain, Reduction of disease-related impacts on important salmonid stocks through broodstock immunization against key pathogens, 7/02-10/05, $101,947.

PI: Dr. Ken Cain, Identifying and evaluating immunogenic components of the fish pathogen *Flavobacterium psychrophilum.* UI seed grant program, 7/02-10/03**, $10,000.**

PI: Dr. Ken Cain, A Quantitative PCR (QPCR) Approach to Rapidly Distinguish Between *Myxobolus* Species and Assess Infection Severity in Fish. Whirling Disease Foundation, 7/02-12/03**, $35,167.**

PI: Dr. Scott LaPatra Co-PI: Dr. Ken Cain, Immunity to *Flavobacterium psychrophilum* antigens and development of a coldwater disease (CWD) vaccine. USDA/SBIR 9/03-9/05, **$299,907** (Subcontract $148,000 to UI).

PI: Dr. Ken Cain, Feasibility assessment and development of Burbot *(Lota lota)* conservation aquaculture. Kootenai Tribe of Idaho, 9/03-9/04, **$46,545.**

PI: Dr. Ken Cain, Primitive mechanisms of immunity in white sturgeon *(Acipenser transmontanus)* to the viral pathogen, white sturgeon iridovirs (WSIV).UI seed grant program, 7/03-7/04**, $9,909.**

PI: Dr. Ken Cain, Gary Fornshell, Bacterial disease workshop,UI/WSU Aquaculture Initiative Extension Products, Support for hosting annual disease workshop in Hagerman, Idaho, 04-05, **$4,142.**

PI: Dr. Fran Wagner, Dr. Ken Cain, Dr. George Newcombe, Dr. Armando MacDonnell, Under the microscope. USDA Equipment grant for teaching microscope, 03 **$25,000**.

PI: Dr. Ken Cain and John Drennan, Direct DNA amplification of the *ribonucleotide reductase* gene from white sturgeon *iridovirus.* Laboratory for Ecological and Conservation genetics – DeVlieg Small Grants Project, **$683.**

PI: Dr. Ken Cain, Burbot *(Lota lota)* Development of Conservation Aquaculture Techniques for Burbot *(Lota lota).* Kootenai Tribe of Idaho, 9/04-9/06, **$97,357**

PI: Dr. Ken Cain, Improved Methods to Limit Vertical Transmission of WSIV in Progeny of White Sturgeon, Kootenai Tribe of Idaho, 3/02-12/05, **$126,373:** ($53,209 – yr 1, $35,068 – yr 2, $38,096 – yr 3)

**Submitted (past 5 years):**

**2020 (total grant dollars for submitted proposals = $1,501,423.50)**

Cain, K.D. (PI) Evaluation of survival and immune response to IHNv challenge in juvenile rainbow trout fed commercial health-promoting diets. Zeigler (private company), **$29,970** (Oct. 1, 2020 – June 1, 2021) - **funded**

Cain, Kenneth (PI) Coldwater vaccine optimization for licensing and commercialization. Private Animal Health Company. **$222,250** (Oct. 2020 – Sept. 2021) – **funded**

Cain, Kenneth, Evaluation of commercial and experimental starter (and grow out) diets for Atlantic Salmon. Skretting (private aquaculture feed company) **$25,880** (July 2020 - Dec 2020) – **funded**

Cain, Kenneth (PI), Lu, L (Co-PI – UI), Hatzenbuehler, P.L. (Co-PI – UI), Ngugi, C.C. (Co-PI – Kenya), Walakira, J.K. (Co-PI – Uganda), Cadogan, T.E. (Co-PI – Kenya), Meijberg, A. (Co-PI – Kenya). Enhancing Food Security, Evidence-based Policy Making, and Sustainable Development in Kenya and East Africa through a Real-time Analytics, Programing, and Information Dissemination System (RAPIDS). USDA – Foreign Agriculture Service (FAS), **$982,323.50** (August, 2020 – July, 2022) – **Unfunded**

Cain, Kenneth (PI), Ma, J. (Co-PI). Training the next generation of aquaculture and aquatic animal health experts for aquaculture/food production workforce development. Food and Agricultural Sciences National Needs Graduate and Postgraduate Fellowship (NNF) Grants Program (USDA – NNF), **$241,000** (Jan. 1, 2021 – Dec. 31, 2025) – **Unfunded**

