STATE OF CALIFORNIA
STANDARD AGREEMENT
STD 213 (Rev 06/03)

AGREEMENT NUMBER
10-C0096
REGISTRATION NUMBER
1121642

1. This Agreement is entered into between the State Agency and the Contractor named below:

STATE AGENCY'S NAME
Department of Pesticide Regulation (DPR)

CONTRACTOR'S NAME
The Regents of the University of California

2. The term of this Agreement is: January 1, 2011 or upon final approval by the State, whichever occurs later through June 30, 2013

3. The maximum amount of this Agreement is: **$20,198.00**
Twenty thousand one hundred ninety-eight dollars and no cents

4. The parties agree to comply with the terms and conditions of the following exhibits which are by this reference made a part of the Agreement.

Exhibit A – Scope of Work	8 Pages
Exhibit B – Budget Detail and Payment Provisions	3 Pages
Exhibit C* – General Terms and Conditions (GIA 610)	
Exhibit D - Special Terms and Conditions	1 Page
Exhibit E – Additional Provisions	1 Page
Exhibit F – Resume(s)	7 Pages

Items shown with an Asterisk (*), are hereby incorporated by reference and made part of this agreement as if attached hereto. *These documents can be viewed at* http://www.ols.dgs.ca.gov/Standard+Language/default.htm

IN WITNESS WHEREOF, this Agreement has been executed by the parties hereto.

CONTRACTOR

CONTRACTOR'S NAME *(if other than an individual, state whether a corporation, partnership, etc.)*
The Regents of the University of California

BY *(Authorized Signature)*: Kathleen P. Nolan — DATE SIGNED *(Do not type)*: 1-4-11

PRINTED NAME AND TITLE OF PERSON SIGNING
Kathleen P. Nolan, J.D.
Associate Director, Sponsored Programs

ADDRESS
Sponsored Programs
1850 Research Park Dr., Suite 300, Davis, CA 95618-6153

STATE OF CALIFORNIA

AGENCY NAME
Department of Pesticide Regulation

BY *(Authorized Signature)*: Samantha Lewis — DATE SIGNED *(Do not type)*: 1-13-11

PRINTED NAME AND TITLE OF PERSON SIGNING
Samantha Lewis, Business Services Manager

ADDRESS
1001 I Street, Sacramento, CA 95814

California Department of General Services Use Only

☒ Exempt per:
Delegation Letter 74.4

EXHIBIT A
STANDARD AGREEMENT

SCOPE OF WORK

1. The Regents of the University of California, hereinafter referred to as UCD, or Contractor, shall perform research for the Department of Pesticide Regulation, hereinafter referred to as DPR or Department.

2. This Agreement will commence on the start date January 1, 2011 as presented herein or upon final approval by the State, whichever is later and no work shall begin before that time. This Agreement is of no effect unless approved by the State. Contractor shall not receive payment for work performed prior to approval of the Agreement and before receipt of notice to proceed by the Contract Manager. This Agreement shall expire on June 30, 2013. The services shall be provided during normal working hours.

3. The Project Representatives during the term of this Agreement will be:

   A. All official communications, except invoices, from the Contractor to DPR shall be directed to the attention of the DPR Contract Manager, Xin Deng, Ph.D., at:

Department of Pesticide Regulation
Environmental Monitoring Branch
Surface Water Program, MS-3B
1001 I Street
P.O. Box 4015
Sacramento, CA 95812-4015

Phone 916-445-2506 Fax 916-324-4088

E-mail: xdeng@cdpr.ca.gov

   B. All invoices from the Contractor to DPR shall be directed to:

Department of Pesticide Regulation
Attn: Accounts Payable
P.O. Box 4015, MS 4A
Sacramento, CA 95812-4015

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C. All programmatic communications from DPR to the Contractor shall be directed to:

Dr. Sharon Lawler
Department of Entomology
UC Davis
One Shields Avenue
Davis, CA 95616-8584

Phone 530-754-8341 Fax 530-752-1537

E-mail: splawler@ucdavis.edu

D. All administrative communications, except payments, from DPR to the Contractor shall be directed to:

Wendy Ernst
Office of Research, Sponsored Programs
1850 Research Park Drive, Suite 300
Davis, CA 95618-6153

Phone: (530) 754-7982; FAX: (530) 754-8229

Email Address: wlbernst@ucdavis.edu

E. All payments from DPR to the Contractor shall be directed to:

The Regents of the University of California
Cashier's Office
University of California Davis
PO Box 989062
West Sacramento, CA 95798-9062

F. The project representatives during the term of this Agreement may be changed by mutual written agreement of the parties without the necessity of an amendment to the Agreement.

4. The Contractor will perform research on "the complex effects of pesticide mixtures upon aquatic community structure, integrating environmental stressors, biological interactions, recovery potential, and re-colonization after contaminant exposure," for the Department's Surface Water Program.

