2012 Annual Report

Western Integrated Pest Management Center

WIPMC

Director's Comments

This is the eighth annual report of the Western Integrated Pest Management (IPM) Center. In July, Rick Melnicoe, past WIPMC Director, and Linda Herbst, past WIPMC Associate Director, both retired. The Center was very successful and productive under Rick and Linda's leadership. We deeply appreciate their years of service, which established a robust and inclusive program. In September the Center received a new 4-year grant. Carla Thomas was hired as Associate Director in April, and I am serving as Interim Director while we recruit a new Director for the Center. In 2012, the WIPMC continued supporting the Legume *ipmPIPE* (Pest Information Platform for Extension and Education) for state monitoring programs; completed two signature programs and launched three others; continued to manage the Regional IPM (RIPM) Competitive Grants Program-Western Region; funded work groups, outreach materials and publications, surveys, and Pest Management Strategic Plans; and participated in national and regional meetings, workshops, and symposia.

The Western IPM Center is one of four regional IPM centers in the United States. Each center is unique in the issues it addresses, but all follow the overarching guidance of the *National Road Map for IPM*, which identifies integrated pest management goals for agricultural, urban, and natural systems. The *Road Map* is available at ***http://www.ipmcenters.org/ipmroadmap.pdf***. The goal of the National IPM Program is to improve the economic benefits of adopting IPM practices and to reduce potential risks to human health and the environment caused by the pests themselves or by the use of pest management practices. The Western IPM Center, through the guidance of its Advisory and Steering Committees, has structured all of its programs to follow the *Road Map*, and it reports the impacts of its funded projects. Funding provided to the Western IPM Center comes primarily from the United States Department of Agriculture-National Institute of Food and Agriculture (USDA-NIFA). This funding is used to support Center activities and programs.

Pest Management Strategic Plans (PMSPs). Regional staff, along with growers, crop consultants, industry groups, and university researchers, develop Pest Management Strategic Plans. These documents are used by industry and state and federal authorities to understand pest management uses and needs in agricultural and other settings. The IPM in Schools PMSP, which focused on developing a plan for IPM implementation in all K–12 schools in the United States by the year 2015, involved a completely different approach and different participants from those utilized in crop PMSPs To view completed PMSPs, visit ***http://www.ipmcenters.org/pmsp/index.cfm.***

Grants. As research and education needs are identified through the work groups and input from other stakeholders, the Western IPM Center is able to provide some funding via annual grant programs and through small startup grants. Addressing Western IPM Issues grants focus on problems identified by stakeholders, work groups, and PMSPs or other documents. These grants may involve research, extension, or a combination of both. The small startup grants can be quickly funded to address newly emerging issues, such as a disease or other pest outbreak. The WIPMC also provides grants for outreach activities, development and printing of IPM publications, and tactics surveys to gather information about pest management methods in a region, crop, or setting.

Work Groups. Additionally, the Western IPM Center provides funding for work groups that address multi-state pest or pest management issues, such as pesticide resistance management, urban IPM, weather modeling and pest forecasting, and other topics. These work groups have been enormously successful in leveraging other funds to address issues identified as important in the West. Several large grants have been obtained by work group members as a result of the small amount of support provided by the Western IPM Center. See "Leveraging" section of this report.

Advisory and Steering Committees

Two standing committees guide the Western IPM Center. The Advisory Committee provides vision and guidance. Its members represent a wide range of stakeholders and link the Center to stakeholder needs and priorities for pest management programs in the West. These advisors, integral to Western IPM Center outreach, promote awareness of the Center's resources to their own constituencies and beyond. The Steering Committee gathers input from stakeholders, determines broad policy goals and priorities, recommends Center budgets, and provides direction for timely and effective Center management. In the pages of this report we highlight some of the projects, people, and impacts that have made the Western IPM Center successful in fostering responsible pest management for a sustainable future.

On a final note, this is the last WIPMC Annual Report that our writer, Diane Clarke, will produce. She leaves the Center, and UC Davis, in December to pursue a career as a mediator. We are very grateful for the high-quality publications and documents Diane has produced for the Center since she joined us in 2006. We wish her all the best and offer a heartfelt thank you. We are in the process of hiring a new writer now.

The WIPMC staff are committed to continued service to the IPM community. Thank you all for your support and participation. You are what has made the Western IPM Center so successful.

—Kassim Al-Khatib

Cover Photos:
Carpenter bee gathering nectar on sunn hemp. Sunn hemp, a legume that can be used as a cover crop or green manure, also attracts pollinators and other beneficial insects. *(Photograph by Kawika Duvauchelle, USDA-Natural Resources Conservation Service);* **Viewing bee boxes at University of Hawai'i Waimanalo Research Station.** Participants in the "Protecting Beneficials in Hawai'i and the American Pacific" workshop suited up to get an up-close look at bee boxes at the University of Hawai'i's research apiary. *(Photograph by Carla Thomas, Western IPM Center)*

Highlights of WIPMC Grants Programs

The following highlights of WIPMC grants programs show the breadth of projects funded and the impacts made to improve the economic benefits of adopting IPM practices and to reduce potential risks to human health and the environment caused by the pests themselves or by the use of pest management practices.