**2019 (total grant dollars for submitted proposals = $314,702)**

Cain, Kenneth, “Evaluation of Atlantic salmon starter feed formulations” Skretting (aquaculture feed company) **$17,437.00** (July 2019- Dec 2019) - **funded**

Kumar, Vikas (PI), Cain, K.D. (Co-PI). OREKA Natural Gut Health. **$20,000** (Cain lab component), (Aug. 2019 – October 2019) - **funded**

Cain, Kenneth, “Evaluation of IHNv vaccination response/efficacy” Pacific Seafoods (aquaculture company) **$8,215.00** (July 2019- Dec 2019) - **funded**

Cain, Kenneth (Principal), Coldwater vaccine optimization for licensing and commercialization. Private Animal Health Company. **$217,696** (Sept 2019 – Aug. 2020) – **funded**

Cain, K.D. (PI). Temperature effects on early life stages of the North American Burbot: Implications for restoring the lower Kootenai River population. Kooetnai Tribe of Idaho, **$20,000** (Jan. 2019 - Feb. 2020) – **funded**

Cain, K.D. (PI). ORED FY19 EIS - CNR Aquatic Animal Laboratory (AAL) ORED FY19 EIS Infrastructure Support Request, UI Office of Research and Economic Development, **$38,791** (Jan. 2019-April 2019) – **funded**

Cain, K.D. (PI) ORED FY19 ARI Generator tie in (infrastructure improvement request), UI Office of Research and Economic Development, **$10,000** (Feb – May 2019) - **funded**

**2018 (total grant dollar for submitted proposals = $6,397,396):**

Welker, Tom (PI), Overturf, Ken, Cain, Ken (Co-PI). Underlying Mechanisms For Selected Disease Resistance And Enhanced Non-Specific Resistance In Rainbow Trout. USDA-NIFA Special Aquaculture Grant program**. $309,489** (Oct. 2018 – Sept. 2020) **- Funded**

Cain, Ken (PI), Hardy, Ron, Bruce, Tim, Small, Brian. Effects of dietary soy replacement on burbot (freshwater cod) growth and immune function: implications for commercial culture of this new and novel species. Soy Aquaculture Alliance. **$92,998** (Oct. 2018 – Sept. 2019) **- Funded**

Cain, Kenneth (Principal), Coldwater vaccine optimization for licensing and commercialization. Private Animal Health Company. **$207,000** (Sept. 2018 – Aug. 2019) **- Funded**

Cain, Ken (PI), Call, Doug (Co-PI) Determining the mechanism by which entericidin B, from the probiotic Enterobacter C6-6, protects trout from coldwater disease. USDA-NIFA, **$499,999** (Oct. 2019 – Sept. 2022) **- Unfunded**

Bruce, T.J. (PI), Cain, K.D. (Co-PI). Investigation of gut microbiota, physiological stress response, and immune parameters in cultured burbot (Lota lota). USDA-NIFA EWD postdoctoral training grant, **$159,829** (March 2019 – Sept. 2020) ­**- Funded**

Small, B.C. (PI), Hardy, R.W. (Co-PI), Cain, K.D. (Co-PI). RII Track-2 FEC: Establishing Core Approaches for Genome to Phenome Associations in Teleost Fish Immune Function. NSF Epscor, **$3,663,467.48** (Aug. 2018 – July 2022) **- Unfunded**

Cain, K.D. (PI). Temperature effects on early life stages of the North American Burbot: Implications for

restoring the lower Kootenai River population. Kooetnai Tribe of Idaho, **$50,884.05** (Jan. 2018 - Feb. 2019) - **Funded**

Kumar, V. (PI), Small, B.C. (Co-PI), Smith, B.M. (Co-PI), Cain, K.D. (Co-PI), Fornshell, G. (Co-PI). An Integrated Approach to Reducing Downgrading Losses Due to Soft Fillet and Gaping in the Trout Industry. Western Regional Aquaculture Center (WRAC), **$478,937.00** (Sept. 2019 – Aug. 2022) **- Unfunded**