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5. Goals and Background

Goals and Objectives:

The proposed project aims to address the complex effects of pesticide mixtures upon aquatic community structure, integrating environmental stressors, biological interactions, recovery potential and re-colonization following contaminant exposure.

The **overall goals** of this project are to generate new information specific to pesticides in common use in Californian agriculture and urban pest controls, attain direct relevance to environmental conditions and pesticide concentrations, and to investigate the effect of contaminant mixtures on organisms at different trophic levels, thus assessing the resulting impacts on community structure.

Amongst one of the most pressing needs in the field of ecotoxicology is a better understanding of the effects of pesticide mixtures in the environment. Proper consideration of contaminant mixtures is of extreme importance, as their combined action can result in effects that are different to the effect expected by each compound individually (Lydy et al, 2004). They can act synergistically, additively or in an antagonistic manner dependent not only on their modes of action, but also on their interaction with environmental variables, and of course species sensitivity.

Many current-use chemicals exert sub-lethal effects on aquatic organisms, which can lead to severe health or reproductive impairment, but cannot be detected with traditional toxicity testing methods. Acute effects of contaminant mixtures assessed for single species under laboratory conditions are often at concentrations above those found in the environment. However, sub-lethal effects occurring at environmentally realistic concentrations can directly impact predator-prey interactions and consequently change community structure. A study that integrates effects on community structure and environmental variables will link laboratory studies with environmentally realistic scenarios.

We hypothesize that species with higher tolerance to pesticide exposure will initially be dominant in the community, and that their numbers will decline as a result of altered foodweb interactions. This study will therefore address the following questions:

i. How do aquatic communities respond to pesticide mixture exposure?
ii. What are the consequences of changes in community structure?
iii. How do contaminant mixtures affect predator prey interactions?

Background:

Aquatic systems represent essential resources and benefits for human society (such as drinking water, biodiversity, recreation area). Agricultural and urban chemicals have a

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negative effect on these systems, which affects water quality and natural aquatic community (Liess and Schulz 1999; Leonard et al. 2000). In contrast to other organic chemicals, pesticides are produced with the aim of protecting crops, directly targeting pest species, however, non-target species are also affected with a resulting decrease in biodiversity. A comprehensive monitoring approach for the protection and conservation of this threatened diversity is therefore crucial. Whereas most data for risk assessment based on single species tests on single substances available, the risk of mixtures commonly present in aquatic ecosystems is difficult to assess.

Surface water bodies are contaminated with pesticides from different sources, e.g. drift, runoff or drainage. Worldwide chemical analyses of surface water bodies have identified a broad distribution of pesticide mixtures. Current risk-evaluation procedures generally evaluate pesticide effects individually, while in agriculture and horticulture it is common practice to apply several pesticides simultaneously and repeatedly, with differing combinations over time. Little information is available on the effects of realistic combinations of pesticides on the structure and functioning of shallow freshwater ecosystems (Hartgers et al. 1998). Experiments with mixtures of pesticides generally are restricted to binary mixtures, or the combination of a few select compounds, that do not mimic actual pesticide treatments (Hartgers et al. 1998; Fairchild et al. 1994; Cuppen et al. 2002; Van den Brink et al. 2002). Methods that evaluate the effects of pesticide mixtures on freshwater ecosystems are therefore necessary. Microcosms and mesocosms are two such approaches that can be used to assess effects simultaneously at the individual and community level. Moreover, these studies can offer valuable information on foodweb disturbances and their effects at the higher trophic levels, such as upon fish species.

Pyrethroid insecticides are rapidly replacing organophosphate pesticides which are gradually being phased out in a number of states, including California (Epstein et al., 2000; Oros and Werner 2005; Werner and Moran 2008). They are thus the primary focus of the proposed study. Pyrethroids have been demonstrated to be highly toxic to non-target organisms such as fish and aquatic invertebrates (Oros and Werner 2005; Werner and Moran 2008; Clark and Matsumura 1982). This is of particular concern in the Central Valley of northern California (USA), where aquatic ecosystems are surrounded by and intermingled with areas of intense agriculture (Brander et al. 2009) and impacts from urban waste.

6. Work to Be Performed

A carefully designed, but relatively simple approach will yield answers to our research questions. Ms. Simone Hasenbein is highly experienced in conducting both micro- and mesocosm studies, having completed a masters research at the Technical University of Munich (TUM), Germany. She will conduct this research towards her PhD thesis under guidance of Prof. Juergen Geist, (TUM) and in collaboration with researchers at the

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University of California at Davis (UCD). Research will be conducted at UCD and will be supervised by Dr. Sharon Lawler at the Department of Entomology, in collaboration with Dr. Inge Werner and Dr. Richard Connon, School of Veterinary Medicine, and Dr. Keith Miles, Ecological Research Center, USGS. Thus the feasibility of this project is high as the collaborative group, and other staff to be involved are highly qualified and suitably experienced to carry out all aspects of this investigation

The proposed research will make use of facilities within Dr. Lawler's laboratory and the ATL, where new experimental systems will be installed in order to conduct these studies.