Growing the Sustainable Places Information Network (SPIN)

Principal Investigator: Josh Vincent, Northwest Center for Alternatives to Pesticides

Josh Vincent, NCAP

Summary: Public and private pest management practitioners, including school and parks groundskeepers, often work with limited resources and in isolation, making it difficult for them to ask questions of their peers, share techniques, and expand their knowledge of IPM tactics. The Sustainable Places Information Network (SPIN), developed by the Northwest Center for Alternatives to Pesticides (NCAP) under a previous Western IPM Center grant, is an online networking resource for parks managers and other urban groundskeepers. (For a report on outcomes under the previous grant, see ***http://www.wripmc.org/Newsletter/index.html***). SPIN offers peer-to-peer communication tools and multimedia resources such as videos, blogs, discussion forums, and webinars focused on IPM topics. The project extends across Oregon, Washington, California, Idaho, and Montana and seeks to connect IPM practitioners, parks managers, school groundskeepers, and other professional landscapers throughout the West with effective IPM resources.

In 2011, NCAP received additional WIPMC funding to expand SPIN's reach and services. Project objectives were to 1) increase the number of pest management practitioners involved with SPIN by approximately 300 percent (totaling at least 200 members across the entire network); 2) improve the interactive Web and multimedia tools provided through SPIN by producing 10 videos and five webinars demonstrating IPM strategies, and one webinar demonstrating Web site functions; and 3) develop a specific Web platform for SPIN that is fully customizable, quickly adaptable, and that does not rely on a third party for any functions beyond basic hosting.

Results: SPIN more than doubled in size in 2011, growing from roughly 60 pest management professionals to more than 130. New content was added to the Web site, including Web videos, webinars, articles discussing urban IPM topics, and policy documents illustrating state and federal IPM models for schools and other public areas. The site itself was entirely rebuilt to provide a better and more flexible technical platform. The focus also expanded to include a broader set of urban environments: while the site originally focused strictly on IPM strategies for public parks, it now also includes discussions regarding schools and housing.

Impacts and Potential Impacts:

- Groundskeepers in two Oregon school districts adopted IPM measures that eliminated their use of several potentially hazardous rodenticides and implemented changes in their landscaping practices that dramatically reduced the use of glyphosate in communal areas on campus.
- Parks managers in an Oregon city and maintenance staff in an Oregon county adopted flame weeding in areas where herbicides had previously been used.
- Parks department staff and other community members in three cities in Idaho communicated via SPIN to draft and adopt new county-wide IPM policies designating pesticide-free areas within many public spaces and eliminating certain classes of pesticides from management protocols.
- SPIN members in an Oregon city worked with NCAP to create the "How to Inspect for Bed Bugs" video, which was then shared widely with staff and residents at various apartment properties. Housing authority staff worked further with residents to carry out regular inspections, reducing the incidence of bed bug infestation, lowering labor/materials costs, and reducing health risks associated with insecticide treatment.
- SPIN membership became more diverse to include staff from school districts in Washington, Oregon, California, and Texas and staff from public housing providers in Oregon, Washington, and California.

Pre- and Post-Harvest Drenches Containing Essential Oils to Control Eggs of Pest Slugs and Snails in the Growing Medium of Potted Plants

PIs: Robert Hollingsworth, USDA-ARS U.S. Pacific Basin Agricultural Research Center; Rory McDonnell and Timothy Paine, University of California, Riverside

Robert Hollingsworth, USDA-ARS

Summary: Export ornamental plants are at high risk for pest species of slugs and snails, since eggs and juveniles can hide within the planting medium of potted plants. Pre-harvest practices for slug and snail control in potted plants include removal of hiding places, weed control in and around the nursery, keeping infested and uninfested plants separate, and using molluscicide baits. While these practices are helpful, they are frequently not sufficient to achieve quarantine security, which requires complete exclusion of pests. An ideal type of chemical treatment would be a botanical extract that is safe to people and plants, legal for use as a post-harvest drench, and lethal to juvenile gastropods and their eggs.