Cain, K.D. (PI), Soto, E. (Co-PI), Fornshell, G. (Co-PI), Bruce T.J. (Co-PI), Ma, J. (Co-PI) Emerging and Re-emerging Flavobacterial Pathogens in Aquaculture, Western Regional Aquaculture Center (WRAC), **$417,000** (Sept. 2019 – Aug. 2022) **- Funded**

Cain, K.D. (PI), Hawkard, M. (Co-PI OSU), Bruce, T.J. (Co-PI), Ma, J. (Co-PI). Development of oral vaccine delivery methods for prevention of disease in finfish culture,Western Regional Aquaculture Center (WRAC), **$479,000** (Sept. 2019 – Aug. 2023) - **Funded**

Cain, K.D. (PI). ORED FY19 EIS - CNR Aquatic Animal Laboratory (AAL) ORED FY19 EIS Infrastructure Support Request, UI Office of Research and Economic Development, **$38,791** (Jan. 2019-April 2019) **- Funded**

**2017:**

Small, Brian (PI), Cain, Ken (CO-PI), Hardy, Ron (Co-PI), Overturf, Ken (Co-PI) Developing critical knowledge of intestinal microbiota and mucosal immune system influence on early fish health using a unique trout model. USDA-NIFA **$149,949.00** (1/1/18 – 12/31/19) ­**- Funded**

Salinas, Irene (PI), Cain, Ken (Co-PI) Understanding the duration and mechanisms of long-lasting protection of nasal vaccines in rainbow trout. USDA-NIFA **$50,000 (UI)** (8/1/17-7/31/21) - **Funded**

Cain, Kenneth (Principal), Coldwater vaccine optimization for licensing and commercialization. Private Animal Health Company. **$187,298** (Feb. 2017 – March 2018) - **Funded**

**2016:**

Small, Brian (PI), Cain, Ken (CO-PI), Hardy, Ron (Co-PI), Overturf, Ken (Co-PI). Using a Model Trout Strain to Explore the Roles of Genotype and/or Gut Microbiota in Non-Specific Disease Resistance for Farmed Fish. USDA-NIFA, **($499,958**) **- Unfunded**

Call, Doug (PI), Cain, Ken (Co-PI). Determining the mechanism by which entericidin B, from the probiotic Enterobacter C6-6, protects trout from coldwater disease. USDA-NIFA, Animal Health and Production, (**$500,000**) **- Unfunded**

Cain, Ken (PI), Myrick, Chris (CoPI), Fornshell, Gary (Co-PI). Developing “freshwater cod” or burbot (Lota lota) into a viable commercial aquaculture species in the United States. USDA-Western Regional Aquaculture Center (WRAC), (**$444, 783**) **- Funded**

Cain, Ken (PI), Sato, Esteban (Co-PI), Fornshell, Gary (Co-PI). Emerging and Re-emerging Flavobacterial Pathogens of Salmonids. USDA-Western Regional Aquaculture Center (WRAC), (**$328,775**) **- Unfunded**

Langdon, Chris (PI), Hawkward, Matt (Co-PI), Cain, Ken (Co-PI), Sudheesh, Ponnerassery (Co-PI). Development of more effective delivery methods for vaccines for prevention of disease in finfish culture. USDA-Western Regional Aquaculture Center (WRAC), (**$471,335**) **- Unfunded**

Cain, Ken (PI), Linley, Tim (Co-PI). Lake Roosevelt Burbot Maturation Study. Colville Tribe, (**$341,177**) **- Unfunded**

Cain, Kenneth (Principal), “Identification of critical thermal bottlenecks affecting embryo and early life-stage development for Burbot Lota lota: Implications for Kootenai River hydro-management” (Idaho Department of Fish and Game. (**$104,371 – yr 2 portion**) - F**unded**

Cain, Kenneth (Principal), “Kootenai River Burbot egg/embryo/larval Temperature dependent survival study. USFWS. FONs project: (**$45,000 year 2 portion**) **- Funded**

Cain, Kenneth (Principal), Thermal bottlenecks affecting reproductive success of burbot. Sponsored by the Kootenai Tribe of Idaho (BPA), Federal, (**$106,194**) **- Funded**