Selection of pesticides
The choice of pesticides will be carried out depending on their importance and impact in Californian waterways. The main focus is on mixtures of pesticides, which are commonly detected in agricultural wetlands.

Test organisms
Organisms recommended by the U.S. Environment Protection Agency (U.S. EPA 1991, 1992, 1994), will be used as primary test species, namely: *Ceriodaphnia dubia* (waterflea), *Hyallela azteca* (amphipod) *Chironomus tentans* (midge larvae). *Pseudokirchneriella subcapitata* (former name: *Selenastrium capricornutum,* green algae) will be used as food source and primary producers. Additional reasons for choosing these organisms are their common occurrence in the Central Valley and the existence of adequate toxicity data.

A. Task 1. Single Substance Laboratory Tests (Toxicity tests)

1) UCD will begin with a review of the literature about existing LC_{50} and EC_{50} for each pesticide. On that basis UCD assess the concentrations of each pesticide for the experiments. Surface water models such as the Generic Estimate Exposure Concentration (GENEEC) will be used to assess pesticide exposures.

2) Sub-lethal effects which haven't been assessed in literature will be conducted on all selected test species detailed above. They are aimed at the levels of environmental contaminations that have been found in natural systems. In one of these sub-lethal studies UCD will conduct behavioral studies using motion tracking software Ethovision XT (Noldus, Netherlands).

B. Task 2. Laboratory Toxicity Tests and Microcosm Studies with Mixtures

As a further step the effects of the mixtures under laboratory conditions will be investigated for each single species as well as for small communities in microcosm tests. Impacts that are measured in these ecotoxicity tests are mortality, reduction in

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growth, reproductive impairment, changes in numbers of species, disruption of community and ecosystem-level functions. Using motion tracking software Ethovision XT (Noldus, Netherlands) not only swimming but feeding behavior alterations can be assessed in order to achieve data about predator-prey-interactions as well.

C. Task 3. Field Tests (Mesocosms)

1) In order to bridge the gap to field conditions a mesocosm study will be carried out. The study represents an artificial outdoor water community which is commonly found in Californian watersheds.

2) A mesocosm study is an experimental system designed to simulate natural conditions, by using naturally occurring organisms and artificial structures that simulate nature as closely as possible. Long-term changes to the ecosystem structure and function can be measured and observed in matters that are not possible in field or laboratory studies. For aquatic animals, such as fish and invertebrates, EPA generally uses computer simulation models to estimate exposure to a pesticide active ingredient. In cases where a pesticide formulation may be more toxic to aquatic animals than the active ingredient, EPA may consider aquatic exposure to the formulation. The Agency's approach for considering formulated product exposure in an aquatic risk assessment follows approaches developed by the European Union (EU Council Directive 91/414/EEC). Well designed and controlled experimental mesocosm studies represent a primary tool providing the process-level understanding necessary to move basic research and development from the laboratory bench-top to field applications. Mesocosm studies are designed to gain information on both watershed management and the impact of contaminants of concern.

3) When constructing the mesocosm, efforts will be made to introduce all the functional groups as recommend by SANCO (2002). This includes primary producers and the various levels of consumers, avoiding introduction of top predators that may greatly influence the system. As the mesocosm will be near Putah Creek, immigration of aquatic insects will be possible which on the one hand helps to create an intact community and on the other hand allows decreased species groups to recover through recolonisation. Before application 15 cylinders made of stainless steel will be pushed into the sediment to separate small enclosures which will be loaded with different pesticide concentrations. Two weeks before application sampling of subsamples of zooplankton, macroinvertebrates, phytoplankton will start in weekly intervals until the end of the sample period. Zooplankton and macroinvertebrates will be counted and identified to the lowest practical taxonomic level. Algae cells will be counted but not identified. As an indicator of the overall oxygen metabolism of primary

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producers, dissolved oxygen (DO) will be measured. Changes in primary productivity affect pH, alkalinity and electrical conductivity (EC). Due to DO, pH, alkalinity and EC are often found to be highly correlated, and because indirect treatment effects can be regarded as a stress syndrome (Giddings 1982), these end points will be monitored on a weekly basis. Referring to SANCO (2002) application of the test substances should be made in the period between spring and midsummer when the communities are in their "growth" phases. Within this timeframe, species richness and abundance are usually most suitable, and the potential time available to observe rates of recovery is long.

4) Five enclosures serve as controls only treated with water to compare the toxic effects. Treatments will be randomly assigned to the enclosures. By pouring a carefully measured volume of treatment solution into the enclosures the pesticide mixtures will be applied. After that the water column will be gently stirred to mix the compound throughout the water column without disturbing the sediment. To trace the availability of the pesticides in the water column water samples will be sent to the California Department of Fish and Game for residue analysis.