In this project, eleven essential oils (pine, bitter orange, eucalyptus, rosemary, lemongrass, cedarwood, clove, spearmint, garlic, peppermint, and cinnamon) and one terpene (limonene) were used in bioassays to investigate the potential of developing a pre- and post-harvest drench for potted plants. Project researchers also tested three commercially-available products (Snail and Slug Away®, Dyna-Gro® neem oil, and Azatin®). Treatments were tested on eggs and juveniles of the European brown garden snail (*Cantareus aspersus*) and the Asian semi-slug (*Parmarion martensi*) and on eggs of amber snails (*Succinea* spp.), giant African snails (*Lissachatina fulica*), and the Cuban slug (*Veronicella cubensis*). Project objectives were to 1) identify which essential oils and/or terpene components of essential oils are most effective in killing eggs and juveniles of target pest species of slugs and snails, 2) test the efficacy and plant safety of various formulations of those essential oils identified as effective, plus commercial formulations of botanical pesticides already labeled for drench applications to potted plants, and 3) provide guidelines and recommendations to USDA and other end-users on how best to use essential oils as molluscicides and transfer technology to appropriate end-users for commercialization.

Results: Seven essential oils (pine, lemongrass, clove, spearmint, garlic, peppermint, and cinnamon) appeared to be most effective (100 percent mortality) against eggs and juveniles of *C. aspersus* and eggs of *Succinea* spp. when tested at a 1 percent concentration. For eggs of the *V. cubensis* and *L. fulica*, hatch was completely inhibited by a 24-hour exposure to 1 percent concentrations of cinnamon oil, lemongrass oil, peppermint oil, or pine oil. Project researchers also quantified the toxicity of these oils. Clove oil proved to be the most toxic to *C. aspersus* juveniles and was three times as toxic to this species as the next most effective oil (pine oil). Cinnamon oil in Snail & Slug Away® was 22 times less toxic to juvenile *C. aspersus* than clove oil. Finally, to test for potential phytotoxicity, researchers drenched the leaves and the soil of gardenia (*Gardenia jasminoides*) with clove oil solution (at the treatment concentration of 0.116 percent). No symptoms of phytotoxicity were observed on the leaves or roots of the test plants over the course of 1 week.

Impacts and Potential Impacts: End users now have guidelines on how to utilize clove oil as a drench treatment. This is a significant impact, since the APHIS treatment manual contains no dip treatments that can be used universally against quarantine species of slugs and snails, and no treatments for mollusk eggs are listed. The project's research will likely lead to development of new commercial molluscicide products containing essential oils as the active ingredients. The U.S. Environmental Protection Agency exempts certain active ingredients from pesticide registration requirements and pesticide residue tolerance requirements under Section 25(b) of the Federal Insecticide, Fungicide, and Rodenticide Act. These exempted ingredients include cinnamon oil, garlic oil, peppermint oil, and clove oil. This exemption dramatically reduces the cost and time required for bringing a new pesticide to market.

Development of a Rapid Detection Protocol for the Fire Blight Pathogen of Pear and Apple

PIs: Kenneth Johnson and Virginia Stockwell, Oregon State University

T. N. Temple, Oregon State Univeristy

Summary: This project developed a rapid detection protocol for the fire blight pathogen (*Erwinia amylovora*) in pear and apple orchards. Fire blight of pear and apple is frequently an inoculum-limited disease (i.e., if the pathogen is not present, disease will not occur); however, weather-based forecasting models commonly assume the pathogen is omnipresent. This assumption can result in unnecessary pesticide sprays. To improve fire blight risk assessment during flowering, project researchers developed a rapid pathogen detection protocol that uses a molecular early detection technology (called loop-mediated isothermal amplification, or LAMP) to detect the DNA of *E. amylovora* on samples of pear and apple flowers before the pathogen has caused infection. Current methods for detection of *E. amylovora* are lacking because of the time needed for results and the expense of testing. LAMP can be done under field conditions in 60 minutes without the use of fragile equipment.

With such an early detection system, fire blight management would improve, because chemicals applied for management are most effective during the critical pre-infection phase of the pathogen on flowers (known as the "epiphytic" phase, when the pathogen is on the surface of the flowers but has not entered the flower nectar). Early pathogen detection would greatly improve the prediction of significant outbreaks, giving growers a valuable tool to guide them about when—or if—to spray and increasing the efficiency of protective sprays when they are warranted. Project objectives were to 1) quantify the sensitivity of LAMP for detection of *E. amylovora* on flower samples and 2) evaluate and optimize sampling protocols for early detection of the pathogen in commercial pear and apple orchards.

Results: In samples from experimental orchards plots, the LAMP assay detected *E. amylovora* in 96 percent of samples with the pathogen, and had no reaction with non-pathogen amended controls. In 2008, for commercial orchards located in two Oregon valleys, *E. amylovora* was detected by LAMP in flower samples from four orchards, all of which developed fire blight. In another four orchards, all floral washes were negative for *E. amylovora*, and no disease was observed. Overall, detection in commercial orchards coincided with full bloom during high-disease-risk periods as determined by a weather-based prediction model. Another 29 orchards were sampled in 2009 (in California, Oregon, and Washington) for which data were still being analyzed at the time of this project's final report.