Cain, Kenneth (Principal), Coldwater vaccine optimization for licensing and commercialization. Private Animal Health Company. (**$34,695**) **- Funded**

**Unfunded (submitted prior to 2016):**

Loch, Tom (Co-PI), Faisal, Mohammed (Co-PI), Cain, Ken (Co-PI). 2015. Evolution and emergence of fish-pathogenic flavobacteria as a consequence of Chinook salmon introductions into the Great Lakes. NSF - **$441,361**

Hardy, Ron (Principal), Rodnick, Ken (Co-principal - ISU), Schreck, Carl (Co-principal OSU), Cain, Ken (Co-principal) 2015. Genomic identity of thermal adaptation: evolutionary and ecological trade-offs. NSF – preproposal

Cain, Kenneth (Principal), Call, Doug (Co-principal - WSU), 2014. US-UK Collaborative: Novel strategies to control coldwater disease and rainbow trout fry syndrome (CWD/RTFS) in rainbow trout and Atlantic salmon aquaculture. USDA AFRI program (**$499,980**)

Loch, Tom (Principal – MSU); Cain, Kenneth (Co-Principal). 2014. Flavobacterial diversity and its effect on disease in aquaculture. USDA AFRI program (**$109,414 – UI portion**)

Cain, Kenneth (Principal) 2014. Develop practical strategies for controlling coldwater disease in salmonids at all life stages. NIFA (USDA Special Grants Program) (**$300,000**)

Hardy, Ron (Principal); Cain, Kenneth (Co-principal) 2014. Exploring the genetic mechanisms and the gut microbiota of a selected trout strains resistant to diseases as a model to develop preventive tools for disease resistance in farmed fish. USDA AFRI program (**$500,000**)

Cain, Kenneth (Principal) 2014. Developing “freshwater cod” or burbot (Lota lota) into a viable commercial aquaculture species in the United States. Western Regional Aquaculture Center (USDA) (**$460,235**)

Cain, Kenneth (Principal) 2014. Defining the relationship between stress, immune function and disease resistance in rainbow trout fed immunostimulants and functional feed additives. Western Regional Aquaculture Center (USDA) (**$480,000**)

Loch, Tom (Principal); Cain, Kenneth (Co-Principal). 2013. Evolution and emergence of fish-pathogenic flavobacteria as a consequence of Chinook salmon introductions into the Great Lakes. NSF **($500,000)**

Cain, Kenneth (Principal), Call, Doug (Co-principal - WSU), LaFrentz, Ben (Co-principal - USDA), 2013. Controlling warmwater and coldwater aquaculture diseases using probiotics with pathogen specific antimicrobial properties. USDA AFRI program (**$499,988**)

Cain, Kenneth (Principal) 2012. Algae-Derived Feed Supplements Containing Beta-1,3-Glucan for Reduced Disease Impact and Improved Aquaculture Productivity. Subcontract – USDA/SBIR phase I proposal submission with the company Algal Scientific ($150,000 - **28,955** to UI)

Cain, Kenneth (Principal), 2012. Development of Techniques to Culture Pacific Lamprey in the Snake River Basin. USFWS, ($89,630)

Cain, Kenneth (Principal), 2012. Finalizing Critical Needs for Commercialization and Licensing of a ColdwaterDisease Vaccine, Research and Development Contract, Aquatic Life Sciences (Private Company), ($127,764) – partially funded

Cain, Kenneth (Principal) Development of a High Sensitivity and Specificity Quantitative Aptamer Assay for Coldwater Disease Management Applications. Subcontract – USDA/SBIR phase II proposal submission with the company InfoScitech ($400,000 – **$177,000** to UI)

Cain, Kenneth (Principal), Understanding *Nucleospora salmonis* infections in wild and hatchery fish to

develop strategies to limit transmission and spread, Lower Snake River Compensation Program/USFWS,

($70,404)

Cain, Kenneth (Principal), Call, Douglas (Co-Principal – WSU), “Characterization and delivery of Flavobacterium psychrophilum 259.93B.17, an attenuated vaccine candidate for coldwater disease” USDA/CSREES AFRI program, Federal, **$374,998** (Submitted – 3/31/09)