5) Species will be elected in order to arrange bioassays. Bioassays are very valuable to estimate the potential recovery of each species and differences between the two aquatic systems can be distinguished. A certain number of untreated laboratory species will be transferred to bioassay cages (constructed of stainless steel gauze) and introduced into each enclosure.

6) The mesocosm study represents both indirect and direct effects on the aquatic food-web which carries very valuable results to understand the interactions between predator and prey for example. This understanding will be gained by statistical analysis of the results with both descriptive and multivariate methods. As descriptive methods abundances (numbers of animals), dominances (percentage of each taxon), Shannon´s index and Evenness will be calculated. NOEC values (No Observed Effect Concentration) can be derived from multivariate analysis using PRC (Principle Response Curves) with the Canoco program (Microcomputer Power, Ithaca NY, USA) which is adjusted for overall changes in community response over time, as observed in control test systems. The principal component is plotted against time, revealing a principal response curve of the community for each treatment. The PRC method emphasizes the complexity of time-dependent, community-level effects of pollutants into a more feasible graphic form than the results of other currently available multivariate techniques. The PRC method also allows a quantitative interpretation of effects towards the species level (Van Den Brink and Ter Braak 1998).

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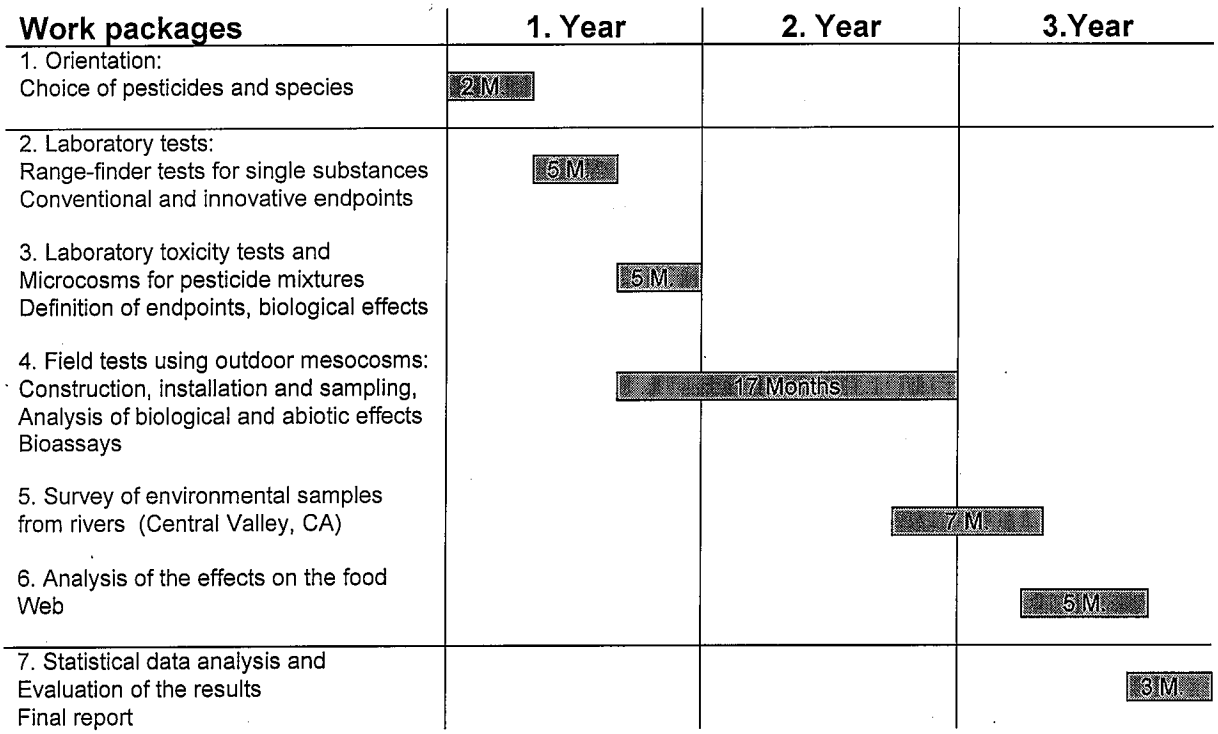
D. Evaluation of Effects on Ecosystems

1) In the last period of the project environmental samples taken from polluted waters in the California Central Valley will be investigated in the established test system. The results will represent the overall effects of the existing mixture of chemicals on the respective ecosystems.
2) UCD will submit a Final Report

7. Project Timeline



8. DPR Responsibilities

DPR shall provide review and approval of the final report within 30 days of submission by UCD.

EXHIBIT B
Standard Agreement

BUDGET DETAIL AND PAYMENT PROVISIONS

1. Invoicing

A. For services satisfactorily rendered and approved by the Contract Manager and upon receipt and approval of the invoices, DPR agrees to compensate Contractor, in arrears, for actual allowable costs incurred as specified herein and in accordance with the rates specified herein or attached hereto. Incomplete or disputed invoices shall be returned to Contractor, unpaid, for correction.