Impacts and Potential Impacts: Because positive samples from commerical orchards coincided with periods of high fire blight risk, this result validated weather-based models used to determine fire blight risk. Such a validation has never been accomplished previously. In several commercial orchards, communication by project researchers to the grower about active pathogen in the orchard intensified grower activities to control the disease, very likely lessening the impact of the disease. Growers in Utah self-funded the training of an individual to perform LAMP-based sampling and assay in their orchards. Project researchers used the assay to re-examine the question of the value of delayed-dormant copper applications for fire blight suppression. In 2 years of study of California pear orchards, the LAMP assay demonstrated a classic sanitation effect of the delayed-dormant copper treatment. Consequently, bloom period antibiotic applications are being delayed to after full bloom, saving at least one antibiotic treatment.

Growers and PCAs have been keenly interested in the LAMP survey results. These surveys are the first data set to provide probabilites for the presence of the fire blight pathogen in flowers depending on the stage of bloom. As a consequence, fire blight spray programs are being modified to achieve higher chemical use efficencies based on probability of pathogen presence. A potential impact is the accelerated adoption of molecular detection technologies. Six companies are commercializing the LAMP assay and making it much easier to use (e.g., through the availabity of sample processing kits). With these improvements, project researchers expect that services that employ molecular detection methods will soon become available in major agricultural production areas.

IPM/Beneficial Insect Demonstration and Outreach

PIs: Tessa Grasswitz, New Mexico State University; David Dreesen, USDA-Natural Resources Conservation Service

Tessa Grasswitz, New Mexico State University

Summary: Numerous studies have shown that increased plant diversity can reduce pest pressure and increase populations of beneficial insects, but site-specific information on the best plants for beneficial insects is needed. In New Mexico, farmers, beekeepers, school groups, and home gardeners have increasingly requested information on enhancing farm, garden, and urban habitats to provide resources for beneficial insects of all types, but high-quality information on which plants will grow, thrive, and be most useful in different parts of the state has been lacking.

Project investigators had addressed this issue by conducting trials of various potential "insectary" plants for biological control agents and by developing a demonstration planting of hedgerows or "shelterbelts" of species likely to be particularly valuable to honeybees and native pollinators. This allowed project researchers to obtain information about which plants were most suitable for the central part of New Mexico. WIPMC funding allowed them to expand on these efforts. Objectives of this project were to 1) raise sufficient plants for three demonstration shelterbelts, 2) establish shelterbelts in three climatically different areas of New Mexico, 3) use demonstration plantings (existing and new) as a basis for four workshops on IPM, focusing on techniques that would help attract and retain beneficial species (both biological control agents and pollinators), and 4) produce two pocket-sized color guides to New Mexico beneficial insects for growers, landscape professionals, and home gardeners.

Results: Demonstration plantings were established at three additional locations, increasing the geographical range of the project team's recommendations and providing additional demonstration sites for outdoor workshops and related outreach efforts. The sites were used for a total of five project-related workshops in 2011, with several additional events planned in 2012. Two full-color pocket guides to New Mexico beneficial insects were produced for growers, landscape professionals, and home gardeners (one on biological control agents and one on common pollinator species). The project team also produced an educational poster and a technical guide with preliminary plant recommendations for New Mexico.

Impacts and Potential Impacts: The availability of state-based recommendations for both pollinator and insectary plants has increased grower confidence in trying these techniques. At least three pollinator plantings that have been established as a result of this work (two in local conservation/recreational sites and one on school grounds). In part because of this project, a recent estimate suggests that in New Mexico several thousand acres may have been enrolled in pollinator habitat in the 2012 round of USDA's Conservation Reserve Program. A wide range of native bees and predatory wasps has been collected at the demonstration plantings, with some insect species apparently being unique to each site. Furthermore, at the most long-established site, additional species were collected in 2011 that were not recorded in 2010, indicating ongoing recruitment to the plantings and a steady increase in biodiversity. In New Mexico and elsewhere, provision of flowering plants has been shown to significantly increase numbers of naturally-occurring biological control agents in adjacent crops, and to have a measurable effect on pest populations. As such, this technique can form a valuable component of IPM programs by helping to reduce the need for pesticide applications, with consequent benefits to both environmental and human health. In addition, increased awarenss of both honeybees and native pollinators may help promote a more sensitive approach to the use of pesticides in home gardens, landscapes, and similar settings.