Cain, Kenneth (Principal), Call, Douglas (Co-Principal – WSU), “Development of vaccines for *Flavobacterium psychrophilum* through enhanced expression of recombinant protein antigens and improved delivery of an attenuated vaccine strain”, Sponsored by USDA/CSREES NRI program, Federal, **$372,002** (October 2008 – October 2011)

Walsh (Principal), Cain and 5 others (Co-PIs), “Characterization of a novel fungus infecting burbot in the pacific northwest”, Sponsored by Smithsonian Institution, Federal, $43,500 (March 2008 – March 2009)

Cain, Kenneth D (Supporting), "Identification and characterization of immunodominant antigens in the

catfish pathogen *Flavobacterium columnare*", Sponsored by USDA/NRI, Federal, $60000. (October

2007 - October 2010).

PI: Dr. Joe Cloud Co-PIs: Cain and others. IGERT for the Impacts of Global Change on Conservation Biology: A Union of Biology and Geography, National Science Foundation (NSF), 2,000,000.

PIs: Dr. Gary Thorgaard, Dr. Chris Bayne, Dr. Ken Cain. “Dissecting a Natural Killer Cell Complex in Trout” National Institute for Health (NIH), 1,702,174.

PI: Dr. Ken Cain, Adaptation of Larval Burbot *(Lota lota)* to Commercially Available diets. UI seed grant program, February 2004, $10,000.

PI: Dr. Ken Cain, Dr. Gary Thorgaard, Dr. Chris Bayne, Dissecting a candidate natural killer complex in trout National Institute of Health (NIH), 7/04-7/08, $1,702,174.

PI: Dr. Cort Anderson, Co-PI: Dr. Ken Cain, Isolation and sequencing of the myxozoan mitochondrial genome, and validation of PCR-based diagnostic tools McIntire-Stennis, 2003, $67,200.

PI: Dr. Ken Cain; Co-PI: Dr. Doug Call, Identification and characterization of vaccine target antigens for the fish pathogen *Flavobacterium psychrophilum.* USDA/NRI Animal Health and Well-Being program, New Investigator/Standard Strengthening, January 2002, $247,640.

PI: Dr. Ken Cain*,* A quantitative PCR (QPCR) approach to rapidly diagnose *Myxobolus cerebralis* and assess infection severity in fish, Whirling Disease Foundation, February 2001, $43,136.

PI: Dr. Ken Cain, Aquaculture Vaccine Development: Eliciting Immunity to *Flavobacterium psychrophilum*, UI seed grant program, February 2001, $10,000.

PI: Dr. Ken Cain, Mucosal Immunity in Fish: Triggering the First Line of Defense, USDA/NRIP Animal Health and Well-Being program, New Investigator/Standard Strengthening, January 2001, $362,166.

PI: Dr. Ken Cain, Virulence-Associated proteins of *Flavobacterium psychrophilum*, USDA/NRI seed grant program, October 2000, $75,000.

PI: Dr. Sandra Ristow, Co-PI’s: Dr. Ken Cain and 7 others, Developmental and Comparative Immunobiology of Finfish, Western Regional Aquaculture Consortium (WRAC), May 2000, $400,000.

PI: Dr. Ken Cain, Immunological Characterization of White Sturgeon, UI seed grant program, February 2000, $10,000.

PI: Dr. Ken Cain, Identification of Unique Cell Surface Markers on Fish Lymphocytes, Washington Sea Grant Program, January 2000, $160,000.

**Honors and Awards:**

**Distinguished Professor Award, University of Idaho, rank granted 2021**

Distinguished Service Award, Idaho Chapter AFS, Aquaculture Committee, Chair 2004-2020

**Excellence in Research and Creative Activity Award, University of Idaho 2020**

Nominated (by Research Office) as Fellow for National Academy of Inventors, 2018, 2019

**Mid-Career Presidential Award, University of Idaho 2013-2014**

Innovation Award for licensed technology, 2012

Innovation Award for Issued Patent “Vaccines for Diseases of Fish”, 2010

Innovation Award for Technology Licensed (Cain/ImmunoPrecise Antibodies, Ltd), 2009

Best Professional Poster presentation (Idaho Chapter AFS meeting), 2009

UI Alumni Award for Excellence, 2008

Certificate of Appreciation, UI Tech Transfer, Invention disclosure, coldwater disease vaccine