B. "Satisfactorily rendered" as used in this Agreement means that the Contractor has complied with all performance requirements of the Agreement.

C. Invoices shall include the Agreement Number and shall be submitted in triplicate, not more frequently than monthly or less than quarterly, in arrears, to:

Department of Pesticide Regulation
Attn: Accounts Payable
P.O. Box 4015, MS-4A
Sacramento, CA 95812-4015

2. Budget Contingency Clause

A. It is mutually agreed that if the Budget Act of the current year and/or any subsequent years covered under this Agreement does not appropriate sufficient funds for the program, this Agreement shall be of no further force and effect. In this event, DPR shall have no liability to pay any funds whatsoever to Contractor or to furnish any other considerations under this Agreement and Contractor shall not be obligated to perform any provisions of this Agreement.

B. If funding for any fiscal year is reduced or deleted by the Budget Act for purposes of this program, DPR shall have the option to either cancel this Agreement with no liability occurring to DPR, or offer an Agreement Amendment to Contractor to reflect the reduced amount.

3. Payment

A. Costs for this Agreement shall be computed in accordance with State Administrative Manual (SAM) Sections 8752 and 8752.1.

B. Nothing herein contained shall preclude advance payments pursuant to Article 1, Chapter 3, Part 1, Division 3, Title 2 of the California Government Code, Sections 11256 and 11257.

C. Transportation and subsistence costs shall not exceed rates authorized to be paid UC system non-represented employees traveling within California.

D. Contractor will be reimbursed for direct costs, other than salary costs, that are identified in the Contractor's rates.

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E. Contractor will bill in arrears for costs incurred during the billing period. If applicable, salary costs will be itemized and billed by position. Documentation supporting specific salary costs will be presented if requested by DPR. Non-wage costs will be billed, in summary, according to general expense categories. A detailed report of transactions will support the billing. Individual expenditures exceeding $500.00 will be supported by a photocopy of the original documentation. Documentation in support of expenditures less than $500.00 will be presented if requested by DPR.

F. Contractor shall not commence performance of work or services until this contract has been approved by the State. No payment will be made prior to approval nor for any work performed prior to approval of this Agreement.

G. Ten percent (10%) of each invoice shall be withheld by DPR until the satisfactory completion of this Agreement.

4. Rates

Rates for these services are as follows:

Table I - Details Budget

	Total Amount
1. Salaries & Wages (100 hours of student intern @ $8.00/hour)	$ 800.00
2. Benefits ① 3%	$ 24.00
3. Travel ②	$ 256.00
4. Supplies③	$ 15,078.00
5. Contractual	$ 0
6. Minor Equipment④ or Equipment	$ 0
7. Indirect Cost⑤ 25%	$ 4,040.00
Total Amount	**$ 20,198.00**

①Benefits include: Worker's Compensation and other benefits appropriate for title
(NOTE: Student Interns are non-personnel employees with no benefits and shall be excluded from the percentage calculation of this line item.)
②Travel includes: Invoice for payments on travel shall be based on current University of California rates and guidelines.
③Supplies include: Copying services, field sampling supplies, lab supplies, reagents
④Minor Equipment: line item does not include any equipment with a unit acquisition of $5,000 or more.
⑤Indirect Cost: 25% indirect cost rate includes: depreciation of buildings and equipment, utility consumption, operations and maintenance costs, administrative services provided at the departmental and central level, and library costs.

EXHIBIT B
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5. Cost Limitation

A. The total amount of this Agreement shall not exceed $20,198.00.

B. It is understood and agreed that this total is an estimate and that DPR will pay for only those services actually rendered as authorized by the DPR Contract Manager or his/her designee.

EXHIBIT D
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SPECIAL TERMS AND CONDITIONS

1. Termination

A. Either Party reserves the right to terminate this agreement without cause upon thirty (30) days written notice to the other Party, or immediately in the event of a material breach. In the event of termination, Contractor shall be paid for all allowable costs incurred up to the date of termination, including any non-cancelable obligations.

B. In the event that the total Agreement amount is expended prior to the expiration date, DPR may, at its sole discretion, terminate this Agreement with 30 days notice to contractor.

2. Subcontracting

Contractor shall perform the work contemplated with resources available within its own organization and no portion of the work shall be subcontracted.

3. Dispute Resolution

A. DPR reserves the right to issue an order to stop work in the event that a dispute should arise, or in the event that the DPR gives the performing agency a notice that this Agreement will be terminated. If DPR exercises this right, the stop-work order will be in effect until the dispute has been resolved or this Agreement has been terminated.

B. Any dispute concerning a question of fact arising under the terms of this Agreement which is not disposed of within a reasonable period of time by agency employees normally responsible for the administration of this agreement, shall be brought to the attention of the Executive Officer or designated representative of each agency for joint resolution.