See the Western IPM Center Web site, **http://www.wripmc.org**, *for further details about objectives, results, and impacts of WIPMC-funded projects.*

Special Issues Projects Yield Results

The Western IPM Center has an ongoing call for proposals to address special IPM issues in the West. Special issues funding may be requested to convene groups of people to address emerging issues such as new pests or environmental concerns, to develop proposals for larger grants based on documented stakeholder needs, or to develop Pest Alerts. The Western IPM Center has recently funded several projects under this program. The results and outcomes of one of these small grants (up to $5,000 each) are summarized below:

"Weeds Cross Borders—Because Weeds Know No Boundaries" Tour

Invasive plants do not recognize political boundaries. Weeds Cross Borders is an internationally coordinated weed management area encompassing two counties in Washington state and two weed districts in Southern British Columbia. In August, utilizing Western IPM Center funding, the management area partners hosted a 1-day, international noxious weed field tour for elected federal and state officials and agency policymakers from both countries. Tour attendees had the opportunity to view noxious weed sites throughout the management area and to learn about control efforts and successes. Tour participants also observed sites where more control is needed to protect native ecosystems and bio-diversity. The purposes of the tour were 1) to educate officials about the necessity of performing weed control, 2) to reveal the negative impacts of uncontrolled noxious weeds on native ecosystems, and 3) to encourage legislative action that will promote and support IPM principles and projects. Twenty-one lawmakers, agency representatives, and landowners from both countries attended the tour.

Results and Outcomes: Attendees saw how an area can be overtaken by invasive weed species and witnessed biological agents—such as the stem-mining weevil, *Mecinus janthinus* (pictured, at right, on Dalmatian toadflax)—at work on noxious weeds. After a lunchtime talk about farm and ranch management from the landowner's point of view, attendees were better equipped to grasp the importance of agency and landowner coordination in weed control efforts. Tour participants also learned how vectors spread noxious weeds and how the spread of seeds and propagating parts is prevented by implementing rapid response measures and keeping equipment clean. In addition, attendees learned about specific noxious weed species and the overall impacts of noxious weeds on agriculture, biodiversity, and the economy. To augment the information provided by speakers, participants received educational brochures to take away with them. Attendees left the tour with increased knowledge about noxious weeds and a positive new outlook on noxious weed control.

Mary Fee, Ferry County Weed Board, Washington

In response to stakeholder-established regional priorities, the Western IPM Center coordinated the development of three new signature programs in 2012. These programs focused on 1) IPM and water quality, 2) pollinators and beneficial species, and 3) invasive species. The first two programs have been completed. The invasive species signature program will continue in 2013, along with two new programs, "Crop Pest Losses and Impact Assessment" and "Developing a Regional Infrastructure for Climate- and Weather-based Decision Support Tools." For details on these two new programs, see the Western IPM Center's October newsletter, ***http://www.wripmc.org/newsletter/index.html***.

Completed Programs

IPM and Water Quality

Collaborators on this project created three 1-hour educational modules on "Best Management Practices to Reduce Pesticide Impacts on Water Quality in the West." The agriculture module targets agricultural licensed pesticide applicators. The two urban modules are tailored for landscape professionals and homeowners/master gardeners. All three modules were peer-reviewed, and the final versions were made available to IPM educators. Visit the Western IPM Center Web site, ***http://www.wripmc.org,*** for a link to these new educational tools.

Protecting Pollinators and Beneficials

A 2-day workshop entitled, "Protecting Beneficials in Hawai'i and the American Pacific: A Workshop on the Conservation of Pollinators and Other Beneficial Species" was held for growers and extension personnel in Waikiki Beach, Hawai'i, in April. A full report on this successful workshop can be found in the Western IPM Center's June newsletter: ***http://www.wripmc.org/newsletter/index.html***.

Continuing Program

Coordinating Responses to Invasive Species in the West

In July, the Western IPM Center convened a meeting of invasive species specialists from throughout the region to identify high-priority invasives in the West. Three pest-specific subgroups (weeds, pathogens, and arthropods) were formed. Each subgroup chose a high-priority invasive species and began planning their approach to providing leadership, communication, and coordination of responses. The weed subgroup will focus on hydrilla (*Hydrilla verticillata*); the pathogen subgroup chose the pathogen *Liberibacter solanacearum*, which causes zebra chip in potato and vein greening in tomato; and the arthropod subgroup chose European grapevine moth (*Lobesia botrana*). Each subgroup will hold a symposium on early detection of, and rapid response to, their targeted species, bringing in others in the region who would benefit by use of the protocols they have developed.

Jack Kelly Clark

European grapevine moth

2012 WIPMC-Funded Projects

The Western IPM Center funded seven publications/outreach projects and three work groups, totaling $135,180.

Publications/Outreach

Field Guide for Beneficial Arthropods in Summer Crops in the Arid and Semi-Arid Regions of the Southwest
PI: Lydia Brown, University of Arizona

Adopting IPM in Oregon Schools
PI: Aimee Code, Northwest Center for Alternatives to Pesticides

IPM Outreach for Control Methods in an Urban Environment
PI: Elena Cronin, 4-County Cooperative Weed Management Area, Oregon

Integrated Pest Management Education and Outreach for Public Housing in Western States
PI: Dawn Gouge, University of Arizona

Weed Seedling Identification Guide for Montana and Northern Great Plains
PI: Fabian Menalled, Montana State University

Development of a Field Guide for IPM in Grapes for the Pacific Northwest
PI: Michelle Moyer, Washington State University

IPM Practitioner's 2012 Directory of Least-Toxic Pest Control Products
PI: William Quarles, Bio-Integral Resource Center (BIRC), California

Caleb Slemmons, University of Maine, Bugwood.org

Assassin bug (Zelus renardii)

Work Groups

See details in separate section of this report.