Certificate of Appreciation, UI Tech Transfer, Invention disclosure, C6-6 probiotic candidate

Outstanding Alumni Award (Alumni Hall of Fame), Swartz Creek High School, 2008

Certificate of Appreciation: As faculty mentor for UI McNair Scholarship program, 2008

Certificate of Appreciation: for Burbot conservation efforts, Kootenai Valley Resource Initiative, 2005

UI Award for Excellence in Teaching (Nominated, 2005)

UI alumni award for excellence in mentoring, 2001

Outstanding graduate student award, (Department of Animal Sciences), 1997

Best paper award nomination, (Progressive Fish Culturist), 1995

Snieszko Student Travel Award, AFS (fish health section), 1995

**SERVICE:**

2019-present, Editorial Board, *Israeli Journal of Aquaculture*

2019-present, Guest editor, Special Issue (Fish Vaccination), *Microoganisms*

2011-2013, Co-editor, Special Issue (New and Emerging Diseases in Aquaculture), JARD

2010-2013, Executive Editor, *The Journal of Aquaculture Research and Development (JARD)*

2007-present, Co-Director (Aquaculture Core Laboratories), WSU/UI Center for Reproductive Biology

2005-present, Editorial Board, *Aquaculture Research*

2005-2018, Editor, Aquaculture Research Institute Newsletter

**Major Committee Assignments:**

AFS-FHS Blue Book Revision Steering Committee (Co-Chair), 2021-present

AFS-FHS Industry Work Group for BB revision (Co-Chair), 2021-present

AFS-FHS Extramural Funding Committee, 2021-present

CNR Awards Committee, 2017-present

CNR Wet lab steering committee (Chair), 2017-present

CNR student programs committee, 2014-present

Western Regional Aquaculture Center (WRAC), Research subcommittee, 2004-present

Burbot Recovery Team, Aquaculture Subcommittee, 2004-present

Board of Director, US Aquaculture Society, 2017- 2020

Idaho Chapter AFS, Aquaculture Subcommittee (Co-Chair), 2004-2021

Institutional Animal Care and Use Committee, 2001-2007, Chair (2005–2007)

University of Idaho AAALAC Accreditation Task Force, 2018-2021

CNR Promotion and Tenure Committee, (Chair, 2019) 2017-2020,

CNR committee on committees, 2015-2019 (Chair, 2018-19)

HUBBS SEAWORLD (Scientific Advisory Committee), White sea bass program review, 2016-2018

3rd year review committee, Chris Caudill, 2015.

ARI new building design and planning committee, 2014-2019

Student Programs Committee (FWS), 2015-present

Search Committee, Fish Physiologist (ARI/FWS), 2014-2015

UI Dismissal Hearing Committee, 2015-2017

UI Scientific Misconduct Committee, 2013-2017; Chair, 2015-2016

Promotion and Tenure committee, AVS, 2014

Search Committee, Department Head (FWS), 2013-2014

Search Committee, College of Business, Professor of Entrepreneurship, 2012

CNR curriculum committee, served for Dr. Rachlow while she was on sabbatical, Fall 2012

Chair, Promotion and Tenure committee, Department of Fish and Wildlife Sciences (Quist), 2012

Promotion and Tenure committee, Department of Animal and Veterinary Sciences, 2011

UI Intellectual Properties Committee, 2010-2013

Chair, 2009-2010, Dismissal Hearings Committee, University of Idaho, 2007- 2010

Ted Bjorn Scholarship Committee, 2009-2014

Idaho Fish Health Policy Committee, 2007-2015

Chair, Rankings committee, USGS, Fish Physiologist Co-op position, 2009

Promotion and Tenure committee, Department of Animal and Veterinary Sciences, 2007

Chair, Search Committee, Riparian Ecologist, Department of Fish and Wildlife, 2007-2008

Search Committee, Department of Fish and Wildlife, Limnologist, 2006-2007

Search Committee, College of Natural Resources, Developmental Director, 2007

Chair, Fisheries Curriculum Review Committee, 2005

Chair, 3rd year review committee, Department of Fish and Wildlife, 2007

Burbot Aquaculture Facility Design Team, 2007-2014

Organizing committee, 46th Western Fish Disease Workshop/conference, AFS/Fish Health Section, June 27-29, Boise, ID. 2005.