C. The Contractor shall continue to perform all its responsibilities under this agreement during any dispute until notified to stop work or expiration of this Agreement.

4. Harassment Free Workplace

The Department of Pesticide Regulation (DPR) is committed to providing a safe, secure environment, free from sexual misconduct. It is policy of the Department that employees have the right to work in an environment that is free from all forms of discrimination, including sexual harassment. This policy specifically speaks to freedom from a sexually harassing act that results in the creation of an intimidating, hostile or offensive work environment or that otherwise interferes with an individual's employment or work performance. As a Contractor with DPR, you and your staff are expected to comply with a standard of conduct that is respectful and courteous to DPR employees and all other persons contacted during the performance of this Agreement. Sexual harassment is unacceptable, will not be tolerated; and may be cause for prohibiting some or all of the Contractor's staff from performing work under this Agreement.

EXHIBIT E
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ADDITIONAL PROVISIONS

1. Contractor Evaluation

The Contractor is hereby notified that its performance under this Agreement may be evaluated within thirty (30) calendar days following the Expiration of this Agreement. The evaluation may include statements on the adequacy of the service or the product, whether the service was satisfactory, whether the service or the product was provided or completed within the time limitations, reasons for time or cost overruns, whether the product is operational or being utilized by the State, and/or the State plans for implementation, and the State's general impression as to the competency of the Contractor and its staff. The evaluation shall be filed in the State's official Contractor Evaluation File.

2. Consulting Services

A. The Contractor is hereby advised of its duties, obligations and rights under Public Contract Code § 10335.5.

B. The Contractor's key personnel assigned to perform work under this Agreement and their level of responsibility shall be mutually acceptable to the State and the Contractor.

3. Disposition of Work Product

The Department retains use and non-commercial governmental distribution rights to all deliverables identified in this Agreement in Exhibit A, Item 6. Work to Be Performed.

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***Curriculum Vitae:* Sharon P. Lawler**

Department of Entomology, One Shields Ave, University of California, Davis, CA 95616
Email: splawler@ucdavis.edu, phone: 530 754-8341

Educational Degrees:

1988-1992 Doctor of Philosophy in Ecology and Evolution, Rutgers, New Brunswick, NJ
1984-1988 Master of Science in Ecology, Rutgers University, New Brunswick, NJ,
1978-1982 Bachelor of Arts in Biology, philosophy minor. Lehigh U. Bethlehem, PA

Employment

1995-present Professor of Entomology, University of California at Davis
1994-1995 Postdoctoral Researcher, Center for Ecology, Evolution and Behavior. University of Kentucky, Lexington, KY.
1992-1994 Postdoctoral Researcher, NERC Centre for Population Biology, Imperial College at Silwood Park, Ascot, Berks, U.K.

Grants

Department of the Interior, United States Fish and Wildlife Service Region 1. Impacts of a fungal pathogen, pesticides, and temperature on the Cascades frog in the mountains of northern California." PIs: Jonah Piovia-Scott and Catherine Johnson; Co-PIs Sharon Lawler, Janet Foley, Carlos Davidson, and Karen Pope. $395,122. 2010-2013.

University of California Academic Senate. Investigating the role of amphibian skin bacteria in combating a deadly disease of frogs. With J. Foley, Co-PI. $23,598. 2009-10.

CA Dept of Fish and Game
Survey for chytridiomycosis in amphibians of the Klamath-Siskiyou mountains: A study of biotic and abiotic factors. 2008-10: Co-PIs J. Piovia-Scott and K.L. Pope.

National Science Foundation-DEB
Effects of an introduced predator on ecosystem subsidy and amphibian decline. 2004-2008: $386,000 (plus 1 REU supplement)

Department of the Interior, U.S. Fish and Wildlife Service Region 1
CA-Environmental Fate of Mosquito Adulticides and Effects on Non-Target Invertebrates in Wetlands of the Sacramento Valley, California. 2004-2008 $188,946

California Department of Fish and Game
Responses of a declining amphibian and other wildlife to changes in fisheries management in California wilderness. 2003-2006: $325,509

University of California Division of Agriculture and Natural Resources Integrated Pest Management Program *and* **University of California Mosquito Research Program**

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Duration of lambda-cyhalothrin effects on mosquitoes and beneficials: assessing biological control disruption and resistance risk. 2003-4: $50,000

University of California Mosquito Research Program

Do repeated applications of ULV pyrenone affect zooplankton or aquatic insects? 2006-2007: $20,186

Effects of Rice Straw Management on the dynamics of mosquito populations: a food web study. 1999-2001: $119,232

Non-Target Effects of Mosquito Larvicides Used on National Wildlife Refuges 1997-1998: $31,298

Non-Target Effects of U.L.V. Mosquito Adulticides on Aquatic Insects and Fish 1996-1997: $32,254