Further information is online at **http://www.wripmc.org.**

Highlights of IPM in Practice

The Western IPM Center supports and participates in regional and national projects that foster the practice of IPM in a variety of ways. The project highlighted here is an example of how the Center's support and collaboration help to put IPM into practice.

Monitoring for Aquatic Invasive Species in Western Montana

In 2011, the Western IPM Center awarded a Special Issues grant to Bryce Christiaens, Weed District Manager with Missoula County Weed District, in Montana, to create and distribute aquatic invasive species monitoring kits for Western Montana watersheds. Aquatic invasive species pose a major threat to the ecology of Western Montana's aquatic environments and to the economy of Western Montana. Since Montana is at the very top of multiple watersheds, the state has had limited infestations of aquatic invasive species via natural dispersal. Thus, human-caused dispersal is the most prevalent method of spread. Christiaens proposed education and outreach to water users and monitoring of high-use areas as the most important actions needed to maximize prevention efforts, adding that active prevention, early detection, and rapid response would be the most cost-effective methods for management of these aquatic invaders.

The aquatic invasive species Eurasian watermilfoil (*Myriophyllum spicatum*), curly-leaf pondweed (*Potamogeton crispus*), and flowering rush (*Butomus umbellatus*) are highly competitive in the northern climates of Western Montana, and they are all listed as Priority 1B noxious weeds in the state. (Priority 1B is defined as having a limited presence in Montana, with management goals of eradication where found, prevention, and education.) The Missoula County Weed District works with a large number of public and private partners in three high-use watersheds in Western Montana: the Upper Clark Fork River watershed, the Bitterroot River watershed, and the Big Blackfoot River/Chain of Lakes watershed. As of early 2012, these watersheds were free from any infestations of these aquatic invasive species.

Bryce Christiaens

Complete aquatic invasive species kit.

Using the WIPMC funding, aquatic invasive species monitoring kits were assembled. The kits contain the equipment necessary for aquatic invasive species monitoring in streams and rivers as laid out in the *Montana Aquatic Invasive Plant Monitoring and Sample Collection Protocol*. Each kit includes:

- 1 storage trunk
- 1 rake and 30 meters of line for deploying the rake (for obtaining samples)
- 1 water-proof GPS
- 1 water-proof camera
- 2 pairs of chest waders with felt-less soles
- 1 cooler (for keeping samples as they are collected)
- 1 clear plastic tub (for ID of aquatic plants after they are removed from the rake)
- 1 bathyscope
- 1 clipboard with necessary data sheets, pencils, etc.
- 1 dry bag for equipment storage while monitoring
- 1 measuring tape
- Aquatic plant identification guides
- Sealable plastic bags
- Cleaning supplies (for decontaminating waders and other equipment)

Once the kits were assembled, Christiaens and his colleagues at the Missoula County Weed District worked cooperatively with their watershed partners to hire and train a crew of two employees for each watershed and to provide each trained crew with two monitoring kits. With two kits per watershed, crews were able to monitor sites independently in order to cover as much ground as possible. Equipment was decontaminated between monitoring sites to prevent the movement of species within and between water bodies. Monitoring occurred early June through mid-September, when target species were most easily identified.

Lindsey Bona, Missoula County Weed District

Worker using drag rake from monitoring kit in Western Montana.

Kits are now stationed and used by four nonprofit partners of the Missoula County Weed District: the Swan Ecosystem Center, the Clearwater Resource Council, the Clark Fork Coalition, and Blackfoot Challenge. In addition, two kits are used by crews at the Weed District. Weed District staff and volunteers from these partner organizations were trained in how to use the kits to monitor for aquatic invasive plants. As a direct result of this project, monitoring for aquatic invasive plants and surveying of baseline vegetation data have taken place for 13 lakes and 2 rivers in Western Montana. The project has contributed to heightened awareness of aquatic invasive plant species and establishment of a yearly monitoring plan for Western Montana watersheds. In addition, this project could potentially lead to a volunteer monitoring network coordinated by the Missoula County Weed District, Swan Ecosystem Center, and Clearwater Resource Council. Monitoring would target the highest-use lakes in the Weed District's work area, with volunteers recruited from lakeshore homeowners associations, local sporting groups, businesses oriented toward outdoor tourism, and other user groups that rely on healthy water bodies.

The monitoring and education efforts carried out in these watersheds have broad support from both private and public entities. The Missoula County Weed District's other partners include the Missoula Conservation District; the Powell County Weed District; the USDA Forest Service; the U.S. Fish and Wildlife Service; the Bureau of Land Management; the Montana Department of Agriculture; the Montana Department of Fish, Wildlife, and Parks; Trout Unlimited; Northwest Connections; and private landowners.