Bacteriology Subcommittee, AFS/FHS Technical standards committee, 2003-2005

EXCOM Secretary/Treasurer, Fish Health Section of AFS, 2002-2005

CNR Scientific Equipment Committee, 2004-present

White Sturgeon Recovery Team, 2002-2015

Chair, Graduate student/postdoc selection committee, Center for Research on Invasive Species and Small Populations (CRISSP), 2004

Search Committee, Department of Fish and Wildlife Resources, Fish Ecologist, 2004

DeVleig Scholarship Committee, 2002

Idaho Fish Health Protection Committee, 2001-present

Promotion and Tenure committee, Biology department, October 2001

Program review committee, Department of Fish and Wildlife Resources, 2000-01

Search Committee, Department of Fish and Wildlife Resources, Riparian Ecology, 2000-01

3rd and 5th year Review Committee, Department of Fish and Wildlife Resources, 2000

Graduate Selection Committee, Department of Animal Science, Washington State University, 1995-96

**Professional and Scholarly Organizations:**

US Trout Farmers Association

European Association of Fish Pathologists

American Fisheries Society (Fish Health Section)

American Fisheries Society (Fish Culture Section)

International Society of Aquatic Animal Epidemiology

World Aquaculture Society

US Aquaculture Society

Idaho Aquaculture Association

Center for Research on Invasive Species

WSU/UI Center for Reproductive Biology

Member of Center for Fish Disease Research (Oregon State University)

International Society of Developmental and Comparative Immunology (former member)

Center for Research on Invasive Species and Small Populations (CRISSP) – former member

Manuscripts reviewed for following journals: (only partial list)

*Nature Immunology*

*Journal of Aquaculture Research and Development* (former Editor)

*Developmental and Comparative Immunology*

*North American Journal of Aquaculture*

*Aquaculture Nutrition*

*Israeli Journal of Aquaculture* (Editorial Board)

*Fisheries*

*Vaccine*

*PLOS ONE*

*Microbiology*

*Microorganisms*

*Journal of Aquatic Animal Health*

*North American Journal of Fish Management*

*Transactions of the American Fisheries Society*

*Aquaculture Research* (Editorial board member)

*Archives in Virology*

*Journal of Veterinary Medicine*

*Diseases of Aquatic Organisms*

*Fish and Shellfish Immunology*

*Journal of Fish Diseases*

*Journal of the World Aquaculture Society*

*Journal of Fish Biology*

Grant proposals reviewed for the following funding agencies: (only partial list)

*French National Research Agency (ANR)*

*USDA-NIFA*

*Kuwait Foundation for the Advancement of Sciences (KFAS)*

*Norwegian Research Council*

*American Academy for the Advancement of Sciences*

*Polish Foundation for Sciences*

*Technology grant program (Greece)*

*Mississippi State University (Center for Veterinary Medicine)*

*Minnesota Sea Grant*

*Maryland Sea Grant*

*National Research Council* (Canada)

*Canadian Foundation for Innovation* (CFI)

*National Science Foundation (SBIR)*

*USDA (SBIR)*

*Western Regional Aquaculture Center*

*Southern Regional Aquaculture Center*

*North Central Regional Aquaculture Center*

*Great Lakes Trust Foundation*

**Outreach Service:**

Cain, K.D., 2021. Ken’s Corner, Sorting through the noise in the farmed-versus-wild debate. *Aquaculture North America.* July/August Vol 24

Cain, K.D., 2021. Ken’s Corner, Aquaculture Opportunities and Education. *Aquaculture North America.* May/June Vol 23

Cain, K.D., 2021. Ken’s Corner, Vaccines may be the biggest tool in the fish health toolbox. *Aquaculture North America.* March/April Vol 22 (2)

Renfrew Colloquium, Invited Speaker – Burbot Aquaculture (University of Idaho), Dec. 10th, 2019

TV commercial for UI branding campaign, ARI research segment, 2019

Aquaculture North America trade journal, Trout farming in the U.S. and Canada, 2019

The freshwater cod with a Lota potential for farming. The Fish Site.