Direct and Indirect Effects of Mosquitofish on a Declining Species of Amphibian, The Red-legged Frog. 1995 -1996: $44,678

Department of the Interior, U.S. Fish and Wildlife Service

Mosquito Control on National Wildlife Refuges: Ecosystem Effect Studies 1995-1999: $290,188

NSF DEB 94-19660

Evolution, Coevolution and Predator-Prey Dynamics: An Experimental Approach. 1995-1997: $30,000

Teaching:

Metacommunity Ecology: Spring 2008, 1-week intensive graduate course in Uppsala, Sweden, funded by the European Science Foundation (20 students from all over the EU).
Biology of Aquatic Insects, now Freshwater Invertebrates (undergraduate, offered annually)
Community Ecology (graduate, offered annually)
Biological Sciences 1B: Zoology. Winter 2007.
Graduate Seminars . Topics vary; approximately 1 annually. Topics have included: Insects as Vectors of Ecosystem Subsidy, Insect Conservation, Microbiology of Enology, Rapid Evolution in Insects, Biology of Hydrothermal Vents.

Publications:

Joseph, M., J. Piovia-Scott, **S. Lawler** and K. Pope. In press. Indirect effects of introduced trout on Cascades frogs (*Rana cascadae)* via shared aquatic prey. Freshwater Biology.

Epanchin, P., R. Knapp and **S. Lawler**. 2010. Nonnative trout impact an alpine-nesting bird by altering aquatic insect subsidies. Ecology 91: 2406-2415.

Pope, K.L., J. Piovia-Scott and **S. P. Lawler**. 2009. Changes in aquatic insect emergence in response to whole-lake experimental manipulations of introduced trout. Freshwater Biology 54:982-993.

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Pope, K. L., J.M. Garwood, H. H. Welsh and **S.P. Lawler**. 2008. Evidence of indirect impacts of introduced trout on native amphibians via facilitation of a shared predator. Biological Conservation 141:1321-1331.

Lawler, S.P., D.A. Dritz, C. S. Johnson and M. Wolder. 2008. Does synergized pyrethrin applied over wetlands for mosquito control affect *Daphnia magna* zooplankton or *Callibaetis californicus* mayflies? Pest Management Science 64:843-847.

Piechnik, D.A., **S.P. Lawler** and N.D. Martinez. 2008. Food-web assembly during a classic biogeographic study: species' trophic breadth corresponds to colonization order. Oikos 117:665- 674.

Boyce, W.M., **S.P. Lawler**, J.M. Schultz, S.J. McCauley, L.S. Kimsey, M.K. Niemala, C.F. Nielson and W. K. Reisen. 2007. Non-target Effects of the Mosquito Adulticide Pyrethrin Applied Aerially During a West Nile Virus Outbreak in an Urban California Environment. Journal of the American Mosquito Control Association 23: 335-339.

Lawler, S. P., L. Reimer, T. Thiemann, J. Fritz, K. Parise, D. Feliz and D. Elnaiem. 2007. Effects of vegetation control on mosquitoes in seasonal freshwater wetlands. Journal of the American Mosquito Control Association 23:66-70.

Lawler, S. P., D. A. Dritz., J.A. Christiansen and A. Cornel. 2007. Effects of lambda-cyhalothrin on mosquito larvae and predatory aquatic insects. Pest Management Science 63:234-240.

Lawler, S. P. and D. A. Dritz. 2006. Effects of rice straw and water management on riceland mosquitoes. Journal of Medical Entomology 43:828-832.

Lawler, S. P. and D. A. Dritz. 2005. Straw and winter flooding benefit mosquitoes and other insects in a rice agroecosystem. Ecological Applications 15:2052-2059.

Lawler, S. P. and G. C. Lanzaro. 2005. Managing mosquitoes on the farm. University of California Division of Agriculture and Natural Resources Publication 8158. 19 pp. Online at http://anrcatalog.ucdavis.edu/pdf/8158.pdf

Holyoak, M. H. and **S. P. Lawler**. 2005. The contribution of laboratory experiments on protists to understanding population and metapopulation dynamics. Advances in Ecological Research 37: 245-271.

Srivastava, D. S, J. Kolasa, J. Bengtsson, A. Gonzalez, **S.P. Lawler**, T. E. Miller, P. Mungia, T. Romanuk, D. C. Schneider and M. K. Trzcinski. 2004. Are natural microcosms useful model systems for ecology? Trends in Ecology & Evolution 19: 379-384.

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***Invited Book Reviews*:**

Lawler, S. P. 2009. Ecology. Authors M.L. Cain, W. D. Bowman and S. D. Hacker. Quarterly Review of Biology.