Contact Bryce Christiaens at **bryce@missoulaeduplace.org**.

Work Groups

Western IPM Center Sponsors Three Work Groups

In 2012, Western IPM Center funding supported three issue-based work groups:

- **Crop Pest Losses and Impact Assessment,** focusing on Arizona and California cotton, melons, and lettuce. *Principal Investigator: Al Fournier, University of Arizona, fournier@cals.arizona.edu*
- **Western Region Functional Agricultural Biodiversity,** focusing on conservation biological control. *PI: Gwendolyn Ellen, Oregon State University, gwendolyn@science.oregonstate.edu*
- **Western Region School IPM Implementation and Assessment,** focusing on communication and shared resources, curriculum development, and training. *PI: Carrie Foss, Washington State University, cfoss@wsu.edu*

Tammy Winfield, Oregon State University

Center Staff

Kassim Al-Khatib

Peter Ellsworth

Paul Jepson

Carla Thomas

Diane Clarke

Dr. Kassim Al-Khatib is the Director of the Western IPM Center (WIPMC) and serves as the Principal Investigator. Dr. Khatib also directs the University of California Statewide IPM Program and is Professor of weed science at the University of California, Davis.

Co-Directors of the Western IPM Center are **Dr. Peter Ellsworth** and **Dr. Paul Jepson**. Dr. Ellsworth is an Integrated Pest Management Specialist and Professor in the Department of Entomology and Director of the Arizona Pest Management Center, University of Arizona. Dr. Jepson is Director of the Integrated Plant Protection Center, College of Agricultural Sciences, Oregon State University; State IPM Coordinator for Oregon; and Professor in the Department of Environmental and Molecular Toxicology, Oregon State University.

Associate Director is Carla Thomas, University of California, Davis. Carla's expertise is in plant pathology/epidemiology, and her area of specialization is weather-based crop risk models and biosurveillance. Diane Clarke, University of California, Davis, serves as writer/editor.

The WIPMC enhances communication between federal and state IPM programs in the western United States: Alaska, Arizona, California, Colorado, Hawaii and the Pacific territories, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

The WIPMC serves as an IPM information source, designed to quickly respond to information needs of the public and private sectors.

Contracted WIPMC staff includes regional comment coordinators located throughout the region and an IPM regional grants manager.

Leveraging

Competitive grants provided through the Western IPM Center yield data and results that have then been used in acquiring additional funding for the advancement of IPM in production agriculture; residential, urban, and institutional settings; research and extension programs; natural resource and wildland spaces; and public areas throughout the United States. Since 2004, Center funding has resulted in more than **$17.6 million** in leveraged funds, representing an overall return of more than **$6 for each $1 awarded** in the grant categories listed below.

Pest Management Strategic Plans (PMSPs) and Crop Profiles

PMSPs and Crop Profiles funded by the WIPMC have yielded more than **$2 million** in leveraged funding.

Rate of Return: $9 for every $1 awarded

Work Groups

Leveraged funds resulting from WIPMC-funded work groups have totaled more than **$6.7 million**.

Rate of Return: $14 for every $1 awarded

Special Projects

WIPMC funding in the Special Projects grants program has leveraged **$805,000**.

Rate of Return: $5 for every $1 awarded

Addressing Western IPM Issues

Funding leveraged through WIPMC-funded "Addressing Western IPM Issues" grants has totaled more than **$7.3 million**.

Rate of Return: $5 for every $1 awarded

Publications/Outreach

Publications/Outreach projects funded by the WIPMC have yielded **$765,000** in leveraged funding.

Rate of Return: $2 for every $1 awarded

*Visit the Western IPM Center Web site, **http://www.wripmc.org**, to download a one-page flyer detailing the granting organizations that awarded this additional funding.*

Work Group Impacts

Western Region Functional Agricultural Biodiversity (FAB) Workgroup and Tour

Functional agricultural biodiversity (FAB) embraces a variety of living organisms that have beneficial roles in agriculture, in the on-farm habitats and communities that support them, and through the ecosystem services (e.g., pollination, pest suppression by beneficial insects, soil stabilization, diversity of soil microbes) and positive synergies they provide to a farming system. In addition, the practical management of on-farm FAB is important because of the value of biological pest management in pest suppression and pesticide use reduction. Regionally-relevant, practical FAB advice to farmers has been lacking. Farmers have struggled to assess what constitutes FAB on their farms; what FAB practices fit within their farm production, conservation, and certification plans; and how can they assess the value of this biodiversity on their farm.

In 2007, to respond to these needs, FAB practitioners across the western United States began meeting and working together. In 2008, the group (then called the Conservation Biological Control work group) received a 2-year WIPMC grant. Additional 1-year WIPMC grants were awarded to the group in 2011 and 2012.