Burbot Bounce Back. Featured story on the University of Idaho’s College of Natural Resources website <https://www.uidaho.edu/cnr/about/feature-stories/burbot-biology>, also distributed to Facebook, Twitter, and LinkedIn, 2019

Here we have Idaho” magazine (https://www.uidaho.edu/news/here-we-haveidaho-

magazine/invention-pipeline), 2018

Press release, Aquaculture North America, 2016

SBOE Legislative lunch, 2013

Moscow/Pullman daily news, 2012

Spokesman review, 2012

Columbia Basin Bulletin, 2012

Argonat interview, 2012

NPR interview, 2012

TV highlights, channel 7 Boise, 2012

Article for *Capital Press*, 2011

Article for *Trout Talk*, 2011

Coldwater Fish Culture Workshop, 2011

Fish Immunology Workshop, 2011

Invited presentation (5) related to Sabbatical in Australia, 2011

Editor for Aquaculture Research Institute bi-annual newsletter, 2005-present

Article for *Hatchery International Magazine*, 2009

Articles for *Waterlines* (published by the Western Regional Aquaculture Center), 2009

Biosecurity Workshop (instructor), presented to trout industry

Salmon Disease Workshop, Corvalis, OR, July, 2009 (Participating instructor): Intensive 2 wk disease course for fish health professionals

Presented research overview at Idaho Aquaculture Association annual meeting, 2008

Spokesman Review, Article on Coldwater Disease Vaccine development, October, 2006

Idaho Science and Technology newsletter, October, 2006

Columbia Basin Bulletin, October, 2006

Spokesman Review, Article on Burbot Aquaculture, December, 2006

CNR magazine, research highlights, 2006

CNR alumni news, research highlights, 2005, 2006, 2007

UI Research Webpage (Today at UI), Press release describing Burbot aquaculture project, 2004

Twin Falls Times (Ag weekly), Article on research presented at IAA meeting, 2004

Coldwater Disease workshop presented to Aquaculture Industry, CSI Hatchery, Twin Falls, Idaho, 2004

Fish Immunology Workshop, AFS/Fish Health Section, Continuing education, 2000

Twin Falls Times (Ag Weekly), Highlighted Fish Health Class tour of Aquaculture Industry

Trout Disease Workshop, Idaho trout industry, provide shortcourse for industry employees

Totally Wild Television program, Sydney, Australia, segment on Fish Vaccination

Twin Falls Times (Ag Weekly), article highlighting invited seminar for Idaho Aquaculture Association

**Community Service**:

Contribution/donation (Steelhead fishing trip), US Trout Farmers Association, 2019

Volunteer Firefighter – Arrow Junction Fire Department, 2014-present

Annual contribution (fishing trip), Palouse Unit, American Fisheries Society, 2000-2016

Taught beginning whitewater kayaking course, University of Idaho Outdoor Program, August 2000

**PROFESSIONAL DEVELOPMENT:**

**Teaching:**

Participant in McNair Scholar Program, 2004, 2007-2008

Writing across curriculum (WAC) workshop, January 2000

**Scholarship:**

Supervisory Excellence Program - Managing Conflict, September 2019

Sabbatical – Jan. 2021-June 2021 (taken in US due to COVID travel restrictions)

Sabbatical application, (accepted 2019) Expanding Aquaculture and Fish Health Research, Teaching, and Outreach Capabilities at UI through International Collaborations. Cawthron Institute – New Zealand (approved for spring semester 2020) –

Sabbatical – Jan. 2011-June 2011.

Sabbatical application, (accepted 2008) Building international collaborations in aquaculture and fish health through research, teaching, and outreach. University of Tasmania, Australia (Spring semester 2011)

Continuing education, AFS/FHS (80+credit hrs – Fish Virology, Histology, Hematology, Immunology, and Neoplasia in Fishes New Molecular Diagnostic Techniques, Early Fish Development, Fish Nutrition, Toxicology, Application of bacterial genomics to fish diagnostics, etc.)

Grant writing workshop, April 2000

**Administration/Management:**

Associate Director, Aquaculture Research Institute, July 2002 - 2020