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Lawler, S. P. 2007. Structure and diversity in food web research. Ecology 88:1335-1336.
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Webpage text:

Lawler, S.P. 2004. Rice: managing mosquitoes in an agricultural situation.
http://www.ipm.ucdavis.edu/PMG/r682000411.html

Invited Symposium Talks*

Lawler, S.P. 2008. Insects linking ecosystems and ecosystem services. Entomological Society of America Annual Meeting 2008, Reno, NV.
Lawler, S.P. 2008. Mosquito larvicides' impacts on non-target organisms. American Mosquito Control Association Annual Meeting, Sparks, NV.
Lawler, S. P. 2002. Should ecologists throw away their aquaria and petri dishes? 'Minature Worlds' Symposium, Ecological Society of America, Savannah, GA.
Lawler, S. P. and P. J. Morin 1998. Food web structure and population dynamics in laboratory microcosms of protists. INTECOL, Florence, Italy.
Lawler, S.P., D. Dritz, T. Strange and M. Holyoak. 1996. Vector control and an endangered species: are mosquitofish the most likely cause of red-legged frog decline? 28th Annual Conference of the Society for Vector Ecology, Berkeley, CA, USA.
Lawler, S.P. 1995. Experimental analysis of microcosm food webs. Experimental Ecology Symposium, American Society of Zoologists, St. Louis, MO, USA.
Lawler, S.P. 1995. Population dynamics of protists in microcosms. The Gordon Research Conference in Microbial Population Biology, Plymouth State College, Plymouth, NH, USA.
Lawler, S.P. 1993. Community complexity and population dynamics in laboratory microcosms of protists. Biodiversity and Conservation Meetings, Paris, France.

Selected Contributed Papers

Piovia-Scott, J., K. Pope, E. Cole, J. Foley and S. Lawler. 2009. Incidence of a fungal pathogen in Rana cascadae and other amphibian species in the mountains of Northern California. 2009 CA-NV Declining Amphibian Task Force Meeting, Bodega Bay CA.
Lawler, S. P. and D. A. Dritz. 2000. Effects of straw management and winter flooding on aquatic food web structure in a rice agroecosystem. 85th Annual Meeting of the Ecological Society of America, Snowbird, UT.
Lawler, S.P. 1998. Are terrestrial ULV applications of pyrethrin, permethrin and malathion safe for nearby aquatic non-target organisms? 64th Annual Meeting of the American Mosquito Control Association, Sparks, Nevada.
Lawler, S.P., D. Dritz, M. Holyoak and T. Strange. 1997. Effects of bullfrogs and mosquitofish on California red-legged frogs. Ecological Society of America, Albuquerque, NM. Suppl. Bull. Ecol. Soc. Amer. 78: 128.

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Lawler, S.P. and D. Balciunas. 1994. Effects of alternate prey and basal resource level in simple microcosm communities of protists. British Ecological Society Winter Meeting, University of Stirling, UK.

Lawler, S.P. 1992. Direct and indirect trophic interactions in laboratory microcosms of protists. British Ecological Society Winter Meeting, University of Lancaster, UK.

Lawler, S.P. and P.J. Morin. 1991. Food web architecture and population dynamics in laboratory microcosms of protists. Ecological Society of America. San Antonio, Tx. USA. Bull. Ecol. Soc. Amer. 72:170-171.

Lawler, S.P. 1990. Competitive priority effects in larval *Bufo woodhousei fowleri* and *Hyla crucifer*. American Society of Ichthyologists and Herpetologists. Charleston, SC. USA.

Lawler, S.P. 1986. Differential behavioral responses of larval anuran prey to predators. Ecological Society of America, Columbus Ohio. Bull. Ecol. Soc. Amer. 68:347.

* In addition to the talks listed above, I give talks to Mosquito and Vector Abatement Districts annually. I have given invited seminars at the NSF Food Web Conference, Pingree Park, CO; The University of Oregon, Eugene, OR; The University of Texas, Austin, TX; The University of Georgia, Athens, GA; The University of Miami, Oxford OH; the University of Chicago, IL; The University of California at Davis; the Bodega Marine Laboratory, CA; Dartmouth College, NH; the University of Pittsburgh, PA; U. California Irvine, the University of British Columbia, and the University of Colorado at Boulder.

Current Professional Activities

Subject Editor, Ecology
Faculty of 1000, Ecology, Marine and Freshwater Ecology section
Member, Ecological Society of America
Society for Conservation Biology
Sigma Xi
Mosquito Control Association of California

Current and Recent University Service (past 4 years)

Department of Entomology: Undergraduate Master Advisor; Curriculum, Courses and Majors Committee, Admissions and Fellowships Committee, various ad-hoc committees.
Graduate Group in Ecology: Chair. Admissions Committee.
Center for Population Biology: Admissions Committee
College of Agriculture and Environmental Sciences: Chair, Search Committee: Quantitative Animal Conservation Ecologist; Member, Search Committee: Conservation Valuation Analyst; Member, Search Committee, Aquatic Physiological Ecologist. Chair, Equity and Diversity Committee.