From the beginning, the group's mission has been to foster regionally-relevant communication and FAB research and outreach. The group aims to preserve and enhance crop pollination by native pollinators and management of pests by predators, parasitoids, and pathogens while promoting FAB in western agriculture.

Group objectives have included 1) developing and expanding a FAB email list server, 2) conducting regional and sub-regional work group meetings, 3) collaborating on funding proposals, and 4) (beginning in 2009) coordinating an annual Biodiversity Working for Farmers Tour/Short Course. These tours were held in Oregon in 2009, Washington in 2010, Idaho in 2011, and Oregon again in 2012. The 2009 tour received additional WIPMC funding through the Special Issues grant program.

Tammy Winfield, Oregon State University

The tours, held on regional farms, have highlighted biodiversity enhancements for the attendees, who have included farmers, industry representatives, researchers, conservationists, policymakers, and regulators. These events have effectively demonstrated FAB practices used by farmers and have revealed how gaps in relevant, eco-region specific research can limit adoption of these practices. In addition, the tours have presented a forum to identify and discuss roadblocks that industry and regulatory policies can place on farmers wishing to implement FAB practices. These valuable educational opportunitities have also included discussions, led by FAB work group members, on topics like biodiversity, conservation biological control, and native pollinators and other beneficial organisms (i.e., owls and frogs).

Impacts and Potential Impacts

Leveraging: In 2011, the group developed a proposal and was awarded a USDA-National Institute of Food and Agriculture Organic Agriculture Research and Extension Initiative (OREI) grant for $46,580.

Tour Impacts: The 2009 tour was referred to in a discussion in Congress before the Food Safety Enhancement Act was passed that year, increasing the visibility of biodiversity issues. Impacts from the 2011 tour included a visit to one of the featured ranches by an Idaho Senator. This occurred after the Senator was informed of the ranch's conservation programs by his staffer, who had attended the tour. In Oregon, Idaho, and Washington, past hosts of the tour have continued to implement new conservation practices (e.g., native plant gardens, hedgerows, and insectary field margins).

Potential impacts of the tours include more policy makers, regulators, farmers, foresters, conservationists, extension personnel, and home gardeners becoming aware of FAB, leading to more conservation practices and more FAB research throughout the western region.

Steven Riley, Oregon Dept. of Ag.

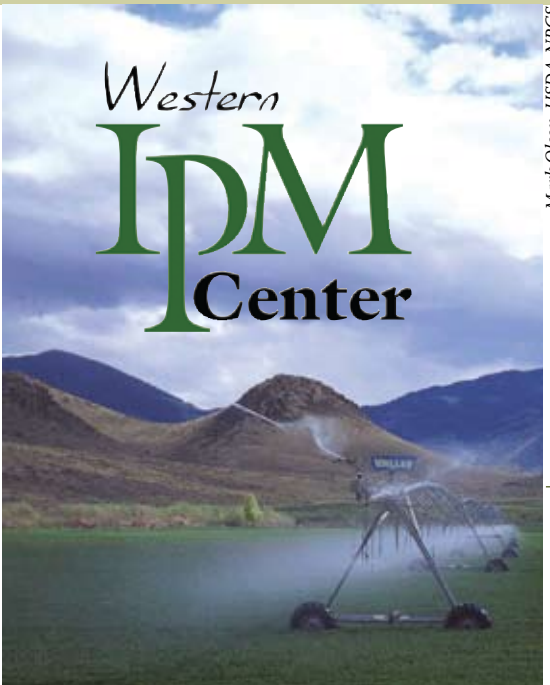
Group Meeting and List Server Impacts: The work group's information exchange has 1) increased their knowledge of farmer innovations, 2) increased the number of FAB research and outreach projects in the western states, and 3) strengthened scientific, agricultural, and community collaborations throughout the region.

Impacts for IPM: FAB is composed of conservation biological control measures important to IPM. Work group members expect the project to have a profound positive effect on regional adoption of conservation practices by farmers, and this in turn could positively affect populations of beneficial insects and result in reduction of pesticide use.

Other Potential Impacts: Other potential impacts include increased implementation of diverse on-farm vegetative habitats (e.g., hedgerows and insectary filter strips) that can increase crop pollination, decrease soil erosion, and directly improve water quality. In addition, enhanced regional agricultural biodiversity can potentially increase carbon sequestration and bolster the resiliency of farms against climatic catastrophies. There is also the potential for decreased pesticide drift, decreased weed seed migration, and decreased stream temperatures (resulting in enhanced fish habitat).

Finally, the group's annual meetings, exchanges of information through the email list server, and sucessful tours directly supply FAB work group members with the vital information and inspiration they need to continue to develop valuable projects, collaborations, and research in FAB in the West.

Visit **http://www.wripmc.org** *for further information about WIPMC-funded work groups.*